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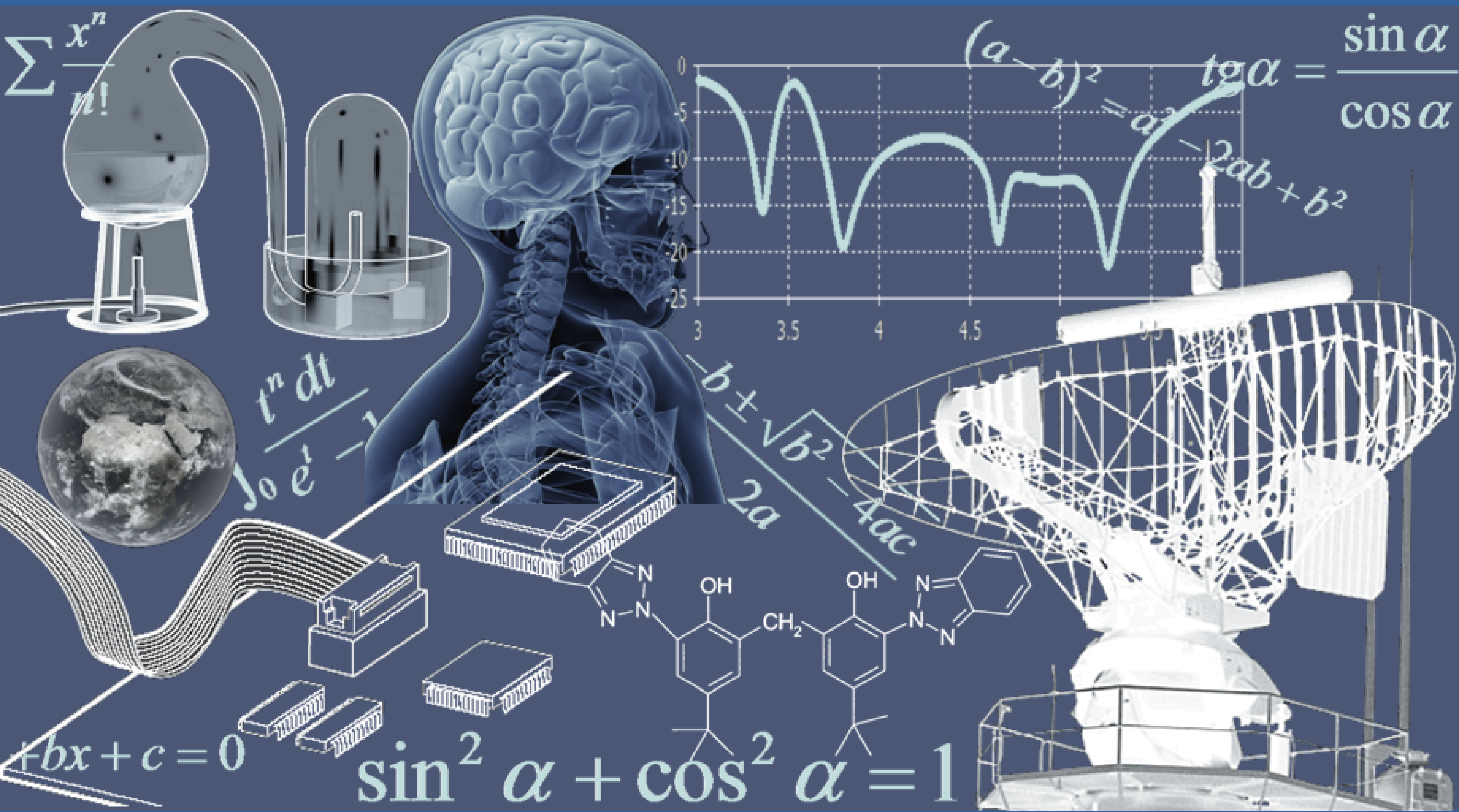

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Determination of Aquifer Characteristics from Geo-electrical Sounding data in parts of Anambra State, Nigeria

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ABSTRACT: The execution of water borehole project is quite expensive, there is therefore need for surface resistivity measurements before drilling to gain sufficient knowledge on the subsurface geo-hydrological conditions of an area. In this study, geophysical investigation of groundwater is aimed at delineating the aquiferous units in the central part of Awka by determining their depths, thicknesses, resistivities and the potential borehole depth at various locations within the area employing the technique of Vertical Electric Sounding (VES) using the Schlumberger array. Ten (10) sounding stations were obtained. The data was interpreted using conventional partial curve matching and computer aided iteration techniques. The vertical electrical sounding curve types identified in the study area includes K, H, QH, HK, and QK. The HK-type sounding curves were predominant in the study area. About four to six geo-electric layers comprising the top soil, shaly- sand, sand, dry sand, water saturated sandstone, and shale were delineated with the shale usually occurring as the last layer. Lithologic log for the borehole located near one of the sounding station at Awka revealed that some of the geologic units were either suppressed or merged into a single geo-electric unit probably due to similarities in electrical resistivity. 3-D surface map of the aquifer characteristics were produced, it was observed that the aquifer properties ranges from 0.0262 to 0.7187cm/s, 1.2995-48.0092cm^2/s, 139.14-3813.22 Ohm-m, 9,294.55-189,135.71 Ohm-m^2, 0.0130-0.4801 Ohm^{-1} for hydraulic conductivity, transmissivity, resistivity, transverse resistance and longitudinal conductance respectively within the study area.

KEYWORDS: Vertical electrical sounding, geo-electric section, transmissivity, hydraulic conductivity, resistivity, aquifer characteristics.

INTRODUCTION

Due to the failure of government to provide portable water sources in Awka, Anambra State and in addition to lack of portable surface water sources, lately there has been a greater interest in the exploitation of groundwater supplies. However, many problems exist as a result of insufficient knowledge of the subsurface geophysical conditions in many parts of Awka. The development of groundwater involves the sinking of boreholes at sites, which most times are chosen arbitrarily. In several cases, this has resulted in abortive boreholes, extremely low yield and total failure of some supply well within this study area. This has therefore underline the importance of taking proper precautions in order to reduce the risks of spending large sums of money in sinking abortive boreholes. Quantitative description of aquifers has become vital in order to address several hydrological and hydro-geological problems. Fluid transmissivity, transverse resistance, longitudinal conductance, hydraulic conductivity and aquifer depth are fundamental properties describing subsurface hydrology. As a result, many investigation techniques are commonly employed with the aim of the estimation of spatial distribution of the above mentioned hydraulic parameters [1].

There are many number of geophysical exploration techniques which can give insight on the nature of the water bearing layers and these include geoelectric, electromagnetic, seismic and geophysical borehole logging [2]. These methods measure properties of formation materials, which determine whether such formation may be sufficiently porous and permeable to serve as an aquifer. The electrical resistivity method and seismic refraction method are the surface geophysical methods commonly used for groundwater exploration [3].

OBJECTIVES OF THE STUDY

Vertical Electrical Sounding (an Electrical Resistivity Survey Method) using a Schlumberger array was used to achieve the following which are the primary objectives of the study:

i. To determine the thickness of the aquiferous layers at various locations within Awka metropolis.

ii. To develop a geo-hydrological database for the study area that will guide government and individuals in groundwater development on the characteristics of the aquifers, the distribution of the aquifers as well as the depths boreholes could be drilled for sustainable water supply.

MATERIALS AND METHODS

STUDY AREA

The study area is Awka, Anambra State, Nigeria located between Latitude 6º12'- 6º16' N and Longitude 7º04' - 7º07' E and lies within the tropical wet climate zone having two distinct seasons: wet season (April- October) and dry season (November – March). The mean temperature which prevails over this region varies between 27 ºC - 28ºC which most times peak to 35ºC between January and April. This region also witnesses a mean annual rainfall of about 2000 mm with maximum monthly rainfall during the peaks ranging from 270 mm – 360 mm [3].

FIELD PROCEDURE

An electrode made of stainless steel was driven into the soil at each end of the spread A and B. Both electrodes were then connected to the current sender of the Terrameter. The electrodes M and N were also driven into the soil and connected to the voltage receiver. At each position of A and B, the current was sent, and the potential difference between M and N was measured. Also, the distances AB and MN were measured.

Following the placing and connection of all electrodes, resistance measurements were made beginning with the smallest spacing and progressing outward. When the ratio of the distance between the current electrodes to that between the potential electrodes becomes too large, the potential electrodes must also be displaced outwards otherwise the potential difference becomes too small to be measured with sufficient accuracy [4].

The aim is to determine the depth of current penetration as a function of current electrode spacing. The ABEM Terrameter SAS 1000C performs automatic recording of both voltage and current, stacks the results, computes the resistance in real time and digitally displays it [5]. From the field data, the apparent resistivity, which is a function of AB/2 (half the current electrode spacing) was calculated and interpreted with computer software (One dimentional Interpex Version3).

The Root Mean Square error was less than 10%. The apparent resistivity values obtained in the field was plotted against half current electrode spacing in a bi-logarithmic graph. The curves of best fit were traced and the data obtained from the smooth curve was noted. Qualitative and quantitative interpretations of the field curves were carried out by inspection to obtain the type of curves. Resistivity measurements were made with a Terrameter SAS 1000 system.

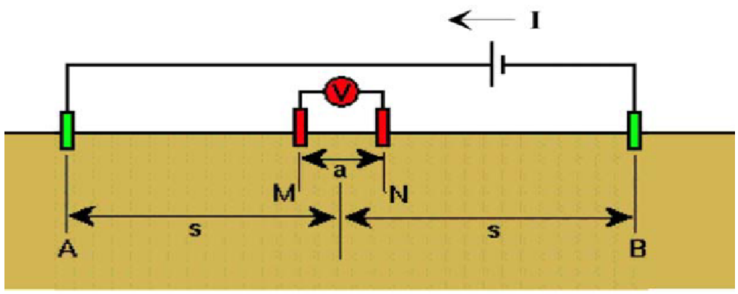

Fig.1: Sketch diagram of Schlumberger Configuration

Ten (10) vertical electrical sounding (VES) points were conducted at various locations within the study area in order to study the variations in the resistivity distribution of the soil with depth. GPS device was used for measuring the spatial location (latitude and longitude) and elevation for the VES points.

Table 1: GPS readings to show the elevations and coordinates of each VES Sounding point

VES	ELEVATION (M)	LATITUDE	LONGITUDE
1	115	6º14.224'N	7 º05.478'E
2	43	6º13.629'N	7 º05.458'E
3	47	6º15.572'N	7 º06.572'E
4	91	6º13.486'N	7 º05.843'E
5	74	6º12.635'N	7 º03.677'E
6	106	6º14.536'N	7 º05.832'E
7	52	6º13.321'N	7 º05.285'E
8	101	6º12.534'N	7 º03.459'E
9	139	6º13.943'N	7 º05.351'E
10	78	6º14.380'N	7 º05.963'E

AQUIFER CALCULATIONS

Hydraulic conductivity is symbolically represented as *K*, which depends on the intrinsic permeability of the material and on the degree of saturation. Saturated hydraulic conductivity, K_{sat}, describes water movement through saturated media.

$$K_c=1/p \quad (1)$$

Where K_c is the calculated hydraulic conductivity and p is the resistivity of the saturated layer

Expressing K in m/day or cm/s and b in m, the transmissivity (T) is found in units m^2/day or cm^2/s.

$$T=Kb \quad (2)$$

The transmissivity (T) of aquifer is related to the field hydraulic conductivity (K) by the equation above. In a porous medium according to [6]:

$$T_C = K_C b \quad (3)$$

Where T_C = Calculated transmissivity (m^2/day) from VES data, K_C = Calcluated hydraulic conductivity (m/day) from VES data. b = Thickness of saturated layer (m).

Transverse Resistance T_r (Ohm-m^2) and Longitudinal Conductance (Ohm^{-1}) L_c are parameters used to define target areas of good groundwater.

$$T_r = h\,p \text{ and } L_c=h/p \quad (4)$$

Where h is aquifer thickness and p resistivity value of the aquifer.

The calculated hydraulic conductivity (K_c), calculated transmissivity T_c, transverse resistance, and longitudinal conductance values estimated from the VES results are presented in Table 4.

Results, Interpretations And Discussions

Qualitative Interpretation

Qualitative interpretation of the vertical electrical sounding curves obtained from the study area showed four to six geo-electrical layers. [7] reported that the distribution of resistivities of different subsurface layers in a three layered earth model can be classified based on curve shapes into H-type ($\rho_1>\rho_2<\rho_3$), K-type ($\rho_1<\rho_2>\rho_3$), A-type ($\rho_1<\rho_2<\rho_3$) and Q type ($\rho_1>\rho_2>\rho_3$); they can be combined to produce

HA-type ($\rho_1>\rho_2<\rho_3<\rho_4$),

HK-type ($\rho_1>\rho_2<\rho_3>\rho_4$),

KH-type ($\rho1<\rho2>\rho3<\rho4$),

QH-type ($\rho_1>\rho_2>\rho_3<\rho_4$) and so on in four to six layer cases. Therefore based on the aforementioned assertions, the vertical electrical sounding curve types identified in the study area includes K (2), H (1), QH (2), HK (3), QK(2). Therefore, HK type is the most dominant sounding curve type in the study area.

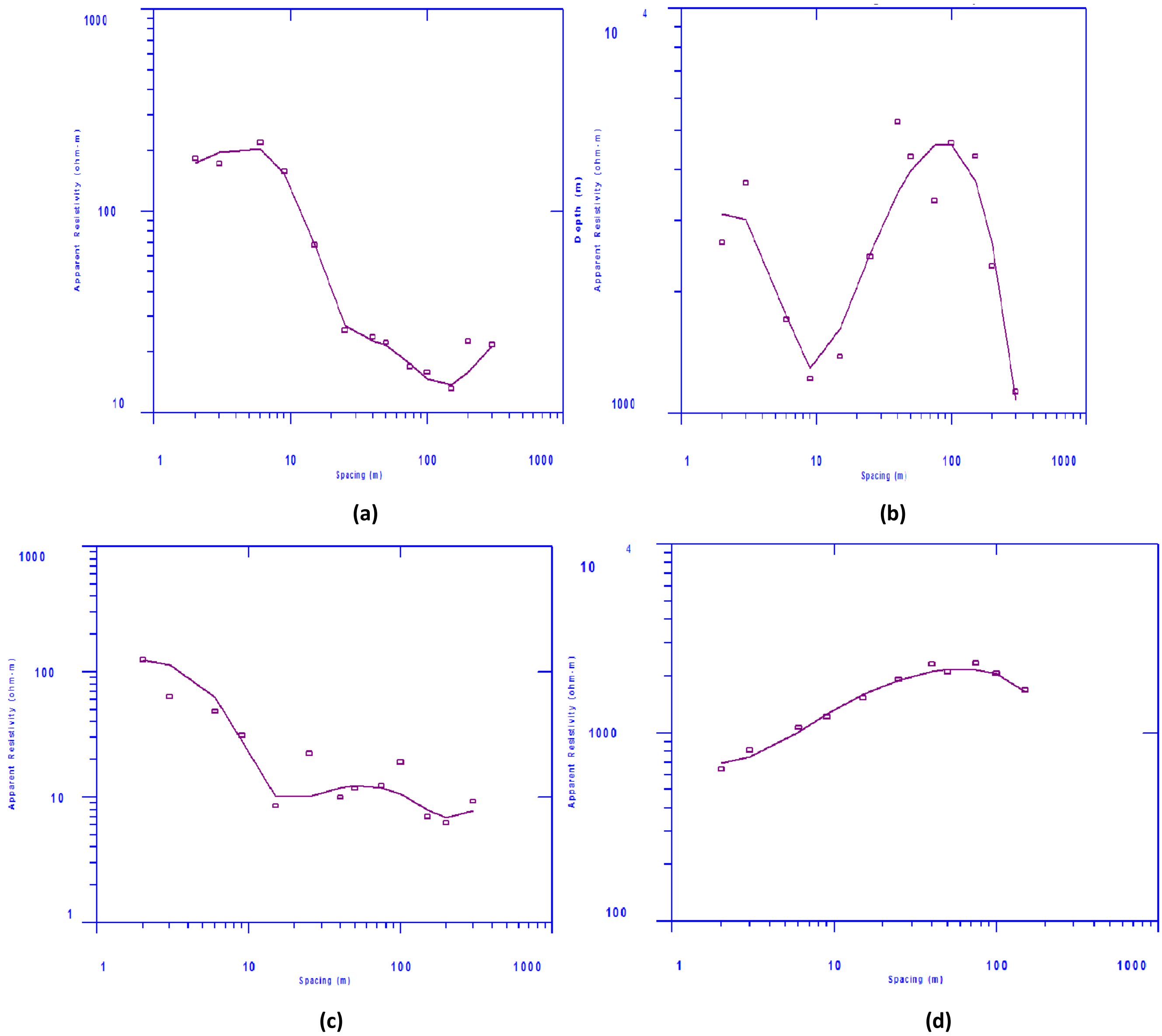

Figure 2: Computer modelled geoelectric curves at VES point (a) 1, (b) 2, (c) 3 and (d) 4

QUANTITATIVE INTERPRETATION

The quantitative interpretation of the curves highlights the geological units encountered, their various depth and thickness and the respective resistivity as shown in Tables 2. The sounding encountered five geo-electric units in VES1 (see Table 2-3). The first layer is about 2.7 metres thick, which is the top soil that is made up of laterite with resistivity of about 182.70Ω-m. The second layer of about 3.7 metres thickness with higher resistivity of about 219Ω-m is interpreted as sand. Third layer with thickness of about 5.1 metres contains shallow saturated shale with resistivity of about 158Ω-m. The next layer is about 180.7 metres thick with moderate resistivity of about 13.20Ω-m and interpreted as shale. The fifth layer, whose base could not be reached has a high resistivity (521.7Ω-m) and is interpreted as water saturated sandstone layer, which is the prospective aquifer unit (the unit of interest).

Table 2a: Summary of the Aquifer formation of layer parameters

Location	Layer 1			Layer 2			Layer 3		
	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)
VES 1	182.7	2.7	2.7	219	3.7	6.4	158	5.1	11.5
VES 2	3103.12	3.5	3.5	1220.19	6.2	9.7	4650.16	90.7	100.4
VES 3	125.70	2.5	2.5	8.54	10.3	12.8	82.01	8.9	21.7
VES 4	640.41	2.3	2.3	2320.17	38.4	40.7	1894	65.2	105.9
VES 5	425.23	2.2	2.2	3.41	23.6	25.8	38.14	24.6	50.4
VES 6	393.01	2.4	2.4	144.16	2.3	4.7	2050.22	45.3	50
VES 7	232.92	2.7	2.7	875.54	6.7	9.4	4090.16	36.9	46.3
VES 8	597.02	2.2	2.2	858.21	6.3	8.5	10.22	29.7	38.2
VES 9	235.21	2.8	2.8	42.54	2.4	5.2	1986.1	98.1	103.3
VES 10	682.1	1.96	1.96	13.85	10.67	12.63	122.11	15.64	28.27

Table 2b: Summary of the Aquifer formation of layer parameters

Location	Layer 4			Layer 5			Layer 6		
	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)	App. Resistivity (Ω-m)	Thickness (m)	Depth (m)
VES 1	13.2	180.7	189.2	521.7	-	Base not Reached			
VES 2	3813.22	49.6	150	210.72	-	Base not Reached			
VES 3	6.27	165.7	187.4	422.41	-	Base not Reached			
VES 4	124.98		Base not Reached		-				
VES 5	532.52	55.8	106.2	183.21	79.5	185.7	10.12		Base not Reached
VES 6	1235.37	106.1	156.1	8.02	-	Base not Reached			
VES 7	1004.04	59.5	105.8	106.52	-	Base not Reached			
VES 8	139.14	66.8	105.0	1221.09	-	Base not Reached			
VES 9	893.2	92.9	196.2	107.04	-	Base not Reached			
VES 10	564.28	14.91	43.18	320.86	77.85	121.03			

In VES 2, the sounding at this station intercepted five geo-electric units (see Table 2-3). The first layer is about 3.5m thick and is the top soil that is made up of laterite with a resistivity of about 3103.12Ω-m. The second layer of about 6.2 metres thickness with higher resistivity of about 1220.19Ω-m is interpreted as shaly-sand. Third layer with thickness of about 90.7 metres contains dry sand with very high resistivity of about 4650.16Ω-m. The next layer is about 49.6 metres thick with resistivity of about 3813.22Ω-m and interpreted as water saturated sand layer which is the prospective aquifer unit. The fifth layer whose base could not be reached has a very low resistivity (210.72Ω-m) and is interpreted as shale (clay).

Table 3: Summary of geo-electric layers

Location	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
VES 1	Top soil	Sand	shallow saturated shale	Shale	Saturated sand	
VES 2	Top soil	Shaly-sand	Sand	Water saturated sand	Shale	
VES 3	Top soil	Shale	Shallow saturated shale	Shale	Water saturated sand	
VES 4	Top soil	Sand	Water saturated sand	Shale	-	
VES 5	Top soil	Shale	Shaly-sand	Sand	Water saturated sand	Shale
VES 6	Top soil	Shale	Sand	Water saturated sand	Shale	
VES 7	Top soil	Shaly-sand	Sand	Water saturated sand	Shale	
VES 8	Top soil	Sand	Shale	Water saturated sand	Sand	
VES 9	Top soil	Shale	Sand	Water saturated sand	Shale	
VES 10	Top soil	Shale	Shaly sand	Sand	Water saturated sand	Shale

Similarly in VES 3, five geo-electric section were delineated in this location (see Table 2-3). The uppermost layer which is mostly laterite has a resistivity value of about 125.7Ω-m and about 2.5 metres thick. The underlying layer has a very low resisitivity value of about 8.54Ω-m and about 10.3 metres thick. It is interpreted as shale. Beneath the layer is another layer with thickness of about 8.9 metres contains sand with high resistivity of about 82.01Ω-m. The next layer which has resisitivity value of 187.40Ω-m and thickness of 165.7 meters. It is interpreted as shale. The last layer whose bottom was not reached has a resistivity value of 422.41Ω-m and was interpreted as water saturated sandstone which is the prospective aquifer unit. Four geo-electric sections were delineated in VES 4, six geo-electric units in VES 5, five geo-electric units in VES 6,7, 8, 9 and 10. The topmost layers have a resistivity value of 640.41Ω-m, 425.23Ω-m, 393.01Ω-m, 232.92Ω-m, 597.02 Ω-m , 235.21 Ω-m for VES 5,6,7, 8, 9 and 10 respectively.

Other results for VES 4-10 is properly presented in Table 2-3.

GEO-ELECTRIC CORRELATIONS WITHIN THE STUDY AREA

The geo-electric correlation sections show vertical and lateral variations in layer resistivity and thickness, which is a revelation of the lateral and vertical lithological changes in the study area. Profile were taken; one A-B through VES locations 10, 4, 7, 2 and 5 in the northwest-southeast direction (Fig.3).

Five subsurface layers were identified as: topsoil, the sand, shaly-sand, water saturated sand and the shale. In Fig.3, the aquifer unit recognized has resistivity values between 183.21 to 3813.22 Ohm-m and the depth to the top of the water saturated sand, which is the propective aquifer unit of interest ranges from 40.7 to 106 meters. The water bearing sandstone depth varies from one region to the other. Beneath this aquiferous region, the profile reveals a layer identified as the shale, which is the last layer whose bottom was not reached.

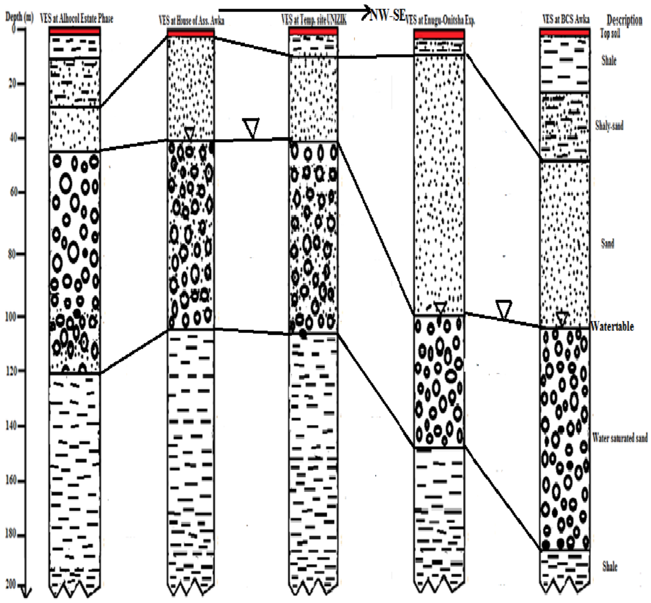

Fig.3: Geo-electric correlation along NW-SE Profile A-B

CORRELATION OF SOUNDING RESULT WITH GEOLOGY

Vertical electrical sounding data interpretation results obtained from the area showed four to six geoelectrical layers, which has been interpreted as: top soil, sand, shaly sand, dry sand, water saturated sand and shale. For better delineation of the underlying geology, results from two (2) vertical electrical soundings (VES 9 and 10) conducted in close proximity to two water boreholes have been correlated with known borehole log (Fig.4). Based on the borehole lithological logs, the correlation showed that the topsoil thickness in the lithologic section is 7.9m and 14.6m while in geo-electric section, it is 2.8m and 2.2m respectively. In the underlying layers, the geo-electric units show suppression and merging of some lithologic units from the borehole. This is due to the fact that geo-electric units are not the same as lithologic units. A given lithologic unit with variations in resistivity will give rise to so many geo-electric units. Also, different lithologic units with similar resistivities would be merged as one geo-electric unit.

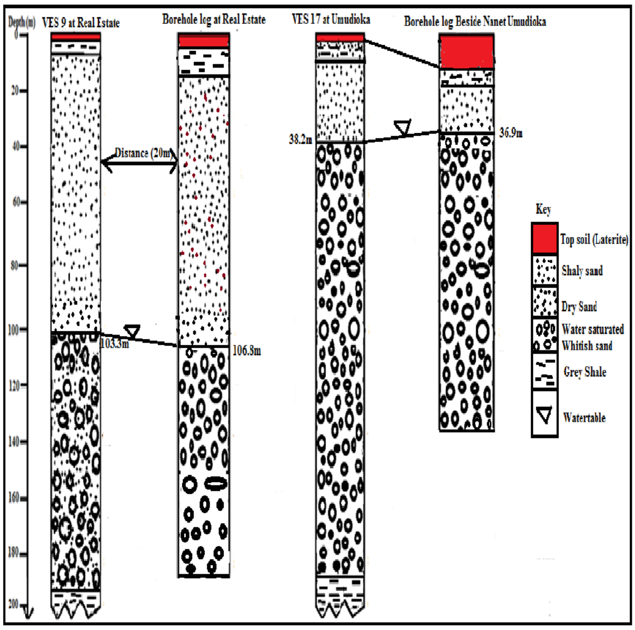

Fig.4: Correlation of Geoelectric and lithologic sections within the study area

AQUIFER CHARACTERISTICS

The hydraulic characteristics of aquifers are important properties for both groundwater and contaminated land assessments and also for safe construction of engineering structures [7]. Application of field hydrogeological method in aquifer parameter estimation is time consuming and capital intensive. In the alternative, surface geophysical method may provide rapid and effective techniques for groundwater exploration and aquifer evaluation. Table 3 shows the values of the aquifer parameters. Fig. 6 shows the distribution of the aquifer thickness computed from the resistivity soundings interpretation ranging from 49.6m at VES 2 to 112.6m at VES 3. The aquifer thickness map revealed that the maximum aquifer thickness is at eastern part of the study area, while the western part of the study area has the minimum thickness.

Table 3: Aquifer parameters estimated from geophysical data

VES NO	b (m)	ρ (ohm-m)	Transverse Resistance (Ohm-m^2)	Longitudinal Conductance (Ohm^{-1})	K_c(cm/s)	T_c (cm^2/s)
1	110.8	521.7	57,804.36	0.2124	0.1917	21.2383
2	49.6	3813.22	189,135.71	0.0130	0.0262	1.2995
3	112.6	422.41	47,563.37	0.2666	0.2367	26.6524
4	65.2	1894.34	123,488.80	0.0344	0.0528	3.4425
5	79.5	183.21	14,565.20	0.4339	0.5458	43.3911
6	106.1	1235.37	131,072.76	0.0859	0.0809	8.5835
7	59.5	1004.04	59,740.38	0.0593	0.0996	5.9262
8	66.8	139.14	9,294.55	0.4801	0.7187	48.0092
9	92.9	893.2	82,978.95	0.1040	0.1121	10.4008
10	77.85	320.86	24,978.95	0.2426	0.3117	24.2658

Maximum aquifer thickness area is characterized by a thick and prolific aquiferous zone, tapped by many productive boreholes and wells. This is due to the composition of the aquifer zone, consisted of unconsolidated medium to coarse grained sands and gravel.

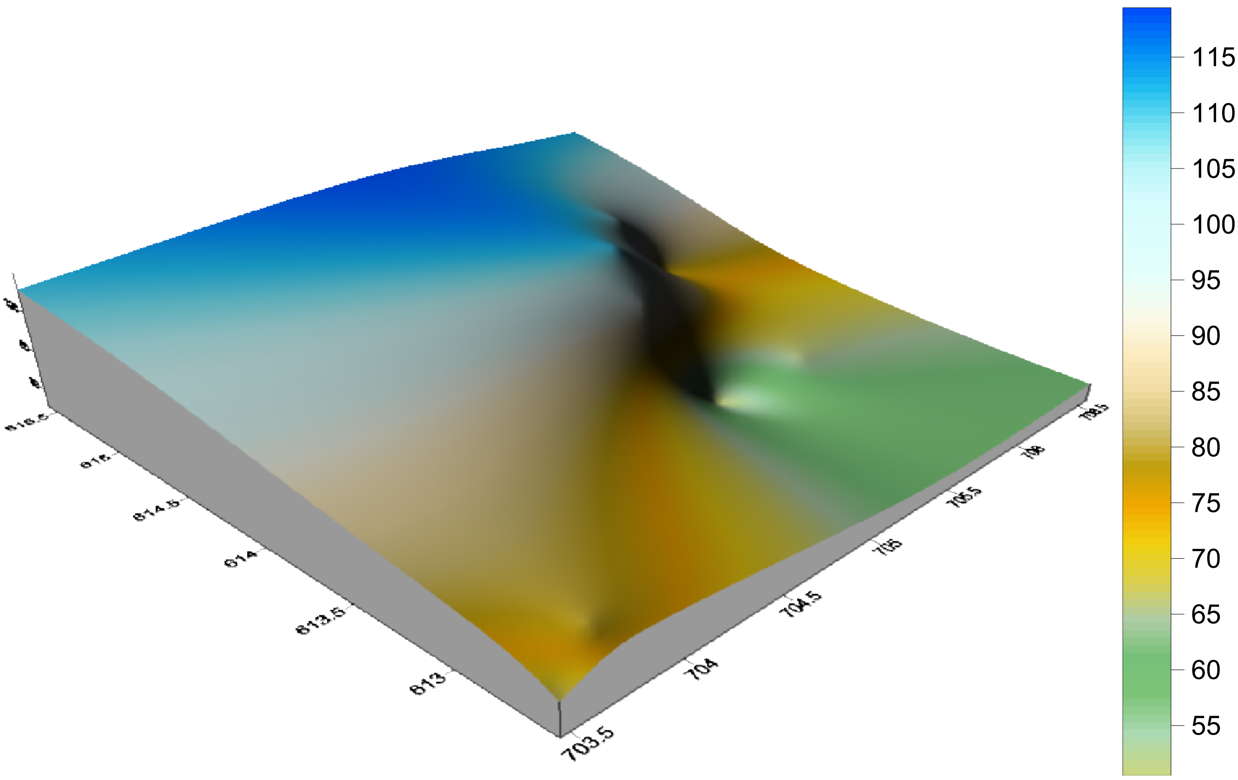

Fig. 5: 3-D Aquifer thickness map of the study area

The calculated hydraulic conductivity (Kc) values estimated from the VES results ranges from 0.0262 to 0.7187 cm/s (Table 3 and Fig.6). Hydraulic conductivity depends on the intrinsic permeability of the material and on the degree of saturation. The maximum hydraulic conductivity values are observed at the extreme north and southern portion of the study area while the transmissivity values (Table 3 and Fig. 8) vary between 1.2995 and 48.0092 cm^2/s, suggesting a high quality reservoir [9].

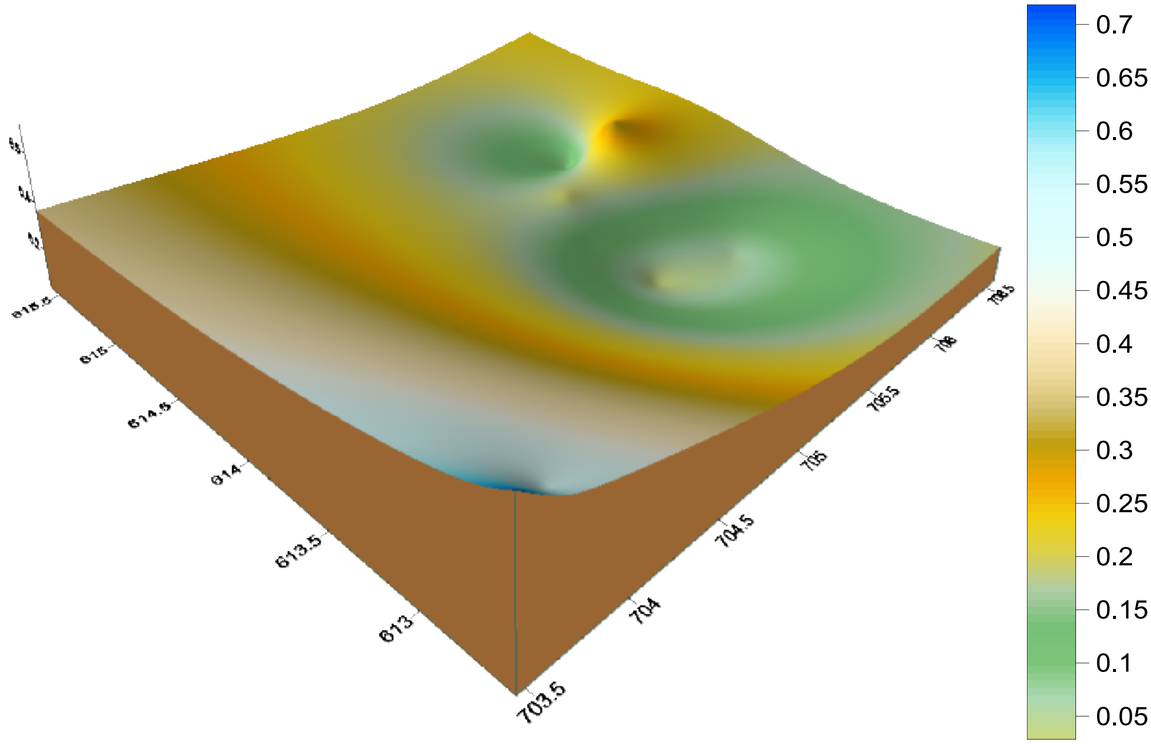

Fig. 6: 3-D Hydraulic conductivity map of the study area

The knowledge of transmissivity distribution is a fundamental source of information for establishing a hydrogeological model [6].

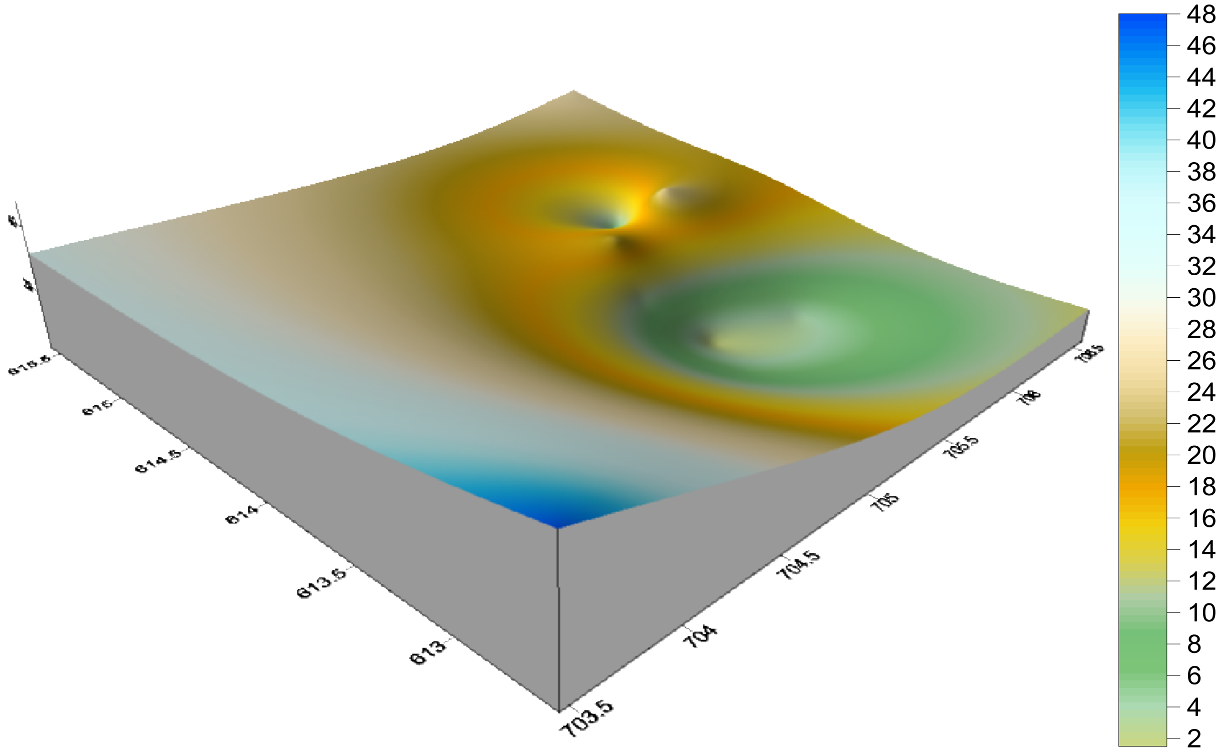

Fig.7: 3-D Transimissivity map of the study area

Transverse resistance is correlated with aquifer transmissivity and is one of the parameters used to define target areas of good groundwater potential. Higher values of transverse resistance indicate aquiferous zones with high transmissivity. VES 2 has the highest transverse resistance and therefore indicates area with good groundwater potential. The transverse resistance in this study is found to be higher than he transverse resistance in the study conducted by [10] in Northwest Bangladesh `which is found to vary between 480 and 5,375 ohm-m^2. Longitudinal conductance is closely related to transverse resistance, the 3-D map of transverse resistance and longitudinal conductance is shown in figure 8 and 9.

However, [1] in a study on estimation of aquifer hydraulic parameters from surficial geophysical methods: A case study of Keritis Basin in Chania (Crete – Greece) reported longitudinal conductance to be within 1.673 -10.500 ohm^{-1} which is slightly higher than values obtained in this study.

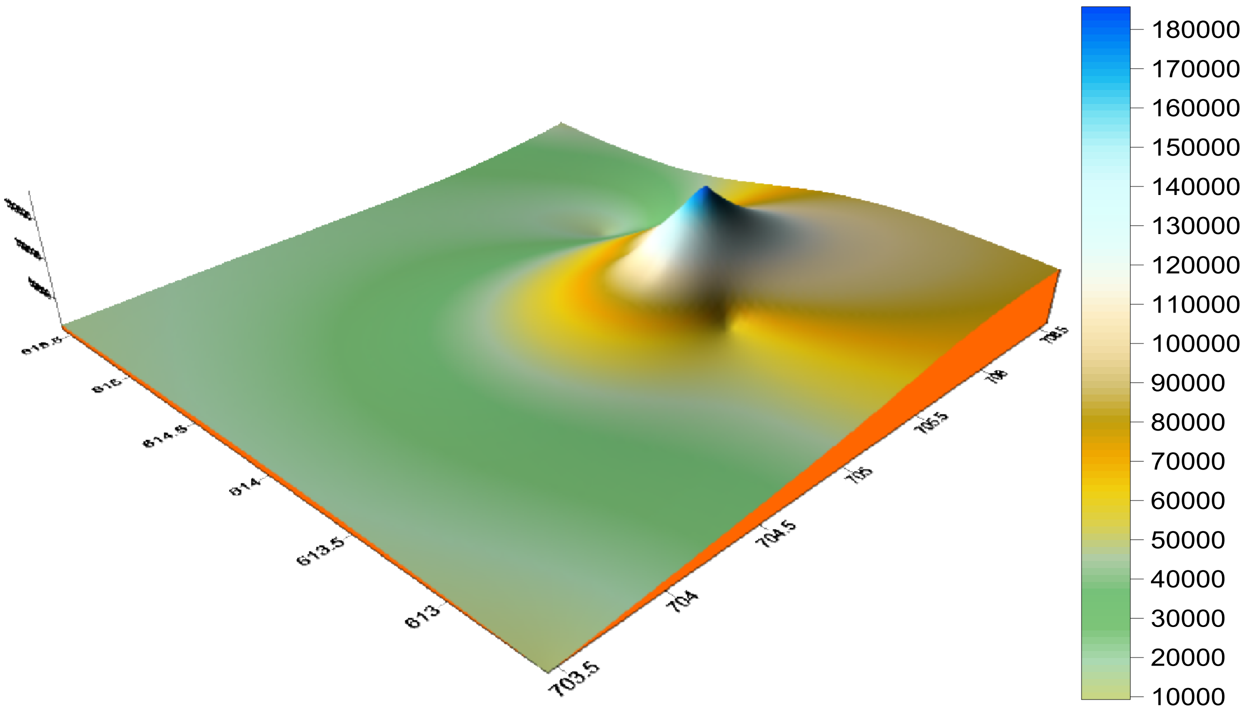

Fig. 8: 3-D Transverse Resistance map of the study area

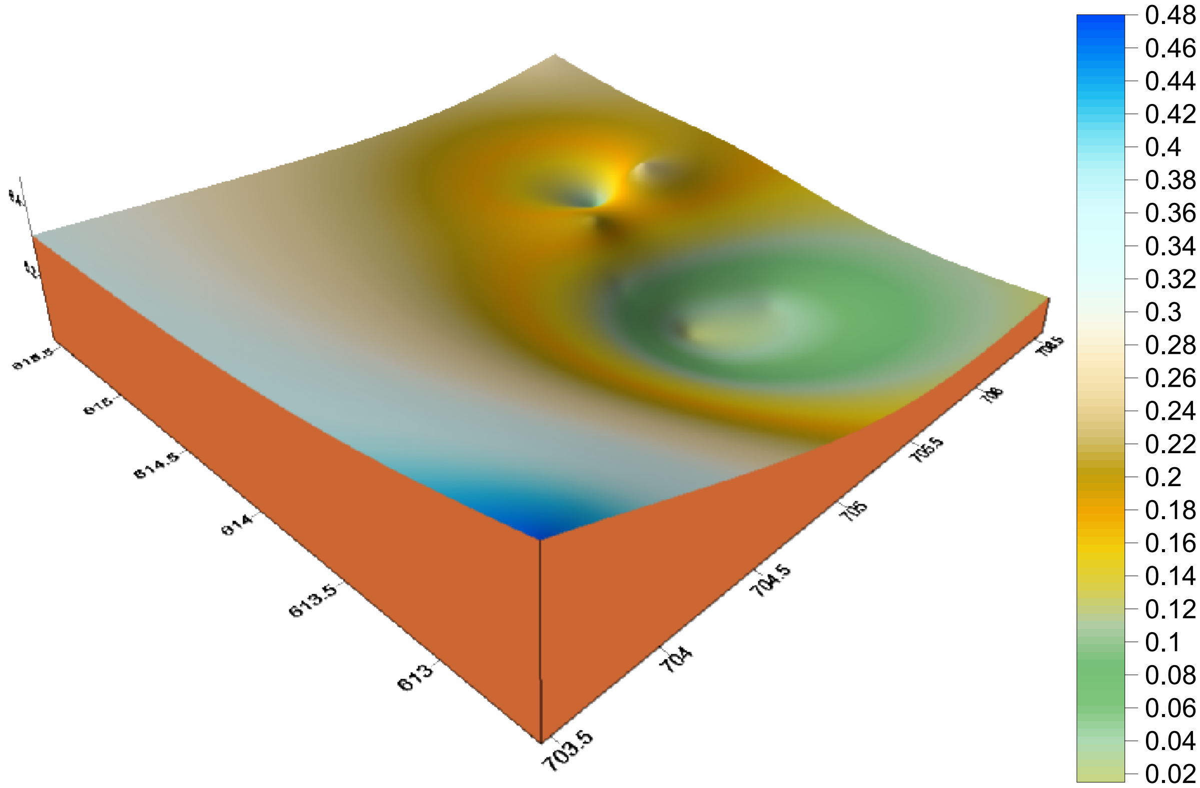

Fig. 9: 3-D Longitudinal Conductance map of the study area

CONCLUSION

The research presented the hydro-geological knowledge of the Study area in other to create awareness on the productive aquifer for sustainable groundwater development. Vertical electrical sounding data interpretation results obtained from the area showed four to six geoelectrical layers, which has been interpreted as: top soil, sand, shaly sand, dry sand, water saturated sand and shale. Lithologic log for the borehole located near one of the sounding station at Awka revealed that some of the geologic units were either suppressed or merged into a single geo-electric unit probably due to similarities in electrical resistivity.

Fluid transmissivity, transverse resistance, longitudinal conductance, hydraulic conductivity and aquifer depth which are fundamental properties describing subsurface hydrology were determined for the study area. 3-D surface map of the aquifer characteristics were produced, it was observed that the aquifer properties ranges from 0.0262 to 0.7187cm/s, 1.2995-48.0092cm^2/s, 139.14-3813.22 Ohm-m, 9,294.55-189,135.71 Ohm-m^2, 0.0130-0.4801 Ohm^{-1} for hydraulic conductivity, transmissivity, resistivity, transverse resistance and longitudinal conductance respectively within the study area.

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Investment of the cloud computing in Education & Learning

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ABSTRACT: Cloud computing is the result of evolution and adoption of existing technologies and paradigms. The goal of cloud computing is to allow users to take benefit from all of these technologies, without the need for deep knowledge about or expertise with each one of them. The cloud aims to cut costs, and helps the users focus on their core business instead of being impeded by IT obstacles.

Building cloud computing serves educational institutions, such that it will serve the educational and administration staff and students.

In our research, web pages site for the educational foundation and the university was designed to spreading the educational concepts specific for the learning of far distance cultures for two types synchronize or unsynchronized by using the cloud to design the students information management systems to monitor the students records from the first day in the course to the last day, which will help the educational staff and the administrator staff to get the right information in a proper time to take a right decision, with high speed and quality.

Finally, planning and building a system using cloud computing technique was explained, and how to design it, what we need of requirements to build this system, as well as how to test and implement that system was presented.

KEYWORDS: Investment, Cloud Computing, Educational, Learning, Services.

1 INTRODUCTION

The cloud computing is a development technique depending of move the process and the storage area for the computer to the cloud, such that the cloud is a service device we can access to him through the internet , by using this technique they will convert all the information technology programs from products to the services .

The original of cloud computing idea return to the middle of sixty of previews century when John McCarthy said it will organize the computing to become a general services, but he was means in that time by using a telephone network to do this technique, as well as we can take a (Gmail – Hotmail – Yahoo) as example for cloud computing.**[1]**

1.1 CLOUD COMPUTING COMPONENTS

The cloud computing consists of three main parts, they are: **[5]**

A- Software As a Services.
B- Platform As a Service.
C- Infrastructure As a Service.

A. Software As a Services

That means we can use a specific application stored at cloud, for example we can use the Word program which store in the information center and connect with him through Net, such that we can written in it and modify and insert data then we can get at output from him, in other word we can do all these activities at the cloud, and our computer is only a connecting tool.

B. Platform as a Service

It means we can use a cloud as platform to put several applications at it and using these applications, as well as we can put a complete operating system, such that there are some integrity between these applications.

For example we can design something in the photo shop and we can insert this design to the other application to move it and add some effects at him and finally we will get at a video with sound, for example of the Platform is (Google Apps), in this platform we can add any application we need to it.

C. Infrastructure As a Service

In this type we will deal with the cloud as infrastructure have specific process ability and a specific storage area, and a specific user's numbers. Such that we have ability to do what we want , for example we can install many operating systems and setup many applications at every system , as well as we can allow to the specific users number to enter to every operating system to use it applications without mix between them.

1.2 Cloud Computing Types

We have three samples to build the cloud computing, they are. **[5]**

A- Public Clouds.
B- Private Clouds.
C- Hybrid Clouds.

A. Public Clouds

The public cloud has the following properties:

- It introduces his services to several customers.
- It found in external building.
- The cloud locates in specific place and the customer in other place.
- It reduces the cost and the risks.

B. Private Clouds

This type has the following properties:

- It locates in internal or external building.
- It will be reliable from the company that dealing with here.
- It will be reliable from the cloud
- It will be reliable from the host company.
- It will give the company ability to monitor the cloud.

C. Hybrid Clouds

It has the following properties:

- They are combining between the properties of the public cloud and private cloud.
- It will be used in the company which has a small data, or the companies which needs to the specific applications.
- In this type the customer can choice between the applications and services of the public cloud and the applications and services of the private cloud.

- In this type the company has ability of controlling at the security.

1.3 THE ADVANTAGES OF USING CLOUD COMPUTING

A. ESSAY TO ACCESS

That means the customer can access to all the own applications and own services from any place and in any time through internet, because the own information will not store in own computer it will be store at the company servers that introduce this service.

B. DECREASE THE COST

Such that it will not necessary at the companies to bay many computers have a high speed processors and a high wide storage area , but it can for every ordinary computer to use any web browser to access to the cloud computing which used by the company to do all the activities like (documents edit , file storage , photo edit ... , etc.). As well as it is not necessary to bay a big cost servers to get at the email services to the employees, or bay the big storage unit to do and store the data backup and company information.

C. UTILIZATION FROM THE CLOUD COMPUTING INFRASTRUCTURE

Such that we can useful from the cloud computing infrastructure to do our work, for example the company can useful from the infrastructure to doing the scientific experiment, as well as to doing the complex calculations which the normal computer needs to many years to complete it. The companies that introduce these services like Google Company and Amazon company, such that these companies have services able to doing this operations in a several minutes or several hours.

1.4 THE DISADVANTAGES OF USING CLOUD COMPUTING

A. DISCONNECTION OF THE INTERNET SERVICE

If we loss with the internet we can't access to our cloud, and we can't doing any work, but the programmers develop some of the HTML applications and Java Script Application which able the user to access to own cloud and do own applications, after the net coming it will update the own cloud automatically.

B. SECURITY FEARS

Some of the companies and persons have fears from put all his information and his files at the cloud, such that if the cloud company exposure to a success infiltrate they will lose all information as well as the hacker will get at the user information.

1.5 CLOUD COMPUTING SECURITY

All the cloud companies are interested of the cloud security, and if we want interested at the cloud security we should focus at the following points. **[11]**

A. DATA SECURE

This point is sharing between the customer and Cloud Company, such that the customer should check the internet connection quality before application his activities like (process his information or store his information, as well as the company should kept the customer information from losing.

B. IDENTIFICATION SYSTEM

It is a system which checking the user identification and making sure the user has this account.

C. HARDWARE SECURE

The company should check the network quality and server's quality which using it, and they don't have any secure gaps.

D. APPLICATIONS SECURE

The company should check all the applications that using by the user doesn't have any secure gaps, and in any times they are having a good quality working.

E. PRIVACY

Such that the company should availability for every customer a special user name and password to enter to own cloud, which give to the cloud computing strength and more secure.

2 LITERATURE REVIEW

2.1 PROJECT REPORT ON "STUDENT INFORMATION MANAGEMENT SYSTEM"

Student information management system lead to a better organization structure since the information management of the students is well structured and also lead to better as well as efficient utilization of resources.

Student Information Management System can be used by education institutes to maintain the records of students easily. Achieving this objective is difficult using a manual system as the information is scattered, can be redundant and collecting relevant information may be very time consuming. All these problems are solved by using this system.

Throughout the system the focus has been on presenting information in an easy and intelligible manner. This system is very useful for those who want to know about Student Information Management Systems and want to develop software / websites based on the same concept.

The system provides facilities like online registration and profile creation of students thus reducing paperwork and automating the record generation process in an educational institution.

The main objective of this System is to allow the administrator of any organization to edit and find out the personal details of a student and allows the student to keep up to date his profile .It will also facilitate keeping all the records of students, such as their id, name, mailing address, phone, number, DOB, ….. etc. So all the information about an student will be available in a few seconds. **[13]**

2.2 STUDENT DATABASE MANAGEMENT SYSTEM

An organized and systematic office solution is essential for all universities and organizations. There are many departments of administration for the maintenance of college information and student databases in any institution. All these departments provide various records regarding students. Most of these track records need to maintain information about the students. This information could be the general details like student name, address, performance, attendance, … etc., or specific information related to departments like collection of data. All the modules in college administration are interdependent. They are maintained manually. So they need to be automated and centralized as, Information from one module will be needed by other modules. For example when a student needs his course completion certificate it needs to check many details about the student like his name, reg. number, year of study, exams he attended and many other details. So it needs to contact all the modules that are office, department and examination and result of students.

The features and improvement that allow achievement to this goal will be demonstrated and highlighted, this work is useful for easy user interface. We are planning to utilize the powerful database management, data retrieval and data manipulation. We will provide more ease for managing the data than manually maintaining in the documents. The system is useful for saving valuable time and reduces the huge paper work. **[11]**

2.3 OVER VIEW OF STUDENT MANAGEMENT SYSTEM

The SIS is designed to assign a unique Student Identifier (SID) to each student, such that it is collect demographic, performance, and program participation data for each student. The goal of this system is to develop and deploy a student information system that provides the state education agency, state and federal entities, the education community, and the public with timely and accurate data collection and reporting for students, schools, school districts, and the state. This information system developed and deployed for the ISBE, provides secure and appropriate access for applications such as student record inquiry, retrieval, and transfer. This system serves as the vehicle to collect all student-related information electronically from school districts.

The SIS application facilitates the batch and online generation of a State ID, as well as the collection and the maintenance of student information for data reporting purposes. Dependent on which system function is utilized, users are able to request a new State ID, search the system for an existing student with a State ID, view records, add or update records, request records, and view summary or detail reports of student records in the system. When batch processes are used, the SIS application provides users with appropriate result codes and messages. The SIS application also provides data validations and offers helpful messages when online processes are used. **[12]**

2.4 SIMS FOR THE ARAB OPEN UNIVERSITY

The Arab open university which has branch in Saudi Arabia used this system to act as academic advisor for the students, such that the student can register and see all his information from his home or his work place, this system named (oasis) this system lead the student to right way for choice his courses.**[15]**.

Fig.1. Main page for SIMS for Arab Open University

2.5 SIMS FOR THE NET LANGUAGE INSTITUTE

This institute to be founded in 1998 in Barcelona / Spain by Jonathan dikes, it specialize for learn different language. It is developed a system to store all information for his students named (advisor) in 2007, such that every institute student can connect to his electronic course through this system that belong to institute web side.

Net language developed this system to use by the students, teachers and training managers to access to the educational tools, connect tools, and reports systems. The characteristic of this system is every customer has own login page. As well as all the teacher can connect with his students through evaluate students, insert students marks, ….. etc.**[16]**

2.6 SIMS FOR THE MINISTRY OF EDUCATION / UNITED ARAB EMIRATES

The ministry of education in united Arab emirates design a system to student information management, its contains at a universal data base for the educational organization, to connect the special schools in Dubai and north emirate with them and support the decision owners to give right decision in suitable time.**[17]**.

Fig.2. Main Page for SIMS for Ministry of Education / UAE

3 METHODOLOGY

The cloud computing systems is a base to publishing and commutation the information between the different peoples on the earth, such that it provide all the common extreme with the information in suitable time, it provides the different extreme at the different information, if the extremes are increases and the type of information are increases also, the complexity of website will increase also, and If we want built a powerful website and consistent, in the first we should analyses the information and study the system, it include build the web pages depends on the information that contains each page, and build the relationship between these pages in website, after that we should specific the tools (programs) that needs to design these pages, it include the hardware requirements and software requirements. Then the next step implement design of our website and written the code of this system, finally before publish of our website we should test it and explorer the errors in this website, if it found, then we can publish it. It is illustrate in bellow. **[1]**

- Feasibility study.
- Analyses & planning of the System.
- System requirement specification.
- System design.
- Coding.
- System testing.
- System implementation.

3.1 FEASIBILITY STUDY

A Feasibility study is conducted to identify the best design that meets all the website requirements. This includes an identification description, an evaluation of the proposed systems and selection of the best design for the job. It is involve:

- Operation Feasibility.
- Technical Feasibility.
- Economic Feasibility.

3.2 ANALYSES & PLANNING OF THE SYSTEM

We can summarize this stage in two steps study of the system and input & output representation, The study of the system involve two things, they are:

- **Administrative user interface**

This interface concentrates on the consistent information that is practically, part of the organizational activities and which needs proper authentication for the data collection. These interfaces help the administrators with all the transactional operation like Data insertion, Data deletion and Date updating along with the extensive data search capabilities.

- **The operational or generic user interface**

The interface helps the end users of the system in transactions through the existing data and required services. The operational user interface also helps the ordinary users in managing their own information in a customized manner as per the included flexibilities.

3.3 SYSTEM REQUIREMENT SPECIFICATION

The second step is specifying the website building requirements, it includes the hardware requirements and the software requirements, and so to build and execute our website we need the following software requirements.

3.3.1 DATABASE: ORACLE 10G

If we have database in our website, the Oracle Database has been commonly used to store files closely associated with database applications including medical images, invoice images, documents, ….etc. in the website. **[7]**

3.3.2 PROGRAMMING LANGUAGE : JAVA LANGUAGE

There are many applications of the computer programs, such that we can use the word processors to write documents, Web browsers to explore the Internet, and email programs to send email. These are all examples of software that runs on computers. Software is developed by using programming languages. Such that there are many programming languages to developed these software, like Cobol, Fortran, Basic, Ada, C-language, C++ , Visual basic and Java language,….etc. Each of these languages was designed for a specific purpose.

So the programmers is preference the java language at the others programming languages, because the java language is enables users to develop and deploy applications on the Internet for servers, desktop computers, and small hand-held devices. The future of computing is being profoundly influenced by the Internet, and Java promises to remain a big part of that future. Java is the Internet programming language. It is a powerful programming language and helpful to review computer basics, programs, and operating systems.**[2]**

3.3.3 WEB TECHNOLOGY : JDBC, SERVLETS, JSP

The vast majority of professional web sites today have some sort of database connectivity. Webmasters have hooked online front ends to all manner of legacy systems, including package tracking and directory databases, as well as newer systems such as e-Commerce Systems. Although database-backed systems may be more challenging to develop, the advantages of allowing a database to manage data records are many fold. Within the database, data definition and manipulation is handled through Structured Query Language (SQL). So all database operations that can be performed on a stand-alone application can be performed on servlets too. Such that all the database operations are performed on the server side, and only data is passed to the client.

The Servlets are protocol and platform independent server-side software components, written in Java. They run inside a Java enabled server or application server, such as the Web Sphere Application Server. Servlets are loaded and executed within the Java Virtual Machine (JVM) of the Web server or application server.

Java Server Pages (JSPs) are similar to HTML files, but provide the ability to display dynamic content within Web pages. JSP technology was developed by Sun Microsystems to separate the development of dynamic Web page content from static HTML page design. The result of this separation means that the page design can change without the need to alter the underlying dynamic content of the page. This is useful in the development life-cycle because the Web page designers do not have to know how to create the dynamic content, but simply have to know where to place the dynamic content within the page. **[2]**

3.3.4 CLIENT – SIDE SCRIPTING : JAVA SCRIPT

JavaScript (JS) is an interpreted computer programming language. It was originally implemented as part of web browsers so that client-side scripts could interact with the user, control the browser, communicate asynchronously, and alter the document content that was displayed. **[1]**

3.3.5 USER INTERFACE : HTML / CSS

HTML is the main markup language for creating web pages and other information that can be displayed in a web browser. The HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets like (<html>), within the web page content. Such that the purpose of a web browser is to read HTML documents and compose them into visible or audible web pages, the browser does not display the HTML tags, but uses the tags to interpret the content of the page.

Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation semantics (the look and formatting) of a document written in a markup language. It's most common application is to style web pages written in HTML and XHTML, but the language can also be applied to any kind of XML document, including plain XML, SVG and XUL.

CSS is designed primarily to enable the separation of document content (written in HTML or a similar markup language) from document presentation, including elements such as the layout, colors, and fonts. This separation can improve content accessibility, provide more flexibility and control in the specification of presentation characteristics, enable multiple pages to share formatting, and reduce complexity and repetition in the structural content. **[4]**

3.3.6 SERVER : TOMCAT 7.0

The Apache Tomcat server is an open source, Java-based web application container that was created to run servlet and Java Server Pages (JSP) web applications. It was created under the Apache-Jakarta subproject; however, due to its popularity, it is now hosted as a separate Apache project, where it is supported and enhanced by a group of volunteers from the open source Java community.

Apache Tomcat is very stable and has all of the features of a commercial web application container yet comes under Open Source Apache License. Tomcat also provides additional functionality that makes it a great choice for developing a complete web application solution. Some of the additional features provided by Tomcat other than being open source and free include the Tomcat Manager Application, specialized realm implementations, and Tomcat valves. **[1]**

4 SYSTEM DESIGN

Website design is the solution to the creation of a new website. This phase is composed of several systems. This phase focuses on the detailed implementation of the feasible website. It emphasis on translating design specifications to performance specification. Website design has two phases of development logical and physical design. During logical design phase the analyst describes inputs (sources), out puts (destinations), databases (data sources) and procedures (data flows) all in a format that meats the uses requirements. The analyst also specifies the user needs and at a level that virtually determines the information flow into and out of the system and the data resources.

The physical design is followed by physical design or coding. Physical design produces the working system by defining the design specifications, which tell the programmers exactly what the candidate website must do. The programmers write the necessary programs that accept input from the user, perform necessary processing on accepted data through call and produce the required report on a hard copy or display it on the screen. In our research we will take SIMS design as example, such that he following figure representing for this system.

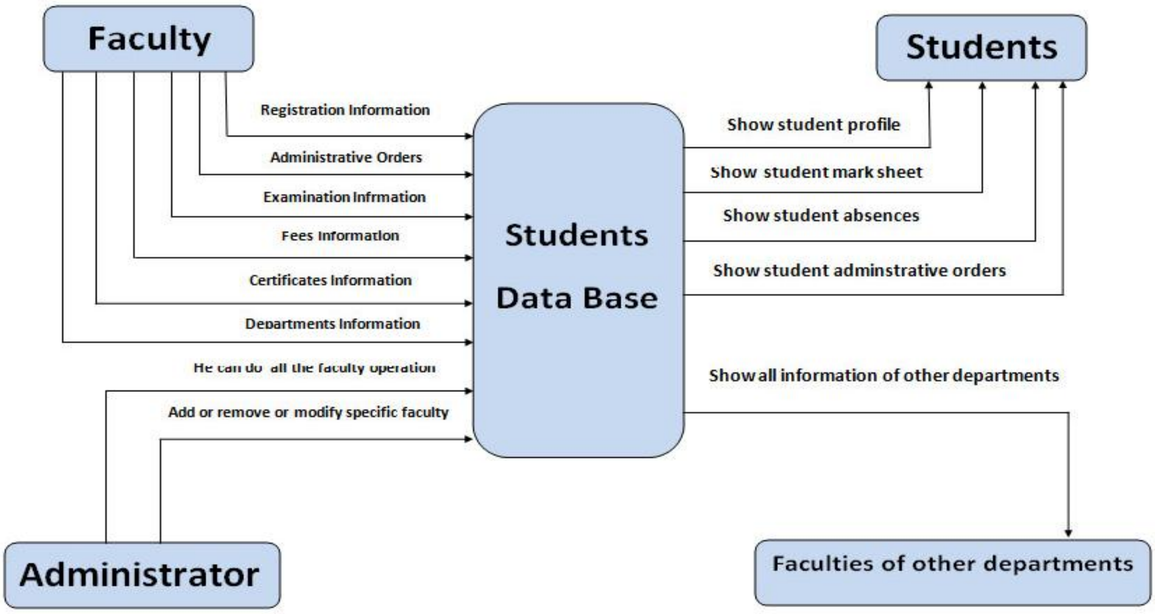

Fig.3. Internal Structure of SIMS [14]

5 CODING

The goal of the coding phase is to translate the design. The aim in this phase is to implement the design in the best possible manner. Well known code can reduce the testing and maintenance effort. During coding, the focus should on developing programs that are easy to read and understand and not simply on developing the programs that are easy to write. Simplicity and clarity should be strived for during the code phase. An important concept that helps the understandability of the programs is structured programming. The program that should be organized as a sequence of statements and during execution of the statements is executed in the sequence given in the program. There are many different criteria for judging of the program, execution time and required memory.

6 SYSTEM TESTING

Website testing is a critical aspect of Software Quality Assurance and represents the ultimate review of specification, design and coding. Testing is a process of executing a program with the intent of finding an error. A good test is one that has a probability of finding an as yet undiscovered error. The purpose of testing is to identify and correct bugs in the developed website. Nothing is complete without testing. Testing is the vital to the success of the system.

7 SYSTEM IMPLEMENTATION

Website publishing includes all those activities that take place to convert from the old system to the new. The old system consists of manual operations, which is operated in a very different manner from the proposed new system. A proper implementation is essential to provide a reliable system to meet the requirements of the organizations. An improper installation may affect the success of the computerized system.

8 RESULTS AND DISCUSSION

The using of cloud computing in the educational and learning field will facilitate for the educational staff and administrative staff follows to the educational foundation and the students likewise to do the following activities:

1- The education staff will able to spread all the scientific and knowledge concepts to the foundation students and all the students' world.

2- Spread learning concepts from a far distance by using a closed television circuit synchronous and asynchronous, such that the teacher will be in a specific place and the students in deferent places.

3- Spread learning videos through record these videos and spreads by using cloud computing to the all-world places, and open educational channels using this technique.

4- By using the cloud computing technique the educational staff will and administrative staff able to monitoring all the activities in the educational foundation from the first day to the last day in the course, such that they will be able to get a right information at right time.

5- By using cloud computing technique we can access to all our information puts at the cloud computing in any time and from any place.

9 CONCLUSION

The using of the cloud computing in the education and learning field will carry out increase the efficiency and the productivity of the educational staff and administrative staff likewise as well as it will increase the students educational level which will belong to the educational foundation through increase the efficiency manage of the students records because they will be able to get all needs information in right time which will carry out to take or make a right decision in a right time, as well as the using of the cloud computing will carry out to decrease the effort for get knowledge , because all the stunts will can get at own knowledge in any time and from any place.

The cloud computing system will facilities us explorer and monitoring all the activities happening in the collage from the first day to the last day in this course, such that we can get at right information in the right time.

Previously the information commutation operations was very difficult between the peoples for example send and received the messages, information commutation, cultures commutation, education commutation and knowledge publishing because it take long time and highest effort and expensive cost, all this reasons to be information commutation operations is impossible operation.

Recently, when can use the world wide web (WWW) and websites to publishing the acknowledge between the nations, such that we can get at desired information in short time, low effort, from any place and suitable cost. As well as we can create and design new website to publish own information to be available for all peoples.

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La césarienne : à propos de 147 cas au niveau de l'hôpital Mohamed V à Chefchaouen au Nord du Maroc

[Caesarean section: about 147 cases at the Mohamed V Hospital Chefchaouen in northern Morocco]

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ABSTRACT: *Objective:* Determine whether the existence of special clinical situations nursery (origin, gestational age, obesity and age) or fetal (breech presentation, and macrosomia term exceeded), associated with risks must include the completion of a C-section.
Patients and methods: cross type prospective study including singleton pregnancies who delivered at the Mohamed V Hospital in Chefchaouen in northern Morocco, from 1 September 2013 to 30 August 2014. The maternal and fetal factors were analyzed.
Results: Over the period studied, 305 were studied childbirth which 147 have given birth to a caesarean section. This population was from, about 53% rural, 26% of Chefchaouen Bab Taza 12% and 7.8% of Ouazzane. At significantly higher rates of caesarean section in patients at from Ouazzane (p <0.018). Analysis summit presentation is an interesting univariate prognostic factor acceptability of vaginal Exp (B) = 0.415 [0.244 to 0.708]. As against a presentation above is to the detriment of birth vaginally Exp (B) = 9.946 [1.225 to 80.720]. Three strong predictors of birth by natural means, term gestational age (Exp (B) = Gross 0.378 [0.178 to 0.799] a normal body mass index (Exp (B) = 0.389 [0.157 to 960]) and macrosomia (Exp (B) = Gross 0.536 [0.308 to 0.933]). While a term greater than 40 weeks of gestation was associated with a significantly increased risk of caesarean section (Exp (B) = 3.480 Gross [1.432 to 8.459]). Using multivariate models, it has been shown that in a patient from Ouazzane, presents a high risk of cesarean birth regardless of the type of presentation in these same patients but from another Ouazzane that the presentation of any seat remains a protective factor in favor of vaginal delivery (Exp $(\beta)_a$ between 0.14 and 0.46 Summit presentation to the top). But is increasing in If the extended term when the presentation is top type.
Discussion and conclusion: There is insufficient current data to systematically carry out a C-section for breech presentation. This is a much debated issue but this work has allowed us to identify a statistical model that should narrow down the choice, but still needs to be validated by a prospective study.

KEYWORDS: childbirth, risk, breech presentation, caesarean section, vaginal.

RESUME: *But de l'étude :* déterminer si l'existence de situations cliniques particulières, maternelles (provenance, age gestationnel, obésité et age) ou fœtale (présentation du siège, macrosomie et terme dépassé), associés à des risques doivent indiquer la réalisation d'une césarienne.
Patientes et méthodes : étude prospective de type transversale incluant les grossesses monofoetale ayant accouché au niveau de l'hôpital Mohamed V à Chefchaouen au Nord du Maroc, du 1er septembre 2013 au 30 aout 2014. Les facteurs maternels et fœtaux ont été analysés.
Résultats : Sur la période étudiée, 305 accouchement ont été étudiés dont 147 ont accouché d'une césarienne. Cette population était originaire, à environ de 53% du rural, 26% de Chefchaouen, 12% de Bab Taza et 7,8% de Ouazzane. Au taux de césarienne significativement élevé chez les patientes à provenance de Ouazzane (p <0,018). En analyse univarié la présentation en sommet est un facteur pronostique intéressant d'acceptabilité de la voie basse $Exp(B)_{Brut}$ = 0,415 [0,244–0,708]. Par contre une présentation en haut est en défaveur de l'accouchement voie basse $Exp(B)_{Brut}$ = 9,946[1,225–80,720]. Trois éléments fortement prédictifs de l'accouchement par les voies naturelles, un age gestationnel à terme ($Exp(B)_{Brut}$ =0,378[0,178–0,799], un indice de masse corporelle normale ($Exp(B)_{Brut}$ =0,389[0,157-960]) et une macrosomie ($Exp(B)_{Brut}$ =0,536[0,308–0,933]). Alors que un terme de supérieur de 40 semaine d'aménorrhée était associé à une augmentation substantielle du risque de césarienne ($Exp(B)_{Brut}$ =3,480[1,432–8,459]). En utilisant des modèles multivariés, il a été montré que chez une patiente à provenance de Ouazzane, présente un haut risque d'accoucher césarien quel que soit le type de la présentation chez ces mêmes patientes mais de provenance autre que Ouazzane, la présentation du siège quelconque demeure un facteur protecteur et en faveur d'accouchement par voie vaginale ($Exp(\beta)_{ajusté}$ entre 0,14 pour présentation en sommet et 0,46 pour celle en haut). Mais s'accentue en cas du terme prolongé quand la présentation est de type haut.
Discussion et conclusion : Il n'y a pas de données actuelles suffisantes pour réaliser systématiquement une césarienne en cas de présentation du siège. C'est une question très débattue mais ce travail nous a permis de déterminer un modèle statistique qui devrait affiner ce choix, mais qui demande encore à être validé par une étude prospective.

MOTS-CLEFS: accouchement, risque, présentation du siège, césarienne, voie basse.

INTRODUCTION

La césarienne est un acte obstétrical permettant l'accouchement par une incision de l'abdomen et de l'utérus, lorsque les conditions, chez la mère ou chez l'enfant, ne sont pas favorables. Elle permet de sauver le nouveau-né et sa mère dans des situations de souffrance fœtale ou de dystocie.

Cependant, la césarienne est parfois associée à des complications majeurs tels que des hémorragies et thrombo-emboliques et de plaies préopératoires; des complications mineures à savoir l'endométrite, infection urinaire, fièvre inexpliquée, anémie, asthénie, douleurs abdominales, douleurs mammaires et difficultés d'allaitement, incontinence urinaire urologiques et anales. La naissance par césarienne semble favoriser la survenue d'une détresse respiratoire, ce d'autant que l'enfant naît avant 40 semaines. À âge gestationnel égal, l'accouchement par voie basse diminue le risque de détresse respiratoire néonatale par rapport à la voie haute [1-2]. La césarienne peut donc être dans bien des cas une source de complications fœto-maternelles plus qu'une issue qui peut sauver la mère et son nouveau-né.

L'arrivée régulière de nouvelles données sur cette question actuellement très débattue, visant spécifiquement à éviter la survenue d'une césarienne pendant le travail surtout pour les présentations du siège, ont été rapportés. Ce travail a pour but d'étudier les éventuels éléments prédictifs de la réalisation d'une césarienne pendant le travail.

PATIENTES ET MÉTHODES

Nous avons réalisé une étude prospective de type transversale sur douze mois, incluant des femmes ayant accouchée à l'hôpital provincial l'hôpital Mohamed V à Chefchaouen au Nord du Maroc. L'étude a été réalisée en intention de traiter. Sur la période allant du 1er septembre 2013 au 30 aout 2014, nous avons répertorié les femmes ayant accouché césarienne. Les critères d'inclusion étaient les suivantes :

- Une présentation de siège de toute sorte
- Une provenance de trois points urbains différents du nord du Maroc et du Rural confondu pour les trois régions.
- Un type de grossesse
- Le critère d'inclusion de la corpulence choisi était l'IMC ; l'obésité étant définie par un IMC supérieur ou égale à 30, le surpoids entre 25 - 29,9 kg/m² un index compris entre 18,5 - 24.9 kg/m², correspondant à un poids normal.

Au cours de cette période, 147 patientes correspondaient à nos critères. L'ensemble des données a été relevé manuellement sur les dossiers obstétricaux des patientes.

Deux groupes ont été individualisés comme suit :

- Un groupe « voie basse » de patientes ayant accouché par les voies naturelle;
- Un groupe « césarienne » de patientes ayant nécessité une césarienne pendant le travail pour raison maternelle ou fœtale.

Une analyse univariée a permet d'étudier la liaison statistique entre le mode d'accouchement (césarienne versus voie basse) et plusieurs variables, dont on a supposé qu'ils avaient un lien avec le mode d'accouchement. La liaison entre deux variables qualitatives a été étudiée par l'intermédiaire du test du Khi^2.

Le seuil de significativité statistique retenu était de 5% et la formulation des hypothèses était bilatérale.

Pour chaque variable significative, l'*odds ratio* a été calculé avec son intervalle de confiance à 95%.

A l'issue de l'analyse univariée et afin d'analyser simultanément l'influence de plusieurs variables, on a utilisé un modèle de régression logistique dichotomique simple puis multiple, afin d'expliquer le mode d'accouchement (césarienne versus voie basse) en fonction des variables explicatives qui avaient un seuil de significativité de moins de 20% en analyse univariée (p < 0,2) après discrétisation des variables continues en classes. Les odds-ratios significatifs au seuil alpha de 5% ont été mentionnés. Un odds ratio supérieur à 1 signifiait que le risque de césarienne était augmenté. Un odds-ratio inférieur à 1 correspondait à la relation inverse.

Résultats

Sur la période étudiée, 305 accouchement ont été étudiés dont 147 ont accouché d'une césarienne, tout age confondu. Les caractéristiques démographiques et obstétricales du groupe des femmes accouchées césarienne et du groupe voie basse sont rapportées dans le Tableau (1). La population de l'étude était en moyenne âgée de moins de 26 ans, que ce soit pour le groupe césarienne ou pour le groupe voie basse avec des extrêmes de 16 ans à 45 ans. Cette population était originaire, à environ de 53% du rural, 26% de Chefchaouen, 12% de Bab Taza et 7,8% de Ouazzane. Au taux de césarienne significativement élevé chez les patientes à provenance de Ouazzane (p <0,018).

La présentation en sommet semble être un facteur pronostique intéressant d'acceptabilité de la voie basse (60,9% vs 39,1 %) avec un seuil significatif en analyse univarié (Exp(B)$_{Brut}$ =0,415; IC: 0,244–0,708; p <0,012). Par contre une présentation en haut est en défaveur de l'accouchement voie basse de manière tout à fait significative (89,1% vs 11,1%; Exp(B)$_{Brut}$ = 9,946; IC:1,225–80,720; p<0,009). La présentation céphalique du groupe césarienne était supérieur à celle du groupe voie basse (55,6% vs 44,4%), mais avec une différence à la limite de la significativité (Exp(B)$_{Brut}$ =1,652; IC:0,932–2,927; p=0,08), il y avait une tendance d'augmentation du risque de césarienne chez les patientes de cette présentation. Les autres présentations du siège complet et transverse sont de risque supérieures mais non significatifs tableau (1).

Trois éléments fortement prédictifs de l'accouchement par les voies naturelles sont, un age gestationnel à terme (53,8% vs 46,2%; Exp(B)$_{Brut}$ =0,378; IC: 0,178–0,799; p=0,009), un indice de masse corporelle normale (4,8% vs 76,9% et 18,4%; Exp(B)$_{Brut}$ =0,389; IC: 0,157-960; p=0,035) et une macrosomie (64,3% vs 35,7; Exp(B)$_{Brut}$ =0,536; IC: 0,308–0,933; p=0,026). Alors que un terme de supérieur de 40 semaine d'aménorrhée était associé à une augmentation substantielle du risque de césarienne (75% vs 25%; Exp(B)$_{Brut}$ =3,480; IC: 1,432–8,459; p=0,015).

Tableau 1 : Comparaison des variables socio-démographiques et obstétricaux entre les femmes accouchées en césarienne et voie basse

	Femmes accouchées par césarienne N= 147 Effectif (%)	Femmes accouchées par voie basse N=158 Effectif (%)	Khi-deux	*p*
Provenance				
Chefchaouen	33 (42,3)	45 (57,7)	10	0,018
Ouazzane	18 (78,3)	5 (21,7)		
Bab Taza	15 (41,7)	21(58,3)		
Rural	75 (48,1)	81(51,9)		
Présentation				
Céphalique du sommet	68 (39,1)	106 (60,9)	14,68	0,012
Céphalique autre	35 (55,6)	28 (44,4)		
Transverse	2 (66,7)	1 (33,3)		
Siège complet et déco.	6(71,4)	3 (28,6)		
Haut	8 (88,9)	1 (11,1)		
Age gestationnel				
< 37 SA	4 (50)	4 (50)	8,40	0,015
A terme	121(46,2)	141 (53,8)		
> 41 SA	21 (75)	7 (25)		
Macrosomie fœtale				
Non	116 (50,9)	112 (49,1)	4,94	0,026
Oui	25 (35,7)	45 (64,3)		
Age moyenne				
25,67	26,19±6,77	25,19±5,99	20,33	0,852
Grades d'obésité				
IMC normale	6 (4,8)	143 (95,2)	4,449	0,035
Surpoids	108 (76,9)	35 (23,1)		
Obésité	26 (18,4)	122 (81,6)		

Tableau 2 : Modèle de régression logistique univarié pour le risque de survenue de la césarienne.

	Césarienne (n)	Voie Basse (n)	$Exp(B)_{Brut}$	IC pour Exp(B) 95%
Provenance				
Chefchaouen	33	45	0,70	0,431–1,225
Ouazzane	18	5	4,3	1,552–11,924
Bab Taza	15	21	0,40	0,366–1,505
Rural	75	81	0,90	0,29–1,577
Présentation				
Céphalique du sommet	68	106	0,415	0,244–0,708
Céphalique autre	35	28	1,652	0,932–2,927
Transverse	2	1	2,359	0,211–26,345
Siège complet et déc.	6	3	3	0,572–15,778
Haut	8	1	9,946	1,225–80,720
Age gestationnel				
< 37 SA	4	4	1,042	0,256–4,247
A terme	121	141	0,378	0,178–0,799
> 40 SA	21	7	3,480	1,432–8,459
Grades d'obésité				
IMC normale	6	143	0,389	0,157-0,960
Surpoids	108	35	-	-
Obésité	26	122	-	-
Macrosomie fœtale				
Non	116	112	0,536	0,308–0,933
Oui	25	45		

Ns : non significatif
Déc : décomplète

Afin de démontrer jusqu'à quel point l'interaction age-provenance-macrosomie-obésité- présentation du siège pouvait entraîner des biais des résultats quand les données étaient combinées, nous avons utilisé un modèle multivarié pour les différentes présentations du siège (Tableau 3). Ainsi, après ajustement, chez une patiente à provenance de Ouazzane, ayant un IMC normal et portait un enfant macrosome, la présentation haut constitue un risque significativement élevé d'accoucher césarien ($Exp(\beta)_{ajusté}$ =10,03; p =0,040); $Exp(\beta)_{ajusté}$ =21,19). Il est presque six fois, cinq fois et quatre fois respectivement plus élevé qu'en cas de présentation sommet ($Exp(\beta)_{ajusté}$ =3,74), présentation céphalique, siège ($Exp(\beta)_{ajusté}$ = 4,50) ou présentation transverse ($Exp(\beta)_{ajusté}$=5.26). Chez ces mêmes patientes mais de provenance autre que Ouazzane, la présentation du siège quelconque demeure un facteur protecteur et en faveur d'accouchement par voie vaginale ($Exp(\beta)_{ajusté}$ entre 0,14 pour présentation en sommet et 0,46 pour celle en haut).

Tableau 3. Modèle de régression logistique multivariée réalisé après ajustement pour l'effet d'interaction age-provenance – macrosomie- obésité-présentation du siège.

Modèle multivarié ajusté pour l'effet d'interaction age –macrosomie- obésité-présentation céphalique du sommet						
	Variable	β	Wald	p-valeur	$Exp(\beta)_{ajusté}$	IC pour Exp(B) 95%
Etape finale	Prov.ouazzane	1,671	6,102	0,014	5,318	1,412-20,026
	IMC normale	-0,920	3,296	0,069	0,399	0,148-1,076
	Macrosomie	-0,681	3,573	0,059	0,506	0,250-1,025
	sommet	-0,789	7,274	0,007	0,455	0,256-0,806
	Constante	0,439	2,938	0,087	1,551	
Modèle multivarié ajusté pour l'effet d'interaction age –macrosomie- obésité-présentation haut						
Etape finale	Prov.ouazzane	1,640	5,791	0,016	5,153	1,356-19,588
	IMC normale	-0,951	3,333	0,068	0,386	0,139-1,073
	Macrosomie	-0,764	4,470	0,034	0,466	0,229-,946
	Haut	2,306	4,201	0,040	10,032	1,106-90,992
	Constante	-0,128	,661	0,416	0,879	
Modèle multivarié ajusté pour l'effet d'interaction age –macrosomie- obésité-présentation céphalique autre						
Etape finale	Prov.ouazzane	1,685	6,253	0,012	5,391	1,439-20,190
	Macrosomie	-0,636	3,290	0,070	0,529	0,266-1,053
	Constante	-0,180	1,484	0,223	0,835	
Modèle multivarié ajusté pour l'effet d'interaction age –macrosomie- obésité-présentation siège complet et décomplète						
Etape finale	Prov.ouazzane	1,685	6,253	0,012	5,391	0,436-1,503
	Macrosomie	-0,636	3,290	0,070	0,529	,479-2,395
	Constante	-0,180	1,484	0,223	0,835	
Modèle multivarié ajusté pour l'effet d'interaction age –macrosomie- obésité-présentation siège transverse						
Etape finale	Prov.ouazzane	1,661	6,077	0,014	5,263	1,405-19,710
	Macrosomie	-0,621	3,104	0,078	0,537	0,269-1,072
	Constante	-0,162	1,167	0,280	0,851	

Ensuite, nous avons utilisé un modèle multivarié après ajustement pour l'effet d'interaction provenance-age – macrosomie- obésité-présentation du siège- dépassement du terme. Dans ce dernier modèle, le terme dépassant 40 semaines d'aménorrhées constituait un facteur de risque significatif pour la survenue de césarienne tableau (4). Avec un niveau de risque élevé à celui rapporté dans l'analyse univarié précèdent.

Tableau 4 : Modèle de régression logistique multivariée réalisé après ajustement pour l'effet d'interaction provenance-age – macrosomie- obésité-présentation du siège- dépassement du terme.

		β	Wald	p-valeur	$Exp(B)_{ajusté}$	IC pour Exp(B) 95%
Etape finale	Prov.ouazzane	1,288	3,503	0,061	3,625	0,941-13,960
	Terme > 40 SA	1,098	4,548	0,033	3,000	1,093-8,232
	Siège haut	1,950	3,138	0,076	7,030	0,813-60,813
	Constante	-0,404	7,826	0,005	0,668	

a. Variable(s) entrées à l'étape 1 : Macrosomie.
b. Variable(s) entrées à l'étape 2.
Pro. : Provenance

DISCUSSION

La prévalence du siège retrouvée dans notre étude à terme (3,2%) corrobore celle de la littérature qui est de 3 à 5% [3]. Des taux similaire du notre relevés par Hannah et al. [4] soit 3,1%. Par contre, des taux plus élevées ont été retrouvés notifiés par sy et al. [5] en Guinée (9,6%).

Cette anomalie de présentation dans notre série d'étude (14,3%) est en presque concordance avec celle publiée par National Institute for Health and Clinical Excellence en 2004 [6] pour un terme entre 18 et 32 semaines d'aménorrhée ou 9% quand le terme entre 33 et 36 semaines d'aménorrhée. Ce résultat peut s'expliquer par notre méthodologie trop restrictive, qui a exclu les cas de siège au cours des grossesses multiples et des accouchements prématurés. Ceux-ci sont fréquemment associés aux présentations du siège.

Concernant le taux de césarienne en présentation du siège d'une grossesse monofoetale, à terme (71,4%) est proche de celui retrouvé par l'enquête national périnatal en 2003 (74,4 %) [7]. Apparemment, nos habitudes obstétricales sur le siège à terme au niveau de l'hôpital Mohamed V de Chefchaouen ne seraient pas influencées par l'étude de Hannah [4], bien qu'il n'existe pas d'études multicentriques antérieures qui ne permettent de tirer des comparaisons. Avec l'analyse multivariée de logistique on peut affirmer qu'il n'y a aucune relation significative entre le siège et la survenue d'une césarienne. En effet, un ajustement pour l'effet d'interaction de quelques facteurs reconnus de risque de survenue de césarienne surtout chez des patientes de l'âge avancé [8-9-10-11-12], portant un enfant macrosome [4], obèse [13] ou ayant un enfant en présentation du siège [4], s'est montré très protecteur et ne pourrait constituer un risque probable pour un accouchement par voies vaginales si on excepte les femmes à provenance de Ouazzane. Ceci pourrait être expliqué d'une part du fait que la seule structure d'accueil hospitalière à Ouazzane des régions avoisinantes transfère l'ensemble des cas à risque accoucher en urgence suite à une complication de la grossesse. Mais ces interventions en faveur de la voie basse dans de telles situations sont dictées par l'arrivée tardée où la césarienne n'est plus possible pour ces patientes. En France, le taux de césarienne sur le siège est passé de 60% avant Hannah et al. [4] à 81% en 2002 [14]. En Hollande, ce taux est passé de 50% en 2000 à 80% en 2005 [15]. Il semble que les pratiques occidentales actuelles, notamment en France, ont pris en compte les recommandations du collège américain des obstétriciens et gynécologues (ACOG) qui impose une césarienne systématique en cas de siège, sauf pour le 2eme jumeau et l'accouchement imminent [16].

Le terme prolongé constitue un autre facteur de risque de survenue de la césarienne dans notre travail. Des auteurs ont depuis longtemps mis en évidence un même résultat, les taux rapportés allant de 12 à 25%, pour la plupart des auteurs [17-18-19-20]. Dans ce série d'étude après ajustement ce taux est très élevé chez les patientes à une grossesse prolongée en provenance de Ouazzane quand la présentation en haut quel que soit les facteurs reconnus de risque (obésité, âge élevé….). Dans ce cas le seul fait de la non détection du fœtus pousse les gynécologues de décider césarienne ce qui expliquerait cette augmentation.

CONCLUSION

Nous pouvons sans doute éviter de césariser des patientes pour qui un accouchement par voie basse a été accepté dans les présentations du siège ou autres situations à risque si nos patientes sélectionnées plus rigoureusement. Et si on excepte les cas transférés d'urgence, des facteurs prédictifs pourraient affiner notre sélection de patientes, chez qui une tentative de voie basse est envisageable et diminuer ainsi le taux de césarienne en cours de travail car il n'y a pas de données actuelles suffisantes pour réaliser systématiquement une césarienne en cas de présentation du siège. L'arrivée régulière de nouvelles données sur cette question actuellement très débattue peut être de nature à revoir cette affirmation. Mais ces résultats obtenus statistiquement, doit encore l'être cliniquement par une nouvelle étude prospective, afin de démonter sa fiabilité pratique.

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INFLUENCE OF PERFORMANCE APPRAISAL ON JOB PERFORMANCE OF LIBRARY EMPLOYEES IN SELECTED UNIVERSITY LIBRARY AND INFORMATION CENTERS IN SOUTH-WEST NIGERIA

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ABSTRACT: This study investigated the influence of performance appraisal on job performance of library employees in selected University library and information centers in South-West Nigeria. The survey research design was used for the study. Study population consisted of 133 library personnel in four university libraries. Sampling was purposive and enumerative as all members of the population were used for the study. Data collected were analyzed using frequency and percentage counts. Findings revealed that library personnel perceived performance appraisal as the routine evaluation of an employees' output; as a management tool aimed at improving the performance of employees; as a technique for determining staff compensation but not a management tool for strengthening superior - subordinate relationship. The study also revealed that performance appraisal could influence job performance as it improves and motivates personnel to work harder. Based on these findings, some recommendations like finding suitable appraisal scheme that will best suit the employees of the library in performing; giving a regular feedback to the employees after an evaluation; and gearing staff performance exercise towards staff productivity and performance were made.

KEYWORDS: Performance Appraisal, Job Performance, Library Employees, Libraries and Information Centers, South-west Nigeria Universities.

INTRODUCTION

Performance appraisal of employees is an essential instrument for management in every organization, including the library and information centers. Assessment of employees' performance is considered as one of the common practices in almost every organization. People are employed to get desired organizational results and consequently, employees' performance could be regarded as one of the major determinant factors in the success or failure of an organization. So, performance appraisal is necessary in organizations as it could be used as a mechanism to improve employees' performance.

Several criteria, according to [1], are needed in order to evaluate job performance of an employee accurately. Ivancevich, Olekans, and Matteson (in [2]) have identified some determinants of job performance and these they referred to as the concomitants of job performance. These concomitant are the capacity to perform, the opportunity to perform, and the willingness to perform. [3] notes that job performance represents behaviors employees engage in while at work which contribute to organizational goals. He further reiterated that job performance is a result of the interaction between declarative knowledge (knowledge of facts or things), procedural knowledge (knowledge of what needs to be done and how to do it), and motivation (reflective of an employee's choices regarding whether to expend effort, the level of effort to expend, and whether to persist with the level of effort chosen). These determinants factors appear to influence performance largely through the acquisition and usage of job knowledge and the motivation to do well.

[4] asserts that the performance of a person on a job can be considered as a function of two different variables namely the ability or skill of the individual to perform the job and the motivation to use this ability or skill in the actual performance of the job. For [5] job performance puts emphasis on the employee's productivity by examining the number of units of acceptable quality produced by an employee in a manufacturing environment, within a specific time period. Finally, [6] view individual job performance as a multidimensional idea consisting of many facets such as an employee's output (job result), employee mode of accomplishing his or her task (job behavior), and the employee's attitude towards his or her job (personal traits). So, the assessment of employees' performance is a necessary phenomenon as it could reveal job performance level of employees and organizations. Thus, organizational performance, its resultant efficiency and effectiveness can be achieved as individuals in the organization are appraised and evaluated.

STATEMENT OF THE PROBLEM

The aim of every organization is to achieve its objectives and goals successfully. The library and information centers are organization and as a result performance appraisal is critical as well as necessary. Without any performance assessment and feedback, the library and information centers might not be able to determine the level at which their employees perform their jobs and consequently, they might not have the basis for any improvement. It is on this premise that this study seeks to examine the influence of performance appraisal on the job performance of library employee in selected library and information centers in Nigeria.

OBJECTIVES OF THE STUDY

The aim of the study is to investigate the subject of performance appraisal in selected University library and information centers in South-West Nigeria. Therefore, the specific objectives are to:

1. discover who does the performance appraisal in the selected Universities library and information centers in Nigeria;
2. find out the perception of performance appraisal among the staff in the selected Universities libraries and information centers in Nigeria; and
3. investigate the influence of performance appraisal on job performance among the employees in selected universities libraries and information centers in Nigeria.

LIMITATIONS TO THE STUDY

This study is limited to the library employees at Babcock University, Federal University of Agriculture, and Olabisi Onabanjo University libraries. It is extended only to professional librarians, para-professionals, library assistants and administrative staff only.

REVIEW OF LITERATURE

Evaluation of employees' performance in organizations including library and information centers is not a new phenomenon. According to [7], the history of performance appraisal itself can be traced to Taylor's pioneering time and motion studies. It is believed that motivation theories are the theoretical basis for performance management and performance appraisal. Theories such as Vroom's expectancy theory and the goal setting theory of Edwin Locke are some of the theories that could explain how employees can be made to be more productive.

PERFORMANCE APPRAISAL

Information from the literature reveals that performance appraisal operates within the principles of goal setting theory of [8]. According to this theory, performance appraisal emphasizes the importance of individual's acceptance and commitment to goals. [8] believe that goals guide peoples' responses and action and also can direct work behavior and performance.

Many authors have given the meaning of performance appraisal. [9] define performance appraisal as the systematic evaluation of an individual employee's job related strengths and weaknesses. It is also seen as a method whereby employees' behaviors are evaluated in the work spot and this evaluation normally includes both the quantitative and qualitative aspects of job performance, [10]. [11] add that performance appraisal evaluates employees' work performance over a given period of time. This definition first connotes judging a staff's performance as is measured against certain standards. Further, [12] asserts that performance appraisal identifies people's talents and capacities which could result in making them aware of advancements, plans and goals. As discussed by [13], the aim of performance appraisal is to identify the strengths and weaknesses of an employee and attempts to address these conditions in relations to how to improve or develop these areas. In addition, performance evaluation aims at motivating the employees thereby providing them with sufficient challenges and responsibilities in relation to the business objectives of the organization. [14] claims that if performance appraisal is performed correctly and logically, it could enable the organization to get its personnel to achieve their interests. Performance appraisal as noted by [15] provides three types of data for managerial actions in decision-making. It provides data that deal with the past, the present and the future. In their view, [16] and [17], further explain that appraisal of workers' performance provides adequate feedback to support employees' development; serves as a basis for modifying or changing behavior to produce more effectively for organization and provides useful information to supervisors.

Recognizing the importance of performance appraisal, [18] affirm that it is could be regarded as a determinant factor in the organization's success or failure. Workers' performance appraisal is an important aspect of the organizational development and productivity measures; as it is to intended to engage, align, and coalesce individual and group effort to continually improve overall organizational mission accomplishment, [19]. In spite of the benefits of performance appraisal, [20] contend that not much attention has been given to performance appraisal by library administrators, especially, in Africa south of the Sahara. Similarly, Banjoko (in [13, p. 90]) contends that many organizations in Nigeria perceive and conduct performance appraisal solely in relation to its evaluative aspect. He further explains that performance appraisal overlooks its use for facilitating growth and development in workers which could be achieved through "training, coaching, counseling and feedback of appraisal information." Banjoke expresses the fact that the Nigerian organizations have accorded a lesser role to performance appraisal as it places emphasis on given to "selection, training, development, and salary administration."

As has been discovered, the basic purpose of a performance appraisal system, according to [9] and [21] is to improve performance of individuals, teams, and the organizations. Having therefore identified these goals of appraisal, it is required that organizations seek a performance system that gives feedback to people of their future in the organization [22]. Based on this, [23] state that whatever method of appraisal that is used must be job-related for the fact that appraisals are created to provide an accurate picture of an individual's job performance. Job relatedness has to do with the fact that the system evaluates critical behaviors that constitute job success. To accomplish this objective or aim, appraisal system should therefore be practical, have standards, and use dependable measures. On other hand, a complicated appraisal approach may cause resentment and confusion and this can lead to inaccuracy which, in turn, reduces the effectiveness of the appraisal. There are various methods of performance evaluation approaches namely, written essays, critical incident method, rating scales, behaviorally anchored rating scales (BARS), management by objectives (MBO); 360-Degree feedback, The checklist, The Forced- Choice, group order ranking and APER system. However, studies done by Locher and Teel (in [23]) revealed out that the three most common appraisal methods in general use are rating scales (56%), essay methods (25%) and results-oriented or management by objective (MBO) methods (13%).

EMPLOYEE'S PERFORMANCE APPRAISAL AND JOB PERFORMANCE IN LIBRARY AND INFORMATION CENTERS

According to [24] and [25], employee performance appraisal in library is considered as a means of control through which library administrators monitor the job performance of subordinates by observing variances between set goals, actual performance, and taking corrective measures. [26] assert that after surveying library literature found out that it is apparent that most academic library administrators implement some kind of performance appraisal even though there may be disparities which probably exists regarding the process itself and the goals sought. According to [24], every library chooses the appraisal system that best suits the need of the library and the staff. [27] cites Arnold who has noted that University libraries perform staff evaluation in line with the rules and procedures mapped out by their parent institutions. Arnold further claims that for public academic libraries, the rules and procedures for appraisal are mapped out by the state/government, while the rules, methods, and procedures in privately owned libraries are determined by the owners of the library. In spite of the fact that disparity exists in various departments in the library, [28] expresses in disagreement that performance standards, whether for customer service or other unit, performance appraisal must be based on behaviors that are measurable.

Performance appraisals in libraries are usually carried out following specific rules and procedures. According to [27], the University of Georgia library conducts staff performance appraisal which serves a variety of purposes such as promotion of communication between subordinates and supervisors about the employee's work performance, policies and practices within the unit which affect that performance; as a forum for establishing goals and expectations for the coming year; and as a means of identifying ways in which the employee can develop his/her skills. It is also used as a method of making changes to the employee's position description so that it accurately reflects the duties and responsibilities performed by the employee. However, a few studies have expressed their reservations about the suitability of the appraisal system particularly, in academic libraries.

Concerning appraisal in the libraries, [29] explains that the library is service oriented and sometimes difficult to evaluate performance. While this fact remains, there are some units, like the technical section which may have more quantifiable measures as the number of books catalogued in a day and this can be easily ascertained. It could also be the reference service department where, normally, performance may be difficult to evaluate and it can also be measured using the "number of customer complaints and traits such as willingness to serve and substantial knowledge of books." Slough (in [27]) adds that no matter what is appraised, evaluation can only be valid if it measures performance related behaviors and productivity; and the evaluation could only be reliable if it provides a consistent view of work performance. Evans and Rugaas (cited in [20]) also observed that in most cases, performance appraisals in libraries have focused on the process of conducting it at the expense of any distinct conclusions or objectives. In the view of [26] many library administrators rarely took performance appraisals seriously, and failed to understand the vital link that connected their personal goals with the organizational behavior.

Another issue highlighted by [27] is that performance assessment in the library starts from the University Librarian whose major role is to link the goals of the library to the strategic objectives of the parent institution. Professional librarians who work in information centers and libraries are categorized as academic staff and as a result, their mode of performance appraisal is based mainly on community service and on the number of publications rather than office performance. However, librarians in carrying out their professional duties, find themselves in positions where they are responsible for the allocation, supervision, and in the evaluation of the work performance of others.

In spite of the above mentioned observations, few studies on performance appraisal on job performance of library employees have been carried out in libraries. [30] conducted a study of staff appraisal schemes in three British University libraries in 1993 with the aim of discovering the extent to which staff appraisal influenced staff training and development. The result of the study revealed that the library using its own appraisal scheme devoted more time and attention to it against those who applied general appraisal schemes. In addition, the study revealed that when recommended follow-up activities, such as enabling attendance at training courses, was implemented, staff showed more interest in appraisals, but where there were disappointments on recommended follow-ups, staff become disillusioned about the appraisal process and viewed it as a waste of time. In their study of library employees' attitudes towards the measurement and appraisal of their work performance: study in Estonian university libraries, [31] discovered that in spite of the fact that the librarians evaluated performance measurement and appraisal as sources of information and feedback, improving their work performance, and seeking out their further training and education needs, they did not see any relation between performance improvement and their salary increase and career.

More, [32] conducted a research of librarians' attitude to performance appraisal. The result showed that eight seven (87%) percent of the respondents said that performance appraisal does not have any positive influence on job performance while thirteen (13%) percent said it has. In the same study, it was also revealed that ninety-seven (97.3%) percent of the employees (respondents) also said they do not think performance appraisal can improve or correct an employee's job performance while only 2.7% said it can. In a research done by [27] on the "perception of performance appraisal as a tool for enhanced productivity and career advancement in three University libraries in Ogun State, Nigeria," it was revealed that the library employees perceived performance appraisal as a routine exercise which can, however, improve job performance to a large extent. In his study of the "annual performance appraisal of practicing librarians: a study of academic institutions in Nigeria," [33] discovered that a higher number of the respondents opined that librarians should be evaluated based on their job specifications.

METHODOLOGY

The survey research design was employed through the use of structured questionnaire. The population comprised the following: Babcock University library 56, Federal University of Agriculture 27, and Onabisi Onabanjo University library, 50. Sampling was taken purposively and enumerative so as to ensure that all members of the population were used for the study. Data was analyzed using descriptive statistics of percentages and frequency count.

PRESENTATION OF FINDINGS

A total of 133 copies of questionnaires were distributed and all were returned.

Tables 1: Demographic information of the respondents

			Frequency	%	Valid %	Cumulative %
Gender	Valid	Male	66	49.6	49.6	49.6
		Female	67	50.4	50.4	100.0
		Total	133	100.0	100.0	
Position in the Library	Valid	Professional librarian	37	27.8	27.8	27.8
		Para-professional librarian	9	6.8	6.8	34.6
		Library Assistant	48	36.1	36.1	70.7
		Administrative staff	30	22.6	22.6	93.2
		7.00	9	6.8	6.8	100.0
		Total	133	100.0	100.0	
Section of Work	Valid	Reference	20	15.0	15.0	15.0
		Cataloguing	27	20.3	20.3	35.3
		Circulation	9	6.8	6.8	42.1
		Bindery	18	13.5	13.5	55.6
		Collection and Acquisition	19	14.3	14.3	69.9
		Other	40	30.1	30.1	100.0
		Total	133	100.0	100.0	

Table 1 above reveals that 66(49.6%) of the respondents are male, while 67(50.4%) are females. Regarding their position in the library, it is shown that 37(27.8%) f the respondents are professional librarians, 9(6.8%) are para-professional librarians, 48(36.1%) are library assistant, 30(22.6%) are library assistants, 30(22.6%) are administrative staff while 9(6.8%) are other

Table 2: Distribution of questionnaire

Valid	Name of library	Frequency	Percent	Valid Percent	Cumulative Percent
	Babcock University (BU)	56	42.1	42.1	42.1
	Federal University of Agriculture (FUNAAB)	27	20.3	20.3	62.4
	Olabisi Onabanjo University (OOU)	50	37.6	37.6	100.0
	Total	133	100.0	100.0	

Table 2 shows that 133 questionnaires were distribution out of which 56(42.1%) were returned from Babcock University (BU), 27(20.3%) from Federal University of Agriculture (FUNAAB), and 50(37.6%) from Olabisi Onabanjo University (OOU).

Table 3: Performance appraisal authority

S/N	**Who does Performance appraisal?**	Response
1	Library management	18(13.5%)
2	University Librarian	68(51.1%)
3	Immediate boss	47(35.3%)
4	Committee	30(22.6%)
5	Outside experts	0
6	Head of the university	20(15%)

Table 3 above shows performance appraisal authority and the findings indicate that the University librarian is the number one performance authority with 68(51.1%); followed by the immediate boss 47(35.3%), then the committee with 30(22.6%).

Table 4: Perception of performance appraisal

SN	Statement	SA	A	UD	D	SD
1	Performance appraisal is the routine evaluation of an employees' output	68(51.1%)	37(27.8%)	9(6.8%)	9(6.8%)	10(7.5%)
2	Performance appraisal helps organizations achieve their meaningful goals	39(29.3%)	48(29.3%)	0	28(21.1%)	18(13.5%)
3	Performance appraisal is a management tool aimed at improving the performance of employees	57(42.9%)	58(43.6%)	0	9(6.8%)	9(6.8%)
4	Performance appraisal is a technique for determining staff compensation	29(21.8%)	57(42.9%)	0	28(21.1%)	19(14.3%)
5	Performance appraisal is a management activity used in favoring some employees	18(13.5%)	37(27.8%)	19(14.3%)	29(21.8%)	30(22.6%)
6	Performance appraisal help to improve the behaviors of employees	28(21.1%)	67(50.4%)	9(6.8%)	10(7.5%)	19(14.3%)
7	Performance appraisal is a management tool for strengthening superior - subordinate relationship	19(14.3%)	18(13.5%)	19(14.3%)	47(35.3%)	30(22.6%)
8	Performance appraisal enables employees to be more responsible	58(43.6%)	57(42.9%)	0	9(6.8%)	9(6.8%)
9	Performance appraisal improves employees' motivation and job satisfaction	38(28.6%)	58(43.6%)	9(6.8%)	19(14.3%)	9(6.8%)
10	Performance appraisal helps one get formal feedback regarding performance	47(35.3%)	48(36.1%)	0	19(14.3%)	19(14.4%)
11	Performance appraisal helps to identify employees' hidden potential	37(27.8%)	47(35.3%)	10(7.5%)	30(22.6%)	9(6.8%)

Table 4 reports the perception of the respondents regarding performance appraisal. From this table, it is revealed that the respondents agreed that performance appraisal is the routine evaluation of an employees' output and that it is management tool aimed at improving the performance of employees. The study also showed that the respondents perceived performance appraisal as a technique for determining staff compensation and also that it enabled employees to be more responsible; and that it helps to improve the behaviors of employee. However, most of the respondents disagreed that performance appraisal is a management tool for strengthening superior - subordinate relationship and that it is a management activity used in favoring some employees. Some of the findings are in agreement with the findings of [28] who discovered in her study that the library employees perceived performance appraisal as a routine exercise. While this study revealed that the respondents agreed that performance appraisal is a technique for determining staff compensation, [31] study did not see any relation between performance improvement, salary increase and career.

Table 5: Influence of performance appraisal on job performance

SN	Statement	SA	A	UD	D	SD
1	Performance appraisal improves job performance	38(28.6%)	76(57.1%)	0	19(14.3%)	0
2	Performance appraisal motivates me to work harder	59(44.4%)	47(35.3%)	18(13.5%)	9(6.8%)	0
3	Performance goals are clearly defined in the process of appraisal	19(14.3%)	37(27.8%)	29(21.8%)	29(21.8%)	19(14.3%)
4	My performance is adequately monitored before and during performance appraisal	28(21.1%)	47(35.3%)	19(14.3%)	39(29(.3%)	0
5	Performance appraisal does not contribute to my job performance	10(7.5%)	0	46(34.6%	67(50.4%)	10(7.5%)
6	Performance appraisal helps in improving the productivity of the employees	10(7.5%)	57(42.9%)	9(6.8%)	28(21.1%)	29(21.8%)
7	I do not need appraisal to monitor my performance	58(43.6%)	10(7.5%)	9(6.8%)	36(27.1%)	20(15%)
8	The quality of my job performance improves as a result of performance appraisal	40(30.1%)	27(20.3%)	27(20.3%)	9(6.8%)	30(22.6%)
9	Performance appraisal makes me perform my job professionally	39(29.3%)	46(34.6%)	9(6.8%)	9(6.8%)	30(22.6%)
10	Performance appraisal effectively evaluates my job performance	29(21.8%)	56(42.1%)	9(6.8%)	19(14.3%)	20(15%)
11	Performance appraisal does not assess my job Description	18(13.5%)	30(22.6%)	0	28(21.1%)	57(42.9%)

Indication from Table 5 reveals the opinions of the respondents regarding the influence of performance appraisal on job performance. The respondents agreed that performance appraisal improves their job performance and that it motivates them to work harder. They also agreed that performance appraisal effectively evaluates their job performance. However, some of the respondents stated that performance appraisal does not contribute to their job performance; that they do not need appraisal to monitor their performance; and that performance appraisal does not assess their job description. Some of these findings are in line with the findings of Onuoha [28] who discovered in her study that performance appraisal as a routine exercise which can, however, improve job performance to a large extent. On the other hand, Evans [32] found in his study that performance appraisal does not have any positive influence on job performance and that they do not think it can improve or correct an employee's job performance. Okpe [33] also found out in his study that a higher number of the respondents opined that librarians should be evaluated based on their job specifications. This is also in agreement with the findings of this study where respondents opined that performance appraisal does not assess their job description.

CONCLUSION AND RECOMMENDATION

The aim of this paper is to determine the influence of performance appraisal on job performance of library personnel in library and information centers. One of the main objectives of performance appraisal is improve the employees' performance, which, in turn, leads towards the accomplishment of the organization's overall mission. Through appraisal, the appraiser will be able to discover what is expected of the employees, gain better understanding of their strengths and faults, adjust and set goals accordingly. Libraries and information centers are service oriented organizations and this makes it difficult to measure job performance. Therefore, it is recommended that libraries and information centers should ensure that their staff performance exercises are geared towards staff productivity and performance, especially due to the nature of the organization. The library and information centers should also find a suitable appraisal scheme that will best suit the employees of the library in performing their daily activities so as to ensure that they are properly guided in their job performances. Failure to find a good appraisal system might result in laxity among library workers which could negatively affect the way services are rendered to library and information centers' users. Further, a regular feedback should be given to each employee after an evaluation. Finally, since it is clear that performance appraisal exercise is inevitable as long as it continues to form the basis for managerial decision in issues that affect the wellbeing of the staff in libraries and information centers, it is also recommended that it is not just sufficient to point a staff's weakness. There should be a remedial plan put in place that could serve either as a source of motivation, encouragement or positive re-enforcement which will, in turn, help influence and improve future performances.

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Thermal stability assessment of antibiotics in moderate temperature and subcritical water using a pressurized dynamic flow-through system

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ABSTRACT: Thermal degradation of antibiotics has been studied for decades in a broad range of disciplines including food production, agriculture and analytical chemistry. Yet, there is a lack of thermal stability data for many antibiotics. Here we systematically investigated the thermal stability of ten commonly prescribed antibiotics applying a laborsaving automated in-house pressurized dynamic flow-through system. The design of the system allowed a fast access to a large number of data at medium to subcritical water temperatures, ranging from 50-250 °C. The five ß-lactams cefadroxil, cefuroxime, amoxicillin, penicillin V, and penicillin G showed a high degree of stability with a maximum degradation of less than 30 % at 150 °C. The two quinolones ciprofloxacin and norfloxacin showed a very high thermal stability up to 200 °C, as did trimethoprim and sulfamethoxazole. At 250 °C all antibiotics were either partly of fully removed. The tetracycline doxycycline showed a specific removal pattern probably involving both binding to metal surfaces at lower temperatures as well as degradation at increased temperatures.

KEYWORDS: Antibiotics, ß-lactams, cephalosporins, penicillins, fluoroquinolones, trimethoprim, sulfamethoxazole, thermal stability, subcritical water, dynamic system

1 INTRODUCTION

The stability of antibiotics at different temperatures has been researched for several decades in various disciplines. Within the food production sector the presence of antibiotic residues in foodstuffs is of concern due to possible direct allergic and/or toxicity reactions as well as the appearances of resistant strains of bacteria in animals with pathways to humans [1,2]. During manure storage temperature conditions will be of importance since the main part of the administered antibiotics in husbandry will be excreted in feces and finally may end up in soils after application of manure on agricultural lands [3-5]. In analytical chemistry, temperature is often a key parameter to promote the release of analytes from matrix active sites and especially so in the discipline of solid sample extraction [6,7].

Almost 60 years ago Landerkin and Katznelson [8] investigated the stability of six antibiotics in sugar syrup and honey and found a higher stability at 4 °C than at 34 °C. Of the compounds investigated, penicillin and streptomycin were the least and the most stable compound, respectively. Cooking conditions may affect antibiotic residues in meat of various origins, and has received considerable attention since the 1980´s [1,9,10]. Thermal degradation of tetracyclines has been studied at some depth in pork [9,10], chicken [10], sheep [11] and fish [12]. Fedeniuk et al. [9] showed that oxytetracycline (OTC) stability was higher in pork tissue than in aqueous solutions in the interval 60-80 °C. Adding calcium chloride decreased reaction kinetics significantly in both matrices due to complex formation with metals. Comparable stability findings were seen for OTC in salmon tissue at temperatures between 60 °C and 100 °C, with superior stability in tissue than in a parallel aqueous buffer [12]. Additionally, OTC was more stable at pH 3.0 than at pH 6.9. More recent studies examined tetracycline (TC) degradation and the formation of degradation products during microwave heating and boiling of pork and chicken meat [10]. Boiling for 14 min and microwave heating for 6 min reduced the amount of TC to between 56 and 82 %. Similarly, a previous investigation on lamb meat showed that boiling for 30 min was necessary to decrease OTC levels by 95 % [11]. Recent studies performed on enrofloxacin (a fluoroquinolone) in chicken meat, showed that this compound is fairly heat tolerable since it could not be degraded fully even after a 3h boiling period [13], indicating major differences between various groups of antibiotics. Liquid food products, primarily milk, have been examined for many years to reveal the effects of various heat treatment procedures on antibiotics [2,14,15]. Several ß-lactams have recently been investigated. Nine spiked ß-lactams were examined by Zorraquino et al. [15] by treating them at five different time-temperature combinations (40-140 °C). A major finding was that medium heating to 60 °C for 30 min, and ultra-high temperature (UHT) treatment to 140 °C for 10 s, only caused slight decreases in antimicrobial activity, while classic sterilization conditions (120 °C) for 20 min showed a considerable inactivation of penicillins (65%) and cephalosporins (90%). Furthermore, five quinolones in milk were investigated in the interval 80-100 °C, finding half-lives ranging from 102-456 min at the highest temperature [2]. This study also showed that ciprofloxacin and norfloxacin were the most sensitive with 12 % degradation at 120 °C for 20 min, while enrofloxacin, flumequine and oxolinic acid were more recalcitrant, being degraded to only 5 % or less. UHT heating to 140 °C for 4 s, had basically no effects on degradation. In this context it should be noted that a comprehensive evaluation of the effects of pH, temperature and buffers has been performed on the ß-lactam cefepime in aqueous solutions at moderate temperatures of 45-75 °C [16]. In this study, maximum stability was obtained in the pH interval 4.6-5.6.

Manure treatment at different temperatures may positively contribute to the removal of various micro-pollutants present in the matrix. Wang and Yates [3] found a faster OTC degradation in manure at 35-45 °C than at 15-25 °C. Correspondingly, Arikan and co-workers [4] detected that OTC degradation in manure occurred within a few days at temperature of 70 °C in the compost. Recent findings on the fate of three TCs and degradation products thereof during manure composting are available in a comprehensive study by Wu and co-workers [5].

Golet et al. [17] investigated temperature effect (50-150 °C) on the extraction efficiency of the two fluoroquinolones (FQ) ciprofloxacin and norfloxacin from sewage sludge. In the interval 50 °C to 100 °C, the extraction was enhanced by temperature, while in the interval 100 °C and 150 °C, efficiency remained constant, but with gradually darker extracts. Sand samples spiked with FQs showed no sign of thermal degradation at 100 °C. Likewise, Göbel et al. [18] found that 100 °C was an optimal extraction temperature for five macrolides, five sulfonamides and trimethoprim. Below 100 °C recoveries were 10 to 20 % lesser for all analytes, while above 100 °C recoveries decreased to between 60 % and 95 %. At the higher temperatures the extracts were also much darker. Decreased recoveries above 100 °C were explained by thermal analyte degradation, yet no specific study was performed to justify this statement. A single spiked sand experiment was performed at 100 °C showing no evidence of thermal degradation of any of the compounds. Other explanations might be plausible such as co-extraction of interfering matrix components causing heavy ion suppression in mass spectrometry as suggested by Díaz-Cruz [19]. In a later study pressurized liquid extraction was used to extract seven macrolides from fish and meat [20]. An optimum temperature of 80 °C was achieved, with a minor reduction in recoveries up to 120 °C, while above 100 °C a cloudy more coloured suspension was seen due to co-extraction of higher molecular compounds possibly hampering the analysis. Once again, decreased recoveries might not necessarily be caused by thermal instability. These arguments may also hold true in a recent study for the extraction of tetracyclines and chloramphenicol from animal feeds applying subcritical water in a temperature range of 60-120 °C [21].

In general, no systematic approach has been performed on the thermal stability of antibiotics during medium and subcritical water treatment covering an extensive range of antibiotic classes. Very few studies are made above 100 °C, and then only for a few seconds. This study aims at expanding the temperature window for antimicrobials. Such fundamental knowledge is crucial in many disciplines dealing with antibiotics. Here ten commonly prescribed antibiotics, covering seven classes of different characteristics, were investigated employing an automated laborsaving in-house pressurized dynamic flow-through system. The system allowed for a fast and systematic testing of antibiotics covering a broad temperature range and a large number of increments from medium to subcritical water temperatures, giving detailed information of thermal stability not previously published.

2 Materials and Methods

2.1 Chemicals

Methanol (HPLC-grade) was purchased from Sigma-Aldrich (Steinheim, Germany), while sodium hydroxide was obtained from VWR (Stockholm, Sweden). Ultra-pure water was obtained from an OPTIMA water purification system (Elga Ltd, High Wycombe, Buckinghamshire, GBR).

Penicillin G sodium salt, penicillin V potassium salt, sulfamethoxazole, ciprofloxacin and caffeine were delivered by Fluka (Buchs, Switzerland). Amoxicillin, trimethoprim, doxycyclin, cefadroxil, and norfloxacin came from Sigma-Aldrich. Finally, Fresenius Kabi (Uppsala, Sweden) supplied cefuroxime. Individual antimicrobial stock standard solutions of 300 mg L^{-1} were prepared by dissolving 0.0150 mg of the individual antibiotics in 50 mL methanol, except for the two quinolones where 100 µL of 1 mol L^{-1} NaOH was added to assist in dissolving the compound.

The thermal stability test cell was manufactured in stainless steel column with a volume of 11.8 mL (150 x 10.0 mm i.d.). The cell was carefully packed with stainless steel particles to obtain an inert chromatographic system, with particle sizes in the range 100-300 µm. The size distribution and surface structure of the added particles are shown in Figure 1.

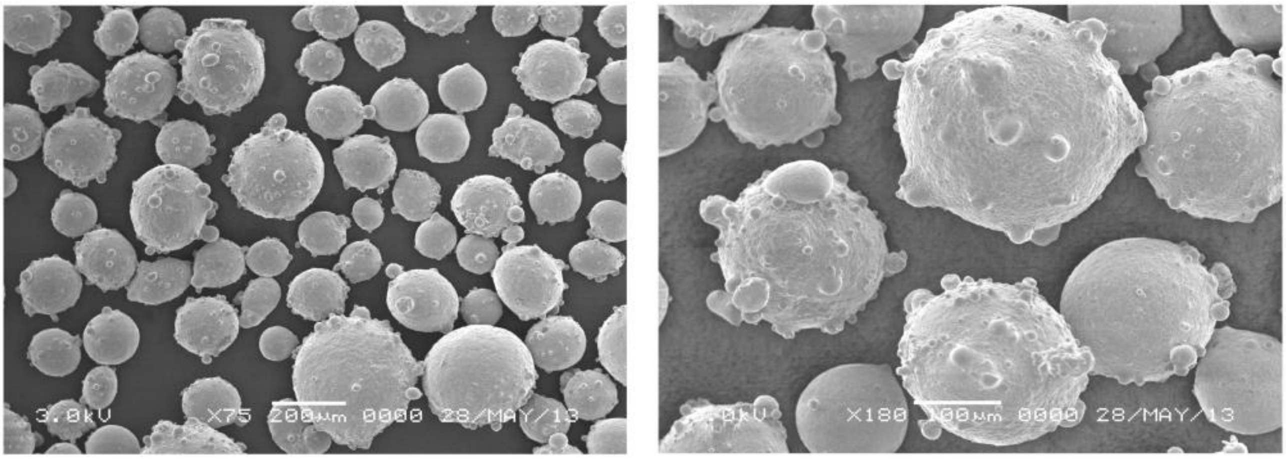


Fig. 1. SEM picture of stainless steel particles showing the size and surface structure of the packing material in the thermal stability test cell.

2.2 INSTRUMENTATION AND BASIC SET-UP

An in-house pressurized dynamic flow-through system was used for thermal stability test as schematically shown in Figure 2. The system was designed on the principles described by Hawthorne et al. for sub- and supercritical water extraction (SHWE) [22].

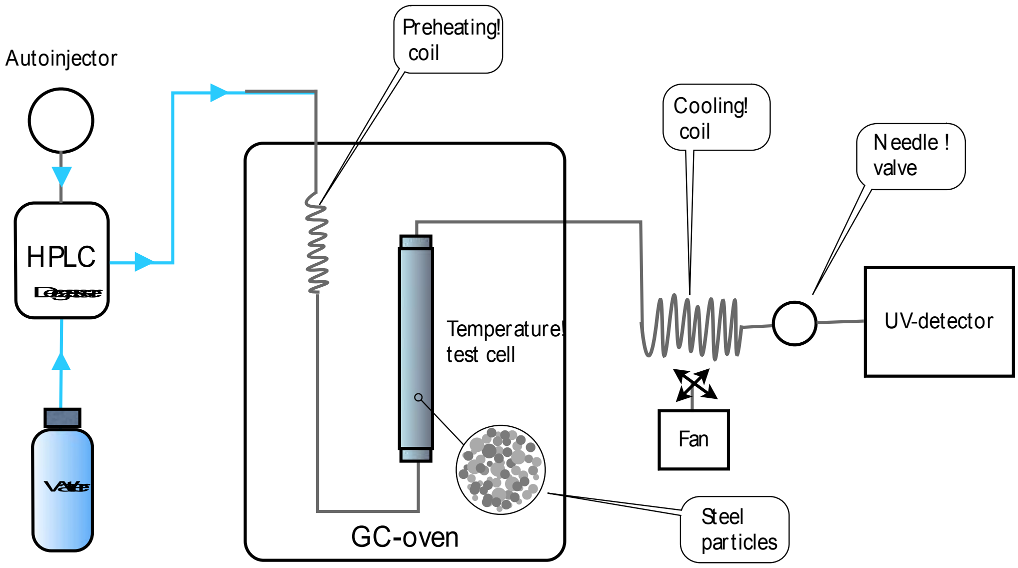


Fig. 2. Schematic picture of the in-house pressurized dynamic flow-through system.

The system consisted of an Agilent 1100 series HPLC instrument (Palo Alto, CA, USA) with an autosampler, vacuum degasser, quaternary pump and a Hewlett-Packard 1050 MWD detector (Palo Alto, CA, USA). The HPLC pump supplied water to the test cell through stainless steel tubing (1/16" o.d. and 0.040" i.d.) with a 1 m preheating coil. Both the preheating coil and the temperature test cell were placed inside a Varian 3400 GC oven (Walnut Creek, CA, USA). The preheating coil ensured that the water reached operating temperature before entering the test cell. The outlet water flow pressure was controlled by a SSI high-pressure needle two-way valve (Grace Discovery Sciences), pressure held at 23 bars during the whole experiment. Prior to the needle valve a 1 m coil (1/16"-o.d. 0.020" i.d.) was mounted and cooled by air using a common electrical fan (12 V), assuring that the temperature of the water reaching the UV-detector was below 25 °C. Temperature was monitored with thermocouples at the outlet from the GC-oven and after the needle valve. A Hewlett-Packard 1100 Chemstation software evaluated all data acquired (Palo Alto, CA, USA).

2.3 TEMPERATURE TEST PROCEDURE

The thermal stability of all ten antibiotics plus caffeine were tested at 50, 100, 150, 200 and 250 °C. Each individual temperature measurement consisted of the following procedure: A total of 200 µL of each compound was prepared in individual vials and 25 µL of each antibiotic solution was thereafter injected individually into the system. Initially one injections was done without the thermal stability test cell in place, with the oven set at 25 °C to obtain a maximum reference absorbance peak area value for each antibiotic. Thereafter the thermal stability test cell, containing the stainless steel particles, was connected and put into the oven, the pump turned on and the system was allowed to reach the chosen temperature. The autosampler was started when pressure and baseline showed steady conditions. Subsequently two runs followed for each antibiotic and temperature, so that duplicate results could be monitored. After the two runs the thermal stability test cell in place was allowed to cool down, and then disconnected. Finally one more reference value was obtained at 25 °C, which concluded one cycle. The flow rate was set to 2 mL min^{-1} the whole cycle through.

2.4 UV ANALYSIS AND RECOVERY CALCULATIONS

Full absorbance spectra were obtained for all antibiotics in the interval 200-800 nm (spectra not shown). Three wavelengths were applied in all runs based on absorbance maxima studies: 218, 230 and 272 nm. The wavelength giving the highest response was chosen for the individual antibiotics; KOF 272, AMO 230, SUL 272, CEL 230, FEN 218, CEF 218, TRI 272, BEN 218, CIP 272, NOR 272 and DOX 272 nm. For each compound, however, all three wavelengths were recorded simultaneously, and stored. The area of the resulting peaks from all injections was integrated and the absorbance mean was calculated. The relative recovery in % was then calculated as [% compound recovery = 100 · (a / b)] where a is the absorbance resulting from the injection when the thermal stability test cell was connected and b is the mean absorbance of the two values when no cell was present in the system and temperature is set to 25 °C.

2.5 CALCULATING ADJUSTED RETENTION TIMES IN THE THERMAL STABILITY TEST CELL

In order to get a value of the average time spent by the antibiotics in the test cell, an adjusted retention time was calculated by subtracting the dead time t_0 from the measured retention time t_R. The dead time t_0 was taken as the time needed for the compound to reach the UV detector without the thermal stability test cell in place at a temperature of 25 °C, and was found to be 1.1 min. All compounds, except the quinolones, had basically the same adjusted retention times, which were close to 3.2 min at 50 °C while at 100 and 150 °C they decreased to between 2.7 and 2.8 min. The quinolones CIP and NOR deviated somewhat and showed adjusted retention times of close to 4 min in the temperature interval 50-150 °C. Increasing the temperature to 200 °C caused the adjusted retention times to decrease to 1.8 min for all compounds but CIP and NOR, which both had an adjusted retention time of 3.2 min at this temperature. It should also be noted that both CIP and NOR showed quite dramatic tailing effects from 50 °C to 200 °C giving runtimes up to 15 min for the lower temperatures.

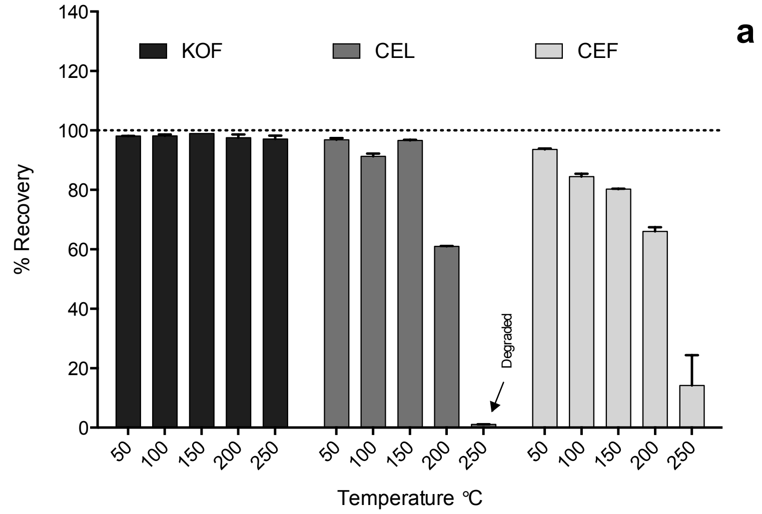
3 RESULTS AND DISCUSSION

3.1 PRE-EXPERIMENTS

Initially the pressurized dynamic flow-through system was developed and various technical constructions were optimized. Thereafter the system performance was tested and evaluated for caffeine (KOF), and all ten antibiotics. These preliminary experiments gave indications of thermal effects for the different antibiotics (data not shown) and served as a basis for the design of a comprehensive thermal stability study in the temperature interval 50-250 °C as outlined below.

3.2 SYSTEMATIC THERMAL STABILITY STUDY

ß-LACTAMS. In all five ß-lactams were investigated, two cephalosporins; cefadroxil (CEL, first generation) and cefuroxime (CEF, second generation) and three penicillins; amoxicillin (AMO), penicillin V (FEN), and penicillin G (BEN). Results for the cephalosporins and the penicillins are shown in Figure 3a and 3b, respectively.



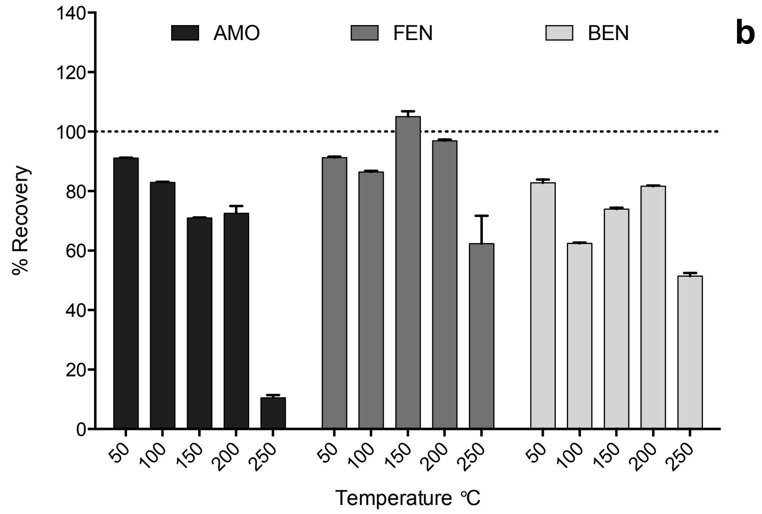


Fig. 3. Thermal stability of caffeine (KOF) and five ß-lactams at medium to subcritical water temperatures presented as amount antibiotic recovered versus a 25 °C test (see Experimental section for details). Investigated compounds covered a) the cephalosporins cefadroxil (CEL) and cefuroxime (CEF) and b) the penicillins amoxicillin (AMO), penicillin V (FEN), and penicillin G (BEN).

Caffeine (KOF) showed to be a thermally stable reference compound throughout the entire temperature series, not even being degraded at 250 °C, while both cephalosporins were almost fully lost at 250 °C. Especially CEL showed poor recoveries, and could hardly be detected. Of the three penicillins AMO was the least thermally stable, with less than 20 % recovered at 250 °C, while FEN and BEN both could be recovered to at least 50 % at the same temperature. Overall, the ß-lactams showed a high degree of stability and a general observation is that none of the antibiotics were degraded more than 29 % at 150 °C. This may explain why Zorraquino et al. [15], who exposed ß-lactams to ultra-high temperature (UHT) treatment at 140 °C for 10 s, only observed minor decreases in antimicrobial activity. An additional notation to be made is that CEF and AMO had a relatively distinct declining recovery pattern over the entire temperature range, while FEN and BEN showed a fairly constant recovery at 150 °C and 200 °C, before levelling of at 250 °C. When comparing the absorption patterns of the three wavelengths at different temperatures, only minor differences were observed for all 10 molecules except CEF, indicating that the detected compound was the same throughout all temperatures until degradation. In the case of CEF the absorption shifted towards 272 nm as the temperature raised. An explanation to this phenomenon might be a change in the molecular structure resulting in a molecule with a different UV-absorption as the temperature rises. Then as the molecule is exposed to the highest temperature (250 °C), the UV-absorbing moiety is destroyed causing poor recoveries. No instrumentation was available to verify such a molecular change, and was not further investigated.

Fluoroquinolones and other antimicrobials Two fluoroquinolones; ciprofloxacin (CIP) and norfloxacin (NOR) and three other antimicrobials; sulfamethoxazole (SUL), trimethoprim (TRI) and the tetracycline doxycycline (DOX), were investigated. Results for theses five antimicrobials are shown in Figure 4a and 4b, respectively.

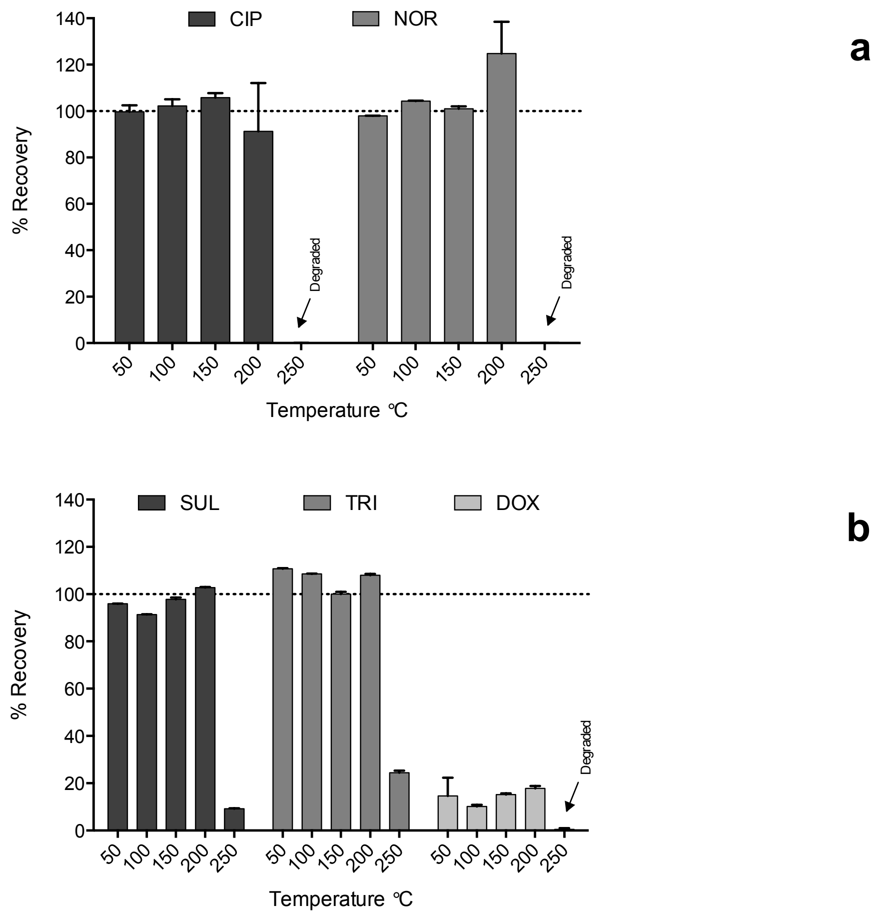


Fig. 4. Thermal stability of two fluoroquinolones and three other antimicrobials at medium and subcritical water temperatures presented as amount antibiotic recovered versus a 25 °C test (see Experimental section for details) Investigated compounds covered a) the fluoroquinolones ciprofloxacin (CIP) and norfloxacin (NOR) and b) sulfamethoxazole (SUL), trimethoprim (TRI) and doxycycline (DOX).

The two quinolones CIP and NOR showed high thermal stability up to 200 °C, with basically no losses, while at 250 °C not even traces of the compounds could be recovered. Almost the same pattern was observed for SUL and TRI, though detectable amounts of both compounds were seen at the highest temperature, with recoveries of 9 % and 24 % for the two compounds, respectively. In a study by Roca and co-workers [2] it was shown that CIP and NOR only were degraded by 12 % at 120 °C when heated for 20 min, while heating to ultra-high temperatures (UHT, 140 °C for 4 s) had nearly no effects on degradation, which is in line with our observations on thermal stability of quinolones.

DOX shows a unique and poor thermal stability pattern never reaching even 20 % in recovery for any of the temperatures, and at 50 °C only 15 % was recovered. This might be explained by both thermal degradation and adsorption of DOX to the metal particles, since tetracyclines are known to form complexes with metal cations [23]. The latter is supported by a small increase in recovery as the temperature is increased up 200 °C, after which DOX can no longer be recovered. The pH investigations described in the next section further helps explain the behaviour of DOX.

3.3 EFFECTS OF PH

It is well-known that pH might have an effect on the stability of antibiotic compounds. We therefore investigated effects of pH at 4, 7 and 9 fixing the temperature in the middle of the temperature interval to 150 °C. The results for five ß-lactams are shown in Figure 5a while fluoroquinolones and other antimicrobials are shown in Figure 5b.

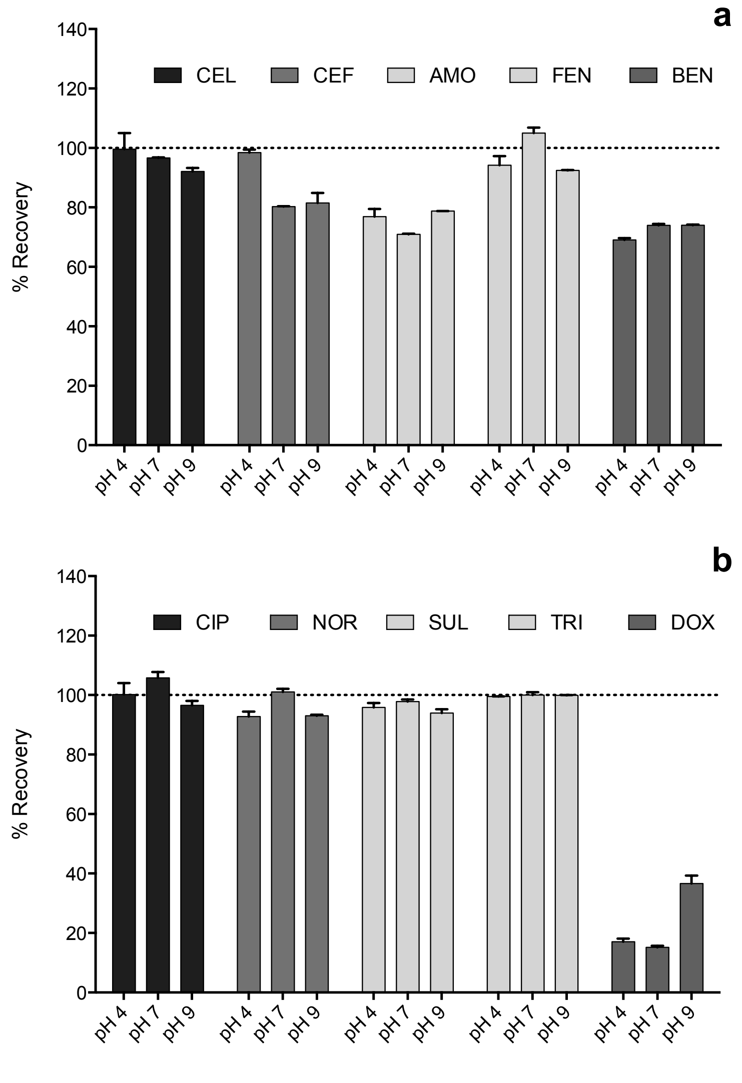


Fig. 5. Thermal stability of a) the five ß-lactams b) the two fluoroquinolones and three other antimicrobials at three different pH, applying a fixed temperature of 150 °C. Results are presented as amount antibiotic recovered versus a 25 °C test (see Experimental section for details).

In general the effects of pH were minor, with only a minor tendency that CEL and CEF were more thermal stability at the lower pH, being fully recovered at a pH of 4. This is comparable to the ß-lactam cefepime investigated by Fubura et al. [16] demonstrating that this compound had its maximum stability in the pH interval 4.6-5.6 in aqueous solutions. Interestingly for the tetracycline DOX, recovery was more than doubled at the highest pH, from around 15 % at pH 4 and 7, to nearly 35 % at pH 9. The explanation to this is not fully clear, but could involve both a higher stability as well as less binding ability and complexation to the metal surface at a pH of 9.

4 CONCLUSION

Thermal stability of antibiotics is of great interest in many disciplines. With the developed in-house pressurized dynamic flow-through system thermal stability of antibiotics could be systematically investigated in the medium to subcritical water temperature range of 50-250 °C. In general ß-lactams showed a high thermal stability and were completely recovered at temperatures up to 150 °C. Concerning fluoroquinolones, trimethoprim and sulfamethoxazole these were even more resistant to degradation surviving temperatures up to 200 °C. The highest temperature investigated was 250 °C where all antibiotics started to more or less vanish from the system. Doxycycline was the only tetracycline investigated and described an explicit pattern of removal, which most likely involved several mechanisms including binding to metal surfaces at lower temperatures and degradation at higher temperatures. The practical implications for food industry is that few if any of the investigated antibiotics can be destroyed at the temperatures applied during food processing. Neither will the heat generated in manure degradation processes affect the stability of the antibiotics during short time. In the field of extraction using hot pressurized solvents, low recoveries are most likely not caused by compound degradation but rather extraction of unwanted components causing matrix effects during final detection.

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Aestivation and time dilation in anurans

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ABSTRACT: Aestivating frogs are able to withstand long periods of immobilisation whilst appearing to maintain their muscle mass and contractile performance. The functional capacity of critical muscles is also not compromised upon emergence from aestivation. Years of starvation and immobilisation endured by aestivating anurans has no deleterious effect on their muscles, bones, water content, or stomach and liver integrity, which suggests there is some sort of time dilation at work in aestivating frogs that makes months or years inside their aestivation cocoon pass as days or weeks would when active normally.

KEYWORDS: Aestivation, time dilation, anurans.

INTRODUCTION

Aestivation is a state of aerobic torpor, which is believed to be a survival strategy for animals living in arid conditions. It is typically associated with a lack of food availability and frequently associated with high environmental temperatures (Pinder et al., 1992; Abe, 1995; Land and Bernier, 1995). Animals that aestivate normally do so for 9–10 months of the year, but there are numerous examples of continuous aestivation lasting two or more years. Aestivating animals are triggered to emerge from their underground burrows by the first torrential rains of summer, at which time they “break their dormancy” or “end their aestivation.”

Aestivating animals enter dormancy to avoid adverse environmental conditions (Guppy et al. 1994). In doing so, they are exposed to a number of physiological challenges, including fasting for months or years, exposure to extreme temperatures, hypoxia and prolonged immobilisation (Guppy and Withers 1999).

Some of these challenges are countered by the characteristic habit of dormant animals to depress their metabolic activity (Storey and Storey 1990). Reduced respiration rates minimise the impact of hypoxia and a decreased rate of ATP turnover lowers the energy demand; thereby prolonging fuel reserves (Guppy et al. 1994).

Several of the frog species that aestivate produce cocoons made from multiple layers of shed epidermis alternated with glandular secretions (Loveridge and Withers, 1981; Pinder et al., 1992). During aestivation, burrowing frogs undergo fasting (Cramp et al. 2009) and are immobilised by the cast-like cocoons (Seymour 1973a; Withers 1993, 1995). Aestivating amphibians dramatically slow down their breathing, heart rate, and metabolic processes, such as digestion.

DISCUSSION

The Green-striped burrowing frog, Cyclorana alboguttata, routinely aestivates as part of a physiological strategy to avoid desiccation in semi-arid environments. During aestivation, the hind limbs are immobilised in a cocoon for months at a time and the frogs experience starvation.

EFFECT OF STARVATION DURING AESTIVATION ON MUSCLE PROTEIN LEVELS

The loss of body protein affects the function of important organs, eventually resulting in death. Starvation in mammals typically leads to a breakdown of muscle protein, however, the Sartorius protein concentration in frogs has been found to be unchanged during aestivation. The protein content in the cruralis increased significantly after prolonged aestivation and remained unchanged in other muscles (Mantle et al. 2010). Furthermore, the protein content of the adductor magnus muscle of the burrowing frog, Neobatrachus centralis, is maintained during aestivation (Fuery et al. 1998).

EFFECT OF STARVATION DURING AESTIVATION ON HYDRATION

Starvation in mammals typically results in dehydration. In aestivating frogs, however, the water content of the Sartorius muscle is significantly above control levels after prolonged aestivation (Mantle et al. 2009). In other muscles, the water content level tends to rise, but less than in the Sartorius. The water content of muscles is conserved throughout aestivation (Withers 1998a), and the water content of most muscles (excluding in the Sartorius, where it increases) has been found to remain stable (Donohoe and Boutilier 1998).

EFFECT OF IMMOBILISATION DURING AESTIVATION ON MUSCLE INTEGRITY

Periods of inactivity due to disuse typically leads to degenerative changes culminating in the atrophy of muscle fibres. Muscle growth depends on the dynamic balance between synthetic and degradative processes (Schimke, 1975). Hudson & Franklin (2002a), however, found no reduction in muscle size, isometric force production or locomotive performance in Cyclorana alboguttata after three months of inactivity associated with aestivation.

This can be contrasted with the significant muscle disuse atrophy (characterised by a reduction in muscle fibre diameter and concomitant loss of performance) typically found in mammals that have had limbs artificially restrained or immobilised with casts or splints (Booth, 1982).

Studies have shown that aestivating frogs are able to withstand long periods of immobilisation during aestivation whilst maintaining whole muscle mass and contractile performance. The functional capacity of critical muscles is not compromised when they emerge from aestivation. (Mantle et al. 2010).

Prolonged immobilisation of mammalian limbs can result in muscle atrophy. However, aestivating anurans do not exhibit skeletal muscle atrophy or decreased functional performance even after long periods of inactivity (Hudson and Franklin 2002a, 2002b, 2003, Hudson et al. 2004, Symonds et al. 2007). The frog, Cyclorana, can withstand long periods of immobilisation whilst maintaining overall muscle mass and contractile performance (Hudson and Franklin 2002a; Hudson et al. 2006; Symonds et al. 2007). The structural characteristics of some muscles, however, such as the cross-sectional area of whole muscle and individual fibres, change significantly during nine months of aestivation. These changes appear to correlate with muscle function (Mantle et al. 2009).

EFFECT OF IMMOBILISATION DURING AESTIVATION ON THE 3D STRUCTURE OF CAPILLARIES

In mammals, prolonged immobilization of the limbs can result in a loss of capillary tortuosity; in turn resulting haemorrhaging of the skeletal muscles if rapid remobilization is permitted. By comparing the scanning electron micrographs from control (active) and aestivating (for four months) C. alboguttata, no differences in the three-dimensional structure of capillaries was detected. Quantification of the tortuosity of the capillaries in the semimembranosus muscle of controls and aestivating C. alboguttata revealed no significant difference. There was also no significant difference in the diameter of the capillaries in the semimembranosus muscles of control and aestivating frogs. The preservation of capillary structure in the hind limb muscles of C. alboguttata in part accounts for their remarkable ability to emerge with a fully competent locomotive system after prolonged immobilisation (Hudson & Franklin, 2003).

EFFECT OF IMMOBILISATION ON BONE DURING AESTIVATION

Extended periods of immobilisation in mammals typically results in bones being remodelled and a decrease in bone strength. Frogs that aestivated in soil for three and nine months and were compared with control animals that remained active, were fed, and had a continuous supply of water. In comparison to the controls, the long bone size, anatomy and bending strength of the aestivating frogs' bones remained unchanged, indicating an absence of osteoporosis due to disuse

(Hudson and Franklin 2004). The effect of aestivation and, hence, prolonged immobilisation, does not appear to have a deleterious effect on the cross-sectional area, histology, or bending strength of the femur and tibiofibular of C. alboguttata.

EFFECT OF STARVATION DURING AESTIVATION ON STOMACH INTEGRITY

Starvation in mammals typically results in atrophy (wasting away) of the stomach, however, the nutrient assimilation following prolonged food deprivation during aestivation can be enhanced (Cramp and Franklin 2003). The last meal before aestivation might be properly processed even if the overall metabolic activity is being reduced.

THE EFFECT OF DECREASED METABOLIC RATES DURING AESTIVATION ON LIVER FUNCTION

The metabolic capacity of the liver has been shown to be maintained during aestivation in some frog species (Berner et al. 2009), even though the in vitro metabolic rate of the liver is reduced significantly during amphibian aestivation (Fuery et al. 1998).

Berner et al. (2009) found that the liver enzyme activity in C. alboguttata remained stable throughout aestivation. Aestivation decreases the hepatic contribution to metabolic requirements, even though the mass-specific enzyme activities remain constant. In vitro liver metabolism may be depressed by up to 55 percent in an aestivating amphibian (Fuery et al. 1998).

Similarly, the accumulation of urea in the plasma of aestivating anurans could be toxic at high levels because of the alteration of protein function. Urea causes a general and consistent inhibitory effect on enzyme activity in rats and in non-aestivating anurans, however, the enzymes in the muscle tissue of speedfoot toads were found to be almost unaffected, or even activated by urea (Cowan and Storey 2002).

THEORY

The extraordinary findings listed above for aestivating frogs suggest that there is some sort of time dilation at work, which makes their months or years inside a cocoon pass as days or weeks would when normally active. Everything is slowed down for the frogs in the time dilation, for example, the basal heart rate is decreased by 60 percent and the metabolic rate by up to 80 percent during aestivation. No deleterious effects from the extended periods of immobilisation or starvation occur. We suggest that frogs can utilise this time dilation via heat isolation and that the duration they can sustain it depends on the surface area of the frog.

More research is needed to calculate the time spent inside and outside the cocoon and the corresponding functional age of the frog before and after the aestivation period.

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Regional aspect of tourism development in Bosnia and Herzegovina

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ABSTRACT: Bosnia and Herzegovina is rich in natural and anthropogenic tourist potentials that are the basis for the development of more specific forms of tourism of both local and regional, and national and international importance. The development of tourism in it massively started to develop from the seventies. In this paper we are going to show significant determinants and indicators of this development to the present day, through the presentation and definition of tourist and geographical position, tourist traffic, accommodation facilities and specific forms of tourism that can be developed in Bosnia and Herzegovina.

KEYWORDS: tourist-geographical position, accommodation facilities, natural resources, tourist arrivals, transport network.

1 INTRODUCTION

The increasing importance of tourism as a distinct socio-economic unit, as an economic multiplier in Bosnia and Herzegovina, then the impact of tourism on the transformation of region call for its scientific analysis including the geographic point of view. Precisely because tourism often has very noticeable effect on region, it should be a subject of specific geographic studies.

The tourism sector in Bosnia and Herzegovina records a positive trend for all the main indicators of growth in the last ten years, but there is still considerable room for further use of its undeniable potential. With its natural resources and the potential for outdoor tourism, rich heritage and history, favourable geographic position, internationally renowned events, excellent gastronomic offer at affordable prices and the status of still unknown tourist destination for major market, Bosnia and Herzegovina has all the predetermination of highly successful tourism sector.

According to the World Tourism Organization, Bosnia and Herzegovina is defined as one of three tourist destinations in the world with the overall growth potential of the tourism market of 10.5% (for the period up to 2020). However, this high growth rate also reflects an extremely low base value of the sector: currently, the tourism sector in Bosnia and Herzegovina represents only 0.2% of European tourism. Among others, potential areas for development of tourism sector in Bosnia and Herzegovina are cultural and historical tourism, urban (city break), rural tourism, outdoor tourism, winter sports and mountain tourism, as well as spa and wellness (health) tourism and business / conference tourism.

Most important studies on the research of the economic impacts of the tourist arrivals are in catering sector (Blake & Sinclair, 2003; Hjalager, 2007; Hope, 1980; Milne, 1990; Sinclair, 1998), transport and activities of travel agencies (DeLorme, Gray & Ferguson, 1999; Osti, Turner, & King, 2009; Pearce & Schott, 2005).

2 TOURIST-GEOGRAPHICAL POSITION OF BOSNIA AND HERZEGOVINA

"Tourist-geographical position is one of the spatial elements essential for the tourist movements and it is very important for tourism development of an area, place or motive. It represents the spatial relation of the observed region, area, or motive to the immediate and distant geographic areas, to the directions of tourist movements and to parent tourist areas“ (Stanković, 2000).

“Tourist-geographical position can be defined as the position which shows relationships of individual attractions and places to the routes of tourist movements“ (Ćomic Đ., Jović G.S., Popović I.B., 2008) .“Tourist-geographical position expresses the relationship of individual motives and places to the routes of tourist movements“ (Jovičić, 1986).

First of all, we will show European tourist routes and where Bosnia and Herzegovina belongs, namely:

1) western tourist route, whose ultimate destination is the Iberian Peninsula and the Maghreb countries,
2) central tourist route, which leads over or past the Alps to the Apennine Peninsula and surrounding islands, but also to Tunisia and
3) eastern tourist route, whose ultimate destination is the Balkans region and the Middle East (Jovičić, 1986).

The territory of Bosnia and Herzegovina is located on the eastern tourist corridor, namely the direction of tourist movements from parents areas of Europe to the Eastern Mediterranean, which indicates that it has a continental tourist-geographical position. Since the eastern tourist route, as opposed to western and central, has intercontinental importance, ie. it links Europe and southwest Asia, it may be considered that Bosnia and Herzegovina has intercontinental tourist-geographical position according to the magnitude of its impact.

In addition to this transit function, Bosnia and Herzegovina has a contact function of its geographical position which is reflected, among other things, in the fact that it borders with three countries: Serbia to the east, Montenegro to the south and Croatia to the north and the west. Having good neighborly relations also has a positive impact on foreign tourist movement, mostly excursion and transit movement. In the Gulf of Neum-Klek, it exits to the Adriatic Sea with the coast 24.5 km long. Its central location, which it has in relation to the neighboring countries, increases its contact tourist zone. Since it is a mountainous, lowland and Mediterranean country as well as for its cultural and historical development, Bosnia and Herzegovina has diverse landscape motifs. We meet these complex tourist motives in various combinations of natural and anthropogenic elements.

The Bosnian regions were under the influence of Roman, Illyrian, Slavic, Ottoman, Austro-Hungarian culture. Moreover, in the First and Second World War, our country was the scene of many great battles of national liberation struggle: Kozara, Sutjeska, Neretva, Drvar, which entered the history and today there are the numerous monuments which are erected in these places in honor of fallen soldiers. Because of their importance, they were a great tourist attraction, and maybe their old glory will come back again soon. Besides, there are indispensable anthropogenic tourist motifs from the period of XIV Winter Olympic Games that took place in 1984, when the capital of Bosnia and Herzegovina was the center of the sports world and fans of the Olympics. Certainly, we should not leave out the period from 1992 to 1995 when the aggression against our country was commited. Numerous monuments were erected after that time to remind us of the suffering and war events which people of Bosnia and Herzegovina went through.

At the Bosnia and Herzegovina's side of the Balkan Peninsula at only 51.209 km^2, there are acquired a multitude of diverse and attractive natural and anthropogenic tourist motives, that are next to each other creating a mosaic. Functionality of tourist and geographical position through the contacts of Bosnia and Herzegovina is reflected in the fact that it has a small part of the area along the Adriatic coast. Thus, Bosnia and Herzegovina's coast as part of the Mediterranean is one of the world's tourist values (Jovičić, 1986).

Versatility of the tourist and geographical position of Bosnia and Herzegovina is reflected in the possibility for tourists to experience Pannonian plain, the Dinaric mountain range as well as areas the Mediterranean region that contain the various anthropogenic motives.

Transit characteristic of the tourist and geographical position of Bosnia and Herzegovina is particularly significant for the development of its tourism. Transit flows are north-south, namely, a straight line that connects two large and different spatial units, Posavina-Sava and the Adriatic. The tourist-geographical position of Bosnia and Herzegovina is its spatial relationship to the main tourist routes of Southeastern Europe. Otherwise, travel directions, as one of three basic spatial categories of tourism development, most completely express the spatial aspect of tourism trends as well as their meaning.

For a country to be as functional as possible, what is essential are form, direction and characteristics of the entire transport network which is in it and also passing through it, and which is usually related to the costs and profits. “Road transport is dominant in modern tourist trends and in almost all countries of the world, its share in international tourist movements is around 75%, the share of air transport is about 12.5%, the share of railway and ship transport is about 10.5% and about 2% are other means of transport“ (Blažević & Pepeonik, 2002).

This means that good road links with neighboring countries and the integration of Bosnia and Herzegovina in international road communication systems are a good prerequisite for strong economic relations and in particular for tourism development. For a tourist to opt for moving along a certain road, the following characteristics are very important: the quality and capacity of the road, the position of the road in relation to international and interregional routes. All these factors enable the extraction of the most important national and international tourist travel corridors and routes (Fig.1.).

European roads in Bosnia and Herzegovina in many sections do not support the traffic intensity and the desired speed. Among other things, the reasons for this are small radius bends, passing through settlements and inadequate maintenance. The main road network in the country is 3,778 km long. The network of regional roads is 4,842 kilometers long, and the network of local roads around 14,000 kilometers. The total length of roads in Bosnia and Herzegovina is about 22,630 km, of which 14,020 km are gravel roads. The length of European roads in our country is 995 km. Once the entire Corridor Vc is completed, it will be included in the transport network of South East Europe and will lead to Budapest via Osijek and Sarajevo to Ploče. The length of the road through Bosnia and Herzegovina will amount to 330 km. Corridor Vc will conect the following in the transport system: road E-73: Šamac - Doboj - Sarajevo - Mostar - Čapljina - Metkovići; the airports in Sarajevo and Mostar; Inland waterways and ports on the Sava, Bosnia and Nertva. It is in the interest of Bosnia and Herzegovina to urgently build the quality road connection on this corridor, and it would be necessary to upgrade and improve the existing railway lines between the major tourist destinations (Ministry of Communications and Transport of Bosnia and Herzegovina, http://www.mkt.gov.ba/doc/default.aspx?id=1073&lang Tag=bs-BA).

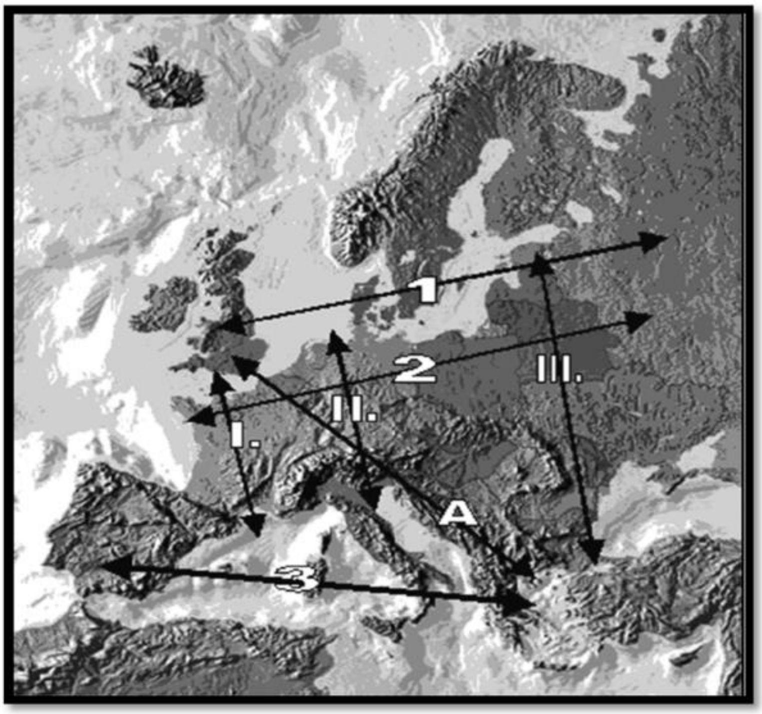

Fig. 1. Main European transport and tourism corridors

1. North direction, 2. Middle direction, 3. South direction, I. West direction, II. Middle direction, III. East direction, A. Nortwest-southeast direction

(adapted from Blažević I., Pepeonik Z., 2002 by author)

By the realization of road projects, besides connecting to its neighborhood and the network of European corridors, Bosnia and Herzegovina would finally be integrated within itself. For a country like that with focus on tourism, good roads are also a precondition of economic development. Positive effects on the overall tourist movement in Bosnia and Herzegovina, which are expected after the construction of the motorway, will enable our country a significant involvement in the international division of labor, and it is expected that the implications of the general world development throught tourist routes will set foot on the premises of our country,too. On the other hand, construction of the highway will also enable evaluation of so far insufficiently evaluated tourist destinations.

3 ACCOMMODATION FACILITIES AND TOURIST ARRIVALS

Accommodation and catering facilities are not visited by tourists due to thier stay at the hotel, but because of motif values that are in the vicinity of these objects (attractive facilities are vital resources without which tourism development is impossible and that with their quality and volume of services, constructed image and the brand have a crucial influence on the results of the tourism economy). Accommodation capacities form the basis of tourism infrastructure and offer and are an essential prerequisite of accepting tourists. These objects, in addition to roads, represent another important precondition for the existence of receptive tourism.

Facilities for accommodation are catering facilities which predominantly provide accommodation as well as facilities of health care institutions where patients stay for medical rehabilitation using primarily natural factors. These are: hotels, motels, guesthouses, inns, spas and health resorts, mountain lodges and houses, youth and children's homes, and more. Number of rooms includes rooms that are available for renting with the situation at the end of the month, or with the situation on the last day of the month when the whole building was open. Property analysis showed that more than 75% of all accommodations in Bosnia and Herzegovina have been categorized as hotels and motels, although there is a considerable number of other facilities in the gray economy zone, which, in the case to be included in the analysis, would significantly increase the structure of available facilities. Almost 90% of all registered visits and 83% of all overnight stays was recorded in hotels and motels (Agency for Statistics of Bosnia and Herzegovina, http://www.bhas.ba/tematskibilteni/BHB_2014_001_01_bh.pdf).

Total number of registered beds according to the Agency for Statistics of Bosnia and Herzegovina is 26,133 and 86% of them were registered in hotels and motels. The remaining part was recorded in boarding houses, private rooms and other types of accommodation. Based on these data, the total number of overnight stays (domestic and foreign) results in an average annual occupancy of beds (all types of accommodation) for 2011 of 15.8%, which shows a large residual capacity.

Officially registered accommodation facilities in 2013 (mainly business-hotel and motels) in Bosnia and Herzegovina were 25,587 beds. Informal data, however, suggest that their number is around 44,000-50,000. More than 90% of the accommodation capacity is concentrated in a few areas: Neum (6000), Međugorje (officially registered 1200, a total of 15,000), Sarajevo Canton, including also the eastern part of the Republic of Srpska entity (10,800), and Banja Luka (1500). The two main spas, Reumal Fojnica and Vrućica Teslić altogether have 1,400 beds. This distribution of accommodation clearly reflects the current movement of tourists in the country. The rest of the country has a shortage of accommodation capacity and quality. This is particularly visible in the national parks / reserves, mountains and places nearby natural attractions (Foreign Trade Chamber of Bosnia and Herzegovina, http://komorabih.ba/wp-content/uploads/2013/06/bhepa-izvozna-strategija-za-sektora-turizma.pdf).

In the last twelve years, since official statistics are maintained, tourist developments in Bosnia and Herzegovina in 2013 proved to be the most successful tourist season with a record number of tourists and overnight stays.

Table 1. Tourist arrivals in Bosnia and Herzegovina, 2011-2013 in thousands

DOMESTIC TOURISTS	**2011**	**2012**	**2013**
Arrivals	294	309	316
Nights	668	714	714
Average stay (nights)	2.3	2.3	2.3
FOREIGN TOURISTS	**2011**	**2012**	**2013**
Arrivals	392	439	529
Nights	836	931	1.109
Average stay (nights)	2.1	2.1	2.1
TOTAL	**2011**	**2012**	**2013**
Arrivals	686	748	845
Nights	1.504	1.645	1.823

Source: Agency for Statistics of Bosnia and Herzegovina

In the period January - December 2011, tourists accounted for 686,000 visits, which is higher by 4.5% compared to the same period in 2010. In the period January - December 2012, tourists accounted for 748,000 visits, which is more by 9.0% compared to the same period in 2011. In the period January - April 2013, tourists accounted for 845,000 visits, which is more by 12.9% compared to the same period of 2012 (Table 1.).

In the period January - December 2011, tourists accounted for 1.504.000 overnight stays, which is higher by 6.2% compared to the same period in 2010. In the period January - December 2012, tourists realized 1.645.000 overnight stays, which is more by 9.4% compared to the same period in 2011. In the period January - April 2013, tourists accounted for 1.823.000 overnight stays, which is higher by 10.8% compared to the same period of 2012.

The average length of stay of domestic tourists is higher (2.3 nights) in comparison to the length of stay of foreign tourists (2.1 nights).

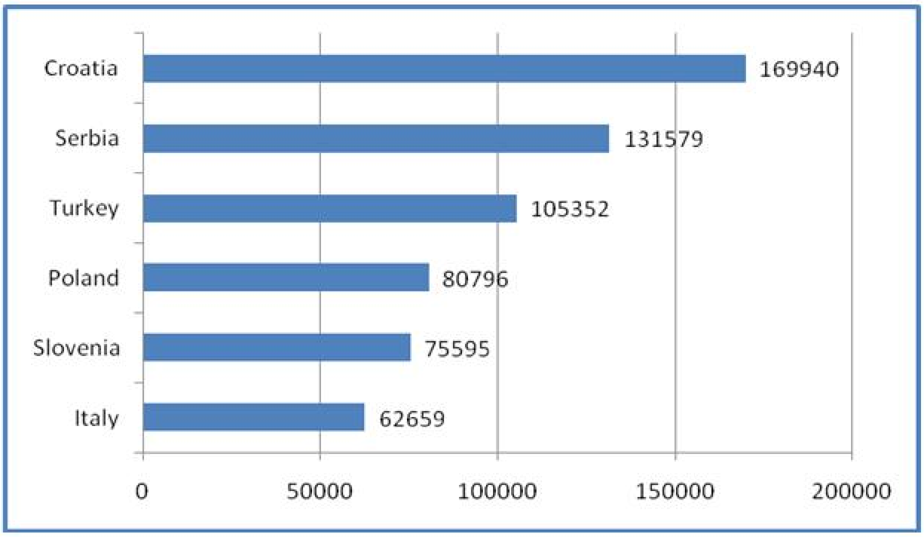

Fig.2. Structure of foreign tourists by overnight stays in Bosnia and Herzegovina, 2013

Source: Agency for Statistics of Bosnia and Herzegovina

In the structure of foreign tourists in the same period, most nights stays were realized by tourists from Croatia (24.6%), Serbia (18.5%) and Turkey (9.2%) making a total of 51.6%. Tourists from other countries realized 48.4% of overnights stays (Fig.2.).

The first city in Bosnia and Herzegovina by the number of tourists is Sarajevo with about 250,000 tourists and approximately half a million nights. According to unofficial data, in the second place is Mostar, and the third Međugorje.

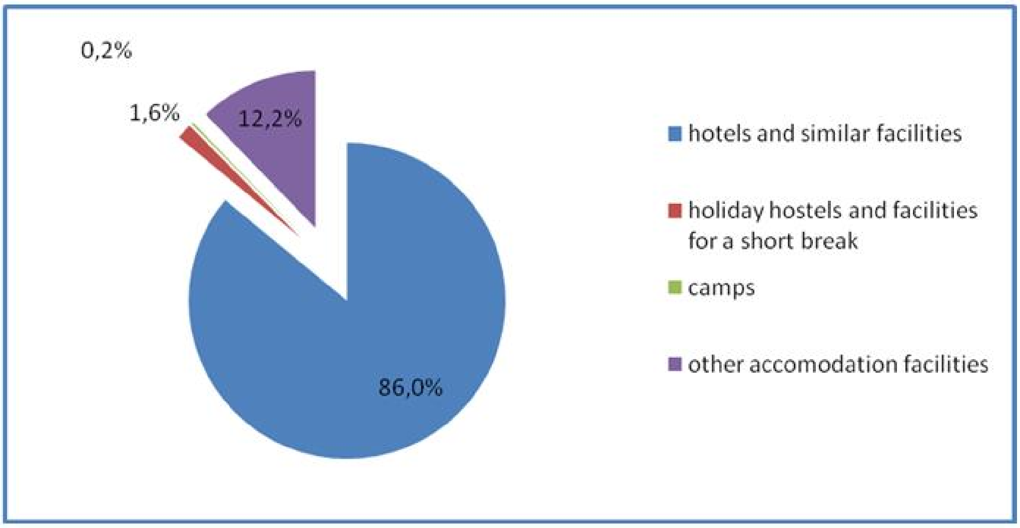

Fig.3. Arrivals and overnight stays of domestic tourists by accomodation facilities, 2013

Source: Agency for Statistics of Bosnia and Herzegovina

Domestic tourists in 2013 have mostly used the services of accommodation in hotels and similar facilities around 86%, then in holiday hostels and facilities for a short break around 1.6%, camps 0.2%, and in other accommodation facilities about 12.2%. The reason for this are favourable prices of hotel accommodation services in contrast to neighboring countries or EU countries which have two or more times higher prices (Fig 3.).

Foreign tourists in 2013, as well as domestic, have mostly used the services of accommodation in hotels and similar facilities around 95.9%, then in holiday hostels and facilities for a short break around 2%, camps 1.2% and other accommodation facilities about 0.9 % (Fig.4.).

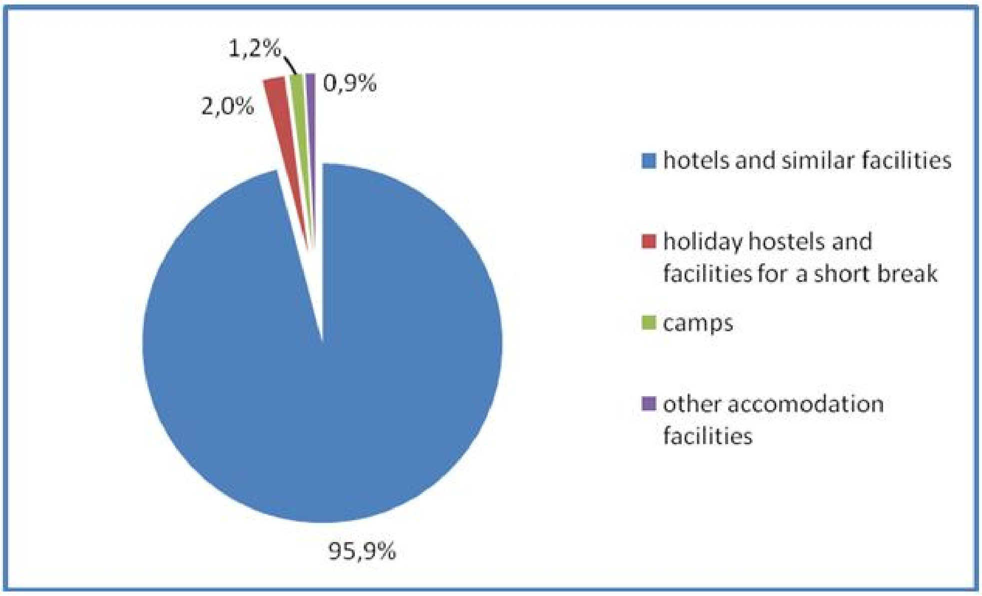

Fig.4. Arrivals and overnight stays of foreign tourists by accomodation facilities, 2013

Source: Agency for Statistics of Bosnia and Herzegovina

Methodology covers the major categories of foreign tourists who have been excluded from the official statistics, such as diaspora tourists, excursionists and tourists who use unregistered accommodation, such as boarding houses or hostels. The research results show that the actual number of arrivals and overnight stays of foreign tourists annually was several times higher than indicated by official statistics.

4 Specific Forms Of Tourism In Bosnia And Herzegovina

Natural resources and diversity of Bosnia nad Herzegovina (mountains, rivers, proximity to the coast, lakes, etc.) provide a strong foundation for the development of outdoor tourism in our country. The geographical position of the country which is located in the center of Europe has the potential to attract large number of tourists within three hours of flying distance. A unique cultural and historical heritage of Bosnia and Herzegovina, including religious sites, also offers great opportunities for the development of creative tourism in this segment. Internationally recognized and important events such as the Sarajevo Film Festival also attracte a significant number of tourists. Bosnia and Herzegovina was recognized as a good destination at a reasonable price because of the relatively low price of services and good but not expensive food and drink. Hospitality is very important for making a good general impression and repeated visits to Bosnia and Herzegovina, and in that sense, exit polls show that tourists are very satisfied with this aspect of tourism services in our country.

The natural tourist potentials (geomorphological, hydrographic, climatic and biogeographical) located in tourist geographical areas of Bosnia and Herzegovina represent the tourist resources that are suitable for the development of the following specific forms of tourism: health, sports and recreational, nautical, eco-tourism, rural tourism, hunting and fishing, naturism, Robinson Crusoe tourism, and so on.

The anthropogenic tourist potentials (archaeological sites, monuments of architectural and cultural heritage, museums, galleries and collections, events) which are located in tourist-geographical areas of Bosnia and Herzegovina, represent the tourist resources that are suitable for the development of cultural tourism, which is today the most developed in the world.

There are many forms of cultural tourism through which anthropogenic tourist potentials can be integrated into the tourist offer, and as the most important are: the urban, archaeological, educational, religious and other forms of tourism with cultural content.

The following table provides an overview of Bosnian and Herzegovinian municipalities and a list of specific forms of tourism that can be developed in them. Data were obtained from the official web-sites of municipalities and tourist associations (Table 2.).

Table 2. Review of specific forms of tourism by municipalities in Bosnia and Herzegovina

Forms of tourism	Municipalities
Maritime	Neum
Mountain	Kreševo, Kupres, Livno, Berkovići, Kneževo, Mrkonjić Grad, Pale, Sokolac, Trnovo, Trnovo (RS), Prača, Široki Brijeg, Novi Travnik, Busovača, Tuzla, Fojnica, Hadžići, Kladanj, Konjic, Kupres,
Speleological	Kreševo, Berkovići, Doboj, Pale, Trnovo, Prača, Sanski Most
Hunting	Ključ, Kreševo, Kupres, Livno, Lukavac, Berkovići, Čelinac, Derventa, Kneževo, Pale, Prnjavor, Sokolac, Zepče, Trnovo, Trnovo (RS), Prača, Prozor-Rama, Novi Travnik, Busovača, Bužim, Tuzla, Bugojno, Konjic, Gacko, Foča
Fishing	Ključ, Lukavac, Čelinac, Derventa, Doboj, Kneževo, Prnjavor, Sokolac, Zepče, Prača, Prozor-Rama, Sanski Most, Novi Travnik, Bužim, Tuzla, Čapljina, Jablanica, Banja Luka, Brčko, Konjic, Mostar, Bihać, Bosanska Krupa
Photo-safari	Kreševo, Stolac, Čapljina, Srbac
Spa	Berkovići, Bijeljina, Prnjavor, Ilidža, Tuzla, Fojnica, Gračanica, Kladanj, Olovo, Teslić, Srebrenica, Višegrad, Bihać, Banja Luka, Laktaši, Sanski Most
Lake	Lukavac, Tuzla, Konjic, Fojnica, Mrkonjić Grad, Gradačac, Živinice, Srebrenica
River	Ključ, Jablanica, Konjic, Doboj, Prača, Brčko, Mostar, Ljubuški, Bihać,
Urban	Ključ, Konjic, Kupres, Livno, Lukavac, Ljubuški, Bijeljina, Čelinac, Derventa, Doboj, Mrkonjić Grad, Prnjavor, Srbac, Zenica, Trnovo, Prača, Stari Grad Sarajevo, Široki Brijeg, Novi Travnik, Busovača, Bužim, Tuzla, Čapljina, Čitluk, Gračanica, Hadžići, Jablanica, Jajce
Rural	Ključ, Kupres, Berkovići, Bijeljina, Derventa, Srbac, Sokolac, Prača, Stari Grad Sarajevo, Novi Travnik, Tuzla, Čitluk, Gračanica, Hadžići, Jajce, Konjic, Goražde
Religious	Fojnica, Trebinje, Lukavac, Sokolac, Zenica, Busovača, Čitluk, Gračanica, Kladanj, Travnik, Mostar
Adventure	Ključ, Kreševo, Kupres, Livno, Lukavac, Čelinac, Berkovići, Kneževo, Sokolac, Zenica, Zepče, Trnovo, Stari Grad Sarajevo, Busovača, Tuzla, Fojnica, Konjic,Višegrad, Bihać

Source: Bidžan 2011.

5 Conclusion

We need to point out that Bosnia and Herzegovina is a very interesting tourist destination as a result of its tourist and geographical position, exquisite natural beauty, cultural and historical values and favorable climatic conditions. For centuries in Bosnia and Herzegovina there were crossings of different cultures, religions and traditions, easy availability, healthy food, varied gastronomy, the vicinity of the source markets, price-competitive, a large number of educational institutions and great hospitality of people of Bosnia and Herzegovina, which adds to the creation of specific tourist products and enriches the offer. The goal is to create a framework for the further development of quality tourism offer which will increase the competitiveness of tourism of Bosnia and Herzegovina in the world markets of tourism demand and capital investments.

The tourism sector in Bosnia and Herzegovina is still at an early stage of development, as measured by official data showing its share in GDP (gross domestic product) in Bosnia and Herzegovina and employment in terms of total turnover and the number of tourist arrivals / overnights stays in the country.

It should be noted that official statistics on the total number of arrivals and overnight stays are only formally registered indicators of the tourism sector, and that there is still a strong informal part of the tourism sector which, if included, significantly changes the overall analysis of the tourism sector for the better.

Based on the opportunities and comparative advantages of Bosnia and Herzegovina's tourism industry, in the next ten years there will still be a strong potential for growth of this sector. This status is also recognized by international organizations responsible for monitoring the performance of the tourism sector on a global scale.

International growth in terms of tourist niches such as natural / eco tourism, adventure, religious, sports and recreational tourism, health spa tourism, cultural and educational tourism, represent the comparative advantages of Bosnia and Herzegovina in terms of its overall offer. These comparative advantages should be transformed into competitive advantages in the future and it is the primary task of all actors and makers of tourism policy in Bosnia and Herzegovina.

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Monitoring behavior-based Intrusion Detection System for 6loWPAN networks

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ABSTRACT: Even when 6LoWPAN has an ideal cryptography line defense, it is still necessary to implement an intrusion detection system (IDS) to deal with threats targeting network performance such as DoS attacks. IDS discover and stop most attacks that make changes on the operation of the network. However, few IDS solution has been proposed for 6LoWPAN networks. IDS missions are to monitor and raise an alarm about any possible threats and pass it to the system to restart the keying process for eliminating the attackers. New technique has been proposed recently based on the principle that neighbor nodes have a trend to have the same behavior, so the detection of the malicious node is based on the detection of the abnormal node that has a bad behavior different than it neighbors. The security goal is to provide a monitoring system that will attempt to detect anomalous malicious behavior and to prevent it from harming the network performance basing on the neighbors nodes behavior monitoring.

KEYWORDS: 6LoWPAN, RPL, IDS, Neighbor-based IDS, Security.

1 INTRODUCTION

One of the most important aspects to be taken into account when creating a 6LoWPAN network is setting the security mechanisms and maintain it. 6LoWPAN networks are inherently open to the attackers whose can eavesdrop the information exchanged within the network, or injecting false packets into the network.

It makes it more complicated the impossibility of application of current security systems used in today's networks, for several reasons, being limited resources and high consumption of energy, making it difficult to provide the protection systems of complex computations, which need high-performance resources and consume a lot of energy. Any proposal to resolve the terms of the security of 6LoWPAN network must take into account two factors; the need to use limited resources and the need for minimal consumption of energy, any proposal that consumes a lot of energy will be ineffective and sentenced to failure.

Among the complications is the ease to capture 6LoWPAN devices, because of their small size and their location in insecure places, so an attacker can steal their data, re-programmed and re-integrated them in the network as an intruder device to eavesdrop data or to damage the network. Generally, threats aim to introduce false information affecting the cost-effectiveness and quality of the network, or to tamper the functioning of the full network as a whole or a part of them as Denial of Service attacks. Attacks can be done via a malicious node, a powerful machine placed approximately to the 6LoWPAN, or remotely through the Internet.

A new approach to intrusion detection has recently been proposed for identifying malicious nodes in 6LoWPAN networks. It is based on the fact that nodes that are in the same neighborhood tend to have the same behavior, i.e. the same number of packets sent, received, and rejected, the same signal strength generated. A node is considered malicious if its behavior significantly differs from its neighbors in the same group. These techniques has many advantages as it does not require prior training, localized and capable of adapting to changing network dynamics, also, it has the most suitable mechanism for a total encrypted network as a node does not require to analyze its neighbors data to detect their behavior change. Moreover, some attacks in 6LoWPAN networks can be observed only by the neighbors of the malicious node [1]. The authors in [2] -[5] use this concept to detect a number of attacks in low power networks. In all these works, the IDS agents monitor their neighbors to detect internal attacks. Monitoring is to collect intrusion data from messages sent in their radio range, and then analyze these packets based on selected like packet-dropping rate, the number of transmitted packets and the strength of received signal, etc. However, the common disadvantages of these propositions are analyzing the signals from all the neighboring nodes, which leads to excessive energy consumption, and the strategy of the location of IDS agents in the network is an important aspect and has not been considered in these researches.

We propose an IDS solution adapted for 6LoWPAN networks. Our simulations and performance analysis shows that our solution provides security, and it is efficient in computation, communication, and storage. We give a preliminary study about IDS systems that are been proposed for resource-constrained networks, especially 6LoWPAN networks to choose the most adequate system to use it for 6LoWPAN networks. In addition, we propose an IDS system based on the preliminary study results and well adapted for 6LoWPAN networks.

The paper is structured as follow. Section 2 gives an overview of the challenges of the application of an IDS in a 6LoWPAN network, Section 3 discusses our proposed security model to deal with these challenges, and Section 4 presents a theoretical analysis and simulation tests of this model. Finally, Section 5 concludes the paper.

2 IDS : Intrusion Detection System

Before Unlike cryptography, the system has the ability to detect with high accuracy internal attacks. Cryptography protect the network only from outside attackers, a compromised node can launch attacks from inside and will not be detected as it is considered as legitimate node. Mainly 6LoWPAN's devices are weak secure and are deployed in non-secure wireless environment. In order to address this problem, an intrusion detection system must be used as a second line of defense and a wall against internal threats. This mechanism is used to detect abnormal or suspicious activities on the analyzed target and trigger an alarm when malicious behavior occurs. The cryptography mechanisms are not effective when protecting against insider threats, also it cannot defend against some external threats like a Denial of Service attack from the Internet to the 6LoWPAN network.

The main components of an IDS agent. IDS agent is installed in the application layer, it consists of three components (or modules). These components are defined as follows:

- Data Collection: this module is responsible for packet capture in the radio range of the node IDS.
- Intrusion Detection: IDS agent analyzes the captured packets in a policy based on detection. Among these policies, there's the signature-based detection of attacking and anomaly detection. These techniques will be detailed in the next chapters.
- Prevention: intrusion prevention is a set of tasks designed to anticipate and stop attacks. These tasks can be defined such as sending an alarm by the IDS to the base station, the latter subsequently ejects the suspect node of the network and apply the update key.

2.1 IDS in a 6LoWPAN

The IDS solutions developed for ad hoc networks cannot be applied directly to 6LoWPAN networks, and this is due to the difference of these two types of networks [6]:

- In ad hoc networks, each node is typically handled by a human user. Unlike 6LoWPAN where all nodes are independent, these sensors send their collected at the base station data. The latter is usually controlled by a human user.
- Energy resources are more limited in the 6LoWPAN nodes compared to ad hoc nodes.
- The task of the 6LoWPAN network is very specific, for example the measurement of the temperature in an agricultural field. Therefore, the hardware modules and communication protocols must depend on the intended application.
- The density of nodes in 6LoWPAN networks is higher than in the ad hoc networks.

Thus, it is necessary to introduce a mechanism for detecting the own 6LoWPAN network intrusion.

2.2 IDS IMPLEMENTATION REQUIREMENTS

Much research in the application of the solution of IDSs in ad hoc networks have been done compared to 6LoWPAN networks, due to limited resources of 6LoWPAN nodes in terms of computing capabilities and communication. The design of an IDS solution for such networks should consider the following limitations [7]:

- Waste of energy: most of the energy consumed in a 6LoWPAN is mainly due to the communication interface, not the calculation process. Therefore, IDSs must preserve their transmission power and minimizing the data exchange between nodes.
- Distributed IDS: in 6LoWPANs, the base station cannot handle a large number of audit data (intrusion detection) from the network to detect any intrusion. In addition, the nodes cannot transmit a large number of packets because energy resources are not used optimally. This is due to a significant packet transmission to the base station. In this case, a distributed detection based on the cooperation of IDS agents is a desirable solution.
- No node is trustworthy: each IDS agent monitors its neighbors, based on the fact that even the IDS node can be malicious.
- Real time: to minimize the impact of a possible attack in critical applications, it is important that an IDS works in real time.
- Support adding new nodes: in practice, it is likely that new nodes can join the network after deployment thereof. The IDS must support this transaction and distinguish normal node from malicious node.
- Accuracy: the accuracy of an IDS in 6LoWPAN is another major problem. It can be defined as the ability of an IDS to determine whether the node in question is malicious or not.
- Availability: an IDS must run continuously and be transparent to users.

2.3 EVALUATION METRICS

To evaluate the effectiveness of any proposed IDS model, there is a set of metrics to be adopted to quantify the level of security and the best use of resources such as energy and storage. These performance indicators will enable a network administrator to choose the best intrusion system [8] and the optimization of the location of the agents in the IDS. Accordingly, the following metrics are considered important characteristics for effective design of IDSs in 6LoWPAN:

- Detection rates: represents the percentage of detecting attacks within the total number of attacks.
- False positives rate (false alarms): This is the ratio between the number of classified as an anomaly on the total number of normal connections normal connections.
- False negative rate: it is the opposite of the detection rate; this metric is defined as the ratio of false detections of attacks on the total number of attacks.

2.4 IDS AGENTS' LOCATION

An important criterion for achieving the IDS mechanisms in the 6LoWPAN is the location of its agents in this type of network. Many researchers have worked on this problem [9]–[11].

The network-based approach puts the IDS agent at the base station to receive and analyze data from monitored nodes. In this way, we benefit from the base station strong resources and its global vision of the entire network, which helps detect cooperation attacks. However, the disadvantage of this architecture is that it creates a lot of communication overhead and is not performing at detecting local attacks.

Otherwise, the host-based approach puts the IDS agents at each node, where each one of them has to monitor data, analyze it and decide for itself. The benefit of this approach is the reduction of monitored traffic. However, it puts more computational work on the node, which shortens its life by consuming its resources. One advantage of this approach is the ability to detect local attacks, but it lacks the global vision, which does not detect cooperation attacks.

There is another approach, the hierarchical approach [11]. It consists of combining the two previous solutions in the network. It places the IDS agents on three levels. The first is the level of the cluster members, which are used to control the behavior of their neighbors and collect audit data. These nodes have the ability to analyze their own data to identify malicious neighbors to isolate them. The second is the level of cluster-heads, which are used as coordinators to consolidate audit data from their cluster nodes, analyze and make decisions to identify intrusions. The highest level is the base station, which collects data to monitor its cluster-heads and detects attacks across multiple clusters.

The main advantages of this architecture are the ability to detect distributed attacks and ensure scalability. Audit data collected from different points of view of the network also allows robust and fault-tolerant architecture [11]. The clustering architecture in 6LoWPAN is similar to the 6LoWPAN graph topology (RPL DODAG) [12] where the border router 6LBR is placed on the side of Internet and acts as a base station (Fig. 1). The border router is typically a wired device connected to the Internet so that it can be considered unlimited resource.

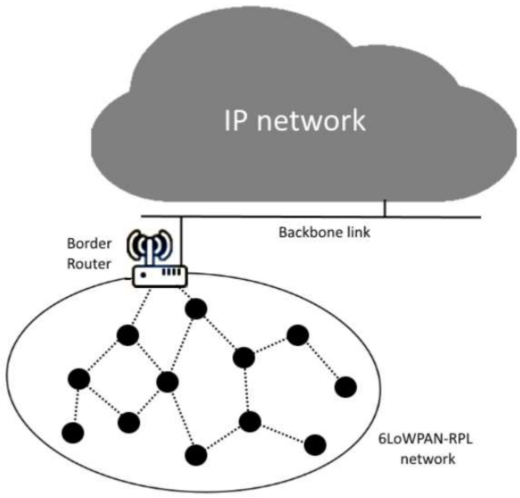

Fig. 1. 6LoWPAN-RPL network architecture

The DODAG roots will act as cluster heads for controlling operation of sensor nodes. Algorithms for attacks supervision in each DODAG will be slightly different because each uses a different objective function and follow DODAG varied routing rule. It is not in the clustering topology where cluster-heads implement the same algorithm. However, it does not affect cooperation between DODAG roots because the border router always has a global vision.

3 DISCUSSION

The IDS systems have become a very attractive research area for intrusion detection. Centralized intrusion detection systems are energy efficient as they are implemented in a powerful node (base station) [13]. However, this solution requires that all sensor nodes are required to submit their data to the base station, which introduce a high communication overload. On the other hand, systems of distributed intrusion detection provides detection performance slightly lower than the previous approaches because they use simple techniques and computationally light detection. In addition, the amount of information exchanged between the nodes is not important, unlike centralized model where all the nodes send their packets to a remote location; the distributed approach therefore is better adapted to the constraints of the resources of the 6LoWPAN devices.

The hierarchical architecture requires low energy consumption. Apply for a distributed intrusion detection in a topology based on clusters will result in a secure network solution that meets the requirements of 6LoWPAN nodes. Our research problem of IDS in the 6LoWPAN network resides on the use of specification-based intrusion detection agent and the location of these agents in the 6LoWPAN nodes. It is interesting to place the IDS agents optimally in the network to cover the entire network and have a global view of the sensor nodes. This leads to the detection of all packets generated by malicious attackers. We proposed and designed an IDS to counter the most threatening attacks for 6LoWPAN network.

The proposed security approach security is applied based on that all nodes in the same group have a similar behavior. We show the performance of our detection model simulation under Tossim and then by an experimental study. We evaluate its performance against several types of attacks. Specifically, we calculate the rate of detection, false positive rate, power consumption and time needed for IDS agents to detect attacks (average efficiency). According to the simulation results and experimental, our model has high accuracy of detection, low power consumption and a short time of detection.

4 PROPOSED SOLUTION

The Basics propositions from the papers that were a source of inspiration for this work are summarized in these solutions; the insider attacker detection scheme [2], the group-based intrusion detection scheme [3], the neighbor-based intrusion detection [4] and Intrusion detection framework of cluster-based wireless sensor network [5].

An IDS system for a 6LoWPAN network must satisfy the following properties: simplicity, full network coverage, utility and scalability. In other words, the system would cover all of the nodes in the network, is simple enough to run on limited devices to detect most attacks that would be designed for and it would be possible to implement new mechanisms to detect new types of attacks easily without having to rebuild the existing system.

We propose to build the IDS as powerful global IDS agent running on the border router and a lightweight agent running on each node. Global agent has access to information of all network nodes. On the other hand, the node's agents can operate with only the information from their neighbors. However, this information is very rich due to wireless nature of communication. Each node upon receiving any message should consider whether it is for the node itself or another node. Then, each node contains information about its neighborhood. For saving energy, it should be possible for a node to turn off its agent to reduce battery consumption.

Symptoms of selected attacks that pose risks of security must be integrated into the node agent detection component. Results of detections are organized in a database alert data. Nodes are marked as suspicious or malicious there. Finally, a cooperative component can be activated when the communication with other parts of the system or neighborhood is necessary.

The global agent consist of a data acquisition component that collects data from the received packets. These data are processed for further analysis. The processed data is stored using a statistical component. A detection component uses the information stored by the component of the statistics and analysis attacks symptoms.

Our intrusion detection system explores the spatial correlation of neighborhood activities and unlike other systems; it does not require prior training. The algorithm is localized, which means that information is exchanged only in the limited neighborhood. In addition, apart from the requirement of no prior training, is that it has a pattern that is generic, it is not related to a specific types of attacks. It can monitor many aspects of the behavior of the 6LoWPAN network at a time. The way this is achieved will be described in more detail in the following paragraphs. The basic idea is that in some areas neighboring nodes that are physically close to each other must be taken with the similar network traffic and provide similar values of their sensors. Then it is possible to watch all the attributes for some spatially correlated group of nodes and nominate these nodes, which differ significantly in some aspects as attackers.

We know in a wireless environment, a node *N* is able to listen to messages coming to its neighbor N_i no matter whether or not it is involved in the communication. The node *N* creates a model of network behavior of the node N_i as a q-component attribute vector

$$f(N_i) = (f_1(N_i); f_2(N_i); \dots; f_q(N_i))$$

with each component describing an N_i's activity in one aspect. The component f_j represents actual monitoring results of some behavioral aspect of the node N_i for each and fixed j. For example, it might be a measured value from the sensor, the number of dropped packets per burst period, packet delivery ratio per some period of time, etc. Behavioral aspects are chosen as appropriate and quantifiable properties, which represent statistics that are used to evaluate symptoms of attacks that should be detected by the IDS. The authors in [2], [3] assume that for any local area of normal sensor nodes N_i, all $f(N_i)$ follow the same multivariate normal distribution.

The data acquisition component of the node N gathers information from its neighborhood and creates the set

$$F(x) = f(f(N_i)) = f(f_1(N_i); f_2(N_i); \dots; f_q(N_i))$$

of attribute vectors, where $N(N)$ is the set of neighbors of the node N. This set of attributes is broadcast within the neighborhood $N(N)$ and is taken as a source of statistics for the detection component. This approach eliminates the need of the training phase and storing its results permanently in the database of the detection component of the IDS. In each period, the normal behavior of a node is defined as the "center" of the set $F(N)$.

Suspect intruders are considered as nodes, which are far from the "center" of the set $F(N)$ that the threshold θ. Details on calculating of this distance can be found in the cited papers, as well as determining the threshold θ. The final decision about the suspect nodes in our solution is made in the level of the border router, this latter may invoke the MCU remote server for help. Different nodes mark the attacker on the basis of information from different neighborhoods. If a local IDS agent finds a suspect, it alerts the entire group with a warning message about the node. If there are more such messages, the entire group wakes up and all of the nodes monitor the proposed malicious node. If abnormal behavior is detected, the border router is alerted and the actual suspect node is blocked from routing tables until the final decision. The border router revoke a node if it is considered suspect by a majority of its neighbors, and it presents an attack and not just a malfunctioning, after that it's excluded from nodes routing tables, reported in the database alert and announced to the remote server.

4.1 IDS AGENTS' LOCATION

We propose a new concept detection to identify and prevent different types of attacks in sensor networks. This detection approach is based on specifications, but without the need for continuous updating of rules to maintain the intrusion detection system reliability. We used the concept screened by the works [2], [3] in a hierarchical topology based on DODAG. We adopt this method as we demonstrated in the previous chapters that the hierarchical topology is most suitable for 6LoWPAN networks using the RPL as the routing protocol. The following studies [2], [3] proved that the nodes that are in the same group or the same cluster tend to have the same behavior. Since the nodes in 6LoWPAN regrouped in DODAGs, we assume that the nodes are in the same group if they are physically close to each other and tend to have the same behavior. If we have an heterogeneous nodes distributed in the same network where they differ from each other even if they are physically close to each other, in the same DODAG we can make sub-groups of the nodes that are from the same type, i.e. the monitoring node collects audit data about its neighbors but only those from the same type. We have developed a new detection model based on this concept to detect the most dangerous attacks for 6LoWPAN. In the presence of several types of attacks, the proposed intrusion detection approach is evaluated using four metrics; the detection rate, the number of false positives, the average efficiency and the total consumed energy.

In what follows, we describe our detection proposition based on the concept of the normal distribution and detection rules for a set of behavioral change signs in a node. Our goal is to protect the network from attacks aimed at tampering it by detecting the anomaly of the malicious node whatever its type. Each node has an abnormal behavior must be suspect to be an intruder. The final decision should be made following statistical analysis that will confirm if the node is really an intruder or it just present a malfunctioning. The advantage of this approach that it provides flexibility by the detection of new attacks that were not defined by the standards, since it is not tied to a specific type of attack. Subsequently, we present the design of the proposed detection model and its operating principle.

4.2 INTRUSION DETECTION TECHNIQUES

Solutions that adopt the concept of neighbor monitoring are based on the determination of the threshold by calculating the mean of the observed phenomena, which means that the node has compared a given phenomenon generated by its neighbor node with a definite value. The result of this comparison is not exact since the phenomenon is a variable that can take a correct value in a large field, more or less than the calculated mean. This explains the high rate of false negative in these solutions. To deal with that, we adopt a new detection techniques based on the concept of the normal distribution (Gaussian distribution) proposed by [5] to detect attacks and allow a normal functioning of the 6LoWPAN network.

An observed value can be considered as random and normally distributed. The mean of the normal distribution is then considered as the real value of the observed value, the dispersion of the law then provides information on the error of observation. That is to say, it is possible to calculate an approximate value of the probability that a variable following a normal distribution is in a around the mean .This is to obtain an approximation of the value of indicator observed by considering errors due to changes in the environment or a malfunction.

In a concept of normal distribution, the mean μ and standard deviation σ of the data are calculated. This data is properly distributed if they are within three standard deviations from the average. In our approach, we assume that all nodes that are located in the same DODAG have the same behavior. Therefore, a node is considered an attacker if its behavior differs from its neighbor in the same DODAG.

4.2.1 ATTACKS INDICATORS

We focus in our study about the most known attacks that can be detected by surveying the communications between the nodes and that are detectable only by an IDS. We was based in our study on [14]-[16] to determine the indicators of these attacks in order to determine the parameters to be monitored. We describe in what follows the main indicators.

- Sending ratio (SR): number of packets sent by a node N.
- Reception ratio (RcR): number of packets received by a node N.
- Forwarding ratio (FR): number of packets received by a node N and forwarded by this node to their destination.
- Retransmission ratio (RtR): number of retransmission of the same packet by a node N.

Each indicator shows its efficiency only in protecting the network from one or some attacks but not all, this why each node must take them all in consideration. Wherever there is other indicators, but a 6LoWPAN node cannot monitor them all because it is limited in resources. Therefore, the IDS needs to prioritize the attacks depending on the scenario. Our approach is based on cooperation between the chosen indicators to monitor all these priority threats.

4.2.2 BEHAVIOUR MONITORING

Behavior monitoring of a node $N_i$by IDS agent is modeled by the following function:

$$f(N_i) = (f_1(N_i); f_2(N_i); \dots; f_q(N_i))$$

where q is the number of monitored behavior defined by:

$$f_1(N_i) = \mathrm{SR}$$

$$f_2(N_i) = \mathrm{RcR}$$

$$f_3(N_i) = \mathrm{FR}$$

$$f_4(N_i) = \mathrm{RtR}$$

All of these behaviors follow the same multivariate normal distribution in any local area within the DODAG. All values associated with these indicators are in the range of three standard deviations around their mean values. The writing normal distribution function is

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\ \mathrm{e}^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}.$$

To determine whether the nodes within the same DODAG have the same behavior, the standard deviation σ and the Euclidean distance E of the indicators must be calculated. Each IDS agent calculates the standard deviation of the set $f_m(N_i), \dots, f_m(N_n), i = 1, \dots, n\}$, where n is the number of monitored nodes by this agent and m is the selected behavior.

$$\sigma(f_m(N)) = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(f_m(N_i) - \mu\, f_m(N)\,)^2}$$

When σ is above a certain threshold θ, the IDS finds that monitored nodes could be an attacker. To determine the node that has a malicious behavior, the IDS agent calculates the E of $f_m(N_i)$ in the center of the set $f_m(N_i), \dots, f_m(N_n)$, given by calculating the mean µ of its components. When *E* is above a certain threshold θ, the node is considered as an attacker.

$$E\big(f_m(N)\big) = f_m(N_i) - \mu(\,f_m(N))$$

Knowing that: $\mu\,(f_m(N)) = \sum_{i=1}^{n}\frac{f_m(N_i)}{n}$

Our goal in this solution is to provide a reliable mechanism for detecting intrusion in terms of attack detection and lightweight in terms of computation process and communication, i.e. obtaining a low overhead. Therefore, our detection mechanism is mainly based on the concept that all nodes in the same DODAG should have similar behaviors. These behaviors are represented by the noted indicators previously described. In our solution, we used a hierarchical architecture based on the DODAG topology.

4.3 INTRUSION DETECTION TECHNIQUES

In our scheme, each node has the ability to enable its intrusion detection agent. When a node performs the heavy calculations, it can disable detection to conserve energy for a while. For the analysis and detection process, we propose two detection agents: node IDS N_{IDS} and global IDS G_{IDS}, located respectively at the nodes and the border router. The first applies a detection based on the behavior of neighbors to identify malicious nodes. The second aims to reduce the number of false positives that occurred when the N_{IDS} agents suspects a normal node as an attacker.

4.3.1 NODE IDS (N_{IDS})

The strategy of the location of N_{IDS} agents in the network is a very important point, since the increase of the number of agents in a network leads to a communication and calculation overhead, and therefore a decrease in the lifetime of the network. Our solution is that each node is monitored by its one-hop neighbors in the DODAG as they are intended by its messages and because they are in its radio range. Therefore, this strategy leads to detect all malicious nodes with low overhead.

The N_{IDS} has the following missions:

- Data collection: it is responsible for collecting packets in the radio range of N_{IDS}, storing the physical address of the analyzed node and calculating indicators behavior, is related to each node.
- Detection: it aims to implement the policy of detection based on the fact that in each DODAG, the indicators behaviors should follow normal distributions. The N_{IDS} agent monitors its one-hop neighbors by calculating the standard deviation and the Euclidean distance of their behavior.
- Prevention: when abnormal behavior occurs, the N_{IDS} off an alarm as a message to the G_{IDS}, so that it can confirm the malicious nature of the suspected node. This alarm message includes the suspect node (physical address) and detected attack type. In this case, the N_{IDS} receiving such a message will trigger an alarm counter. When this counter reaches a certain threshold θ, the N_{IDS} will make a final decision.

4.3.2 GLOBAL IDS (G_{IDS})

Each G_{IDS} agent has the following missions:

- Data collection: it receives an alarm message from N_{IDS} agents. This message contains the suspect node and detected attack type.
- Decision: N_{IDS} stores the address of the suspect node in a database (blacklist) and increases a specific counter of malicious nodes. The latter is calculated as the number of times N_{IDS} agents within the same DODAG identifies a node as malicious. When this counter exceeds a threshold θ, the corresponding node will be ejected from the network. When the N_{IDS} identifies a node as normal and the N_{IDS} agent detects it as malicious one, the N_{IDS} stores the address of the N_{IDS} in a blacklist and the counter associated with this agent is increased. When this counter exceeds the threshold θ, this N_{IDS} will be designated as the intruder who tries to tamper the network by false information, it will be ejected when the other N_{IDS} agents identify it as a malicious node and the N_{IDS} affirmed that decision.

4.3.3 COMMUNICATION ACTIVITIES BETWEEN IDS AGENTS

In 6LoWPAN networks, the communication process requires a large amount of energy compared to the process of calculation. Therefore, our detection approach aims to reduce the cost of communication between agents of intrusion detection to increase the lifetime of the network. This is achieved by minimizing the amount of information exchanged between N_{IDS} agents and between N_{IDS} and G_{IDS}. The N_{IDS} sends two types of messages: the first is for the G_{IDS}, the second to all N_{IDS} agents that are located on its radio range. They contain the address of the suspect node and the type of detected attack.

In addition, the mechanisms of cooperation between IDS agents can be classified into two approaches: Each IDS agent exchange intrusion data with other agents. This approach generates high communication load. Each IDS agent works with its neighbors agents to make a final decision about the suspect node (intruder or not). In this approach, the IDS agent only sends an alarm message to its neighbors, where the length of the message is much smaller compared to the previous approach, which indicates a low communication load. Accordingly, our detection scheme is based on this cooperative approach to detect malicious nodes with high accuracy and low power consumption.

Cooperative approach is used for the information exchange between IDS agents running of different nodes. When network density is low and there is not enough nodes monitored by a single IDS agent, it is helpful that an agent collaborates with its one-hop neighbors; the neighboring nodes exchange the information about the suspect nodes they have gathered. Alternatively, this can be done among nodes that are two or more hops away from each other, but we limit our solution to one-hop to reduce the number of monitored nodes and also, in order to reduce false alarms as some indicators may differ only if the monitor node is far from the other. The IDS agent would not extend the number of nodes it is monitoring but only refine the information about them.

The result of these cooperative information are sent to the G_{IDS}. These information will help it as data for its statistical technique that used for analyzing the relationship between the received alarms from the network N_{IDS} for potential threats. Evaluating only one indicator of a suspect node behavior can be seen normal in given range; but, evaluating alarm messages in a combined manner can indicate a threat.

4.4 INTRUSION DETECTION MODULES

In order to establish a system adapted to the distributed nature of 6LoWPANs networks, we have designed a distributed detection system. It locates nodes with abnormal functioning by listening to the traffic. After treatment, it decided to discard the package or transmit it to the next hop. Each node that receives a packet from its neighbor node, it treats it in two modules: local control and data collection. The local control module verifies the legitimacy of the neighboring node sending the message. If this is the case, that mean that sending node is not reported malicious, the node processes the packet and perform other normal tasks. At the same time, the data collection module interprets the header information to be used by the intrusion detection system. The interval of the threshold already determined, if the result of the treatment is different from the predicted value, an alarm is generated, the node is declared abnormal and action must be taken to detect if it is malicious or just a dysfunction.

4.4.1 LOCAL CONTROL

The local control unit the audit engagement and validation of received packets. It verifies the identity of the sender and decides to reject the package or transmit to treatment. This module listens systematically all communications that took place in the radio field. He decides for each packet to treat or reject it. It deals only with packets received from neighboring nodes to a jump, so his children or his parents. The intrusion detection processing will take place only if the sending node belongs to this category, and it is not reported as malicious.

4.4.2 DATA COLLECTION

Generally, sensor nodes listen jumble communication exchanged between neighboring nodes residing in its radio range. Since 6LoWPANs nodes have very limited memory and storage space, the data collection unit will not store data, it will be limited to listening to the data and transmit them to the processing unit. This unit acquired the information required by interpreting the header. The detection strategy is applied once the data is being processed. If the result shows a different level of the predicted value, an alert is issued. After collaboration with neighboring nodes, the local agent says the node as normal or abnormal. Results are sent after the overall agent to determine if the node is malicious to take the necessary measures against him.

4.4.2.1 INTRUSION DETECTION

A number of rules have been chosen to detect a variety of attacks that are determined by the established indicators to set their thresholds after the normal execution of the 6LoWPAN network. As explained in previous sections, the threshold values are set using the normal distribution. These rules are represented as follows:

- Low: if the value of the result is below the minimum ”μ - σ”, in the case where he has an attack pattern.
- High: if the value of the result is greater than the maximum threshold ”μ + σ”, if it has any attack pattern.
- Normal: if the value is between the minimum and the maximum threshold, but it shows no attack pattern.

5 EVALUATION

5.1 INTRUSION PERFORMANCE EVALUATION

In our study, we use the TelosB in Tossim simulator as we did on the previous simulations of the security keys establishment, in order to evaluate the performance of our model in terms of the detection rate of true positive and false positive rates. IDS works well should have a false positive rate near to 0% and a very high rate of detection rate. According to these metrics, we determined the optimal detection thresholds for each attack (relative to the standard deviation and the Euclidean distance) to meet the requirements of our target.

Subsequently, we simulated our model to assess experimentally the average efficiency resulted in the time required for IDS agents to detect all attacks in the network, the number of true positives and the number of false positives. In addition, we evaluated the total energy consumed during the execution of our model. In what follows, we present the simulation results of our detection model.

5.2 THE ATTACK SCENARIOS

A 6LoWPAN network can undergo several types of attacks as we studied in the previous chapters. In our solution, it is not intended for a specific attacks as explained, but our approach is based on the study of the normal operation of the network indicators, their disturbance will indicate the network exposure to an attack whatever this attack. A number of malicious nodes was randomly chosen from all scenarios. We chose to implement the most known and most dangerous attacks for the test; these attacks are ”hello flood”, ”blackhole” sinckhole ”,” wormhole ”,” selective forwarding ”,” crash ”and” jamming ”. The threshold is obtained after running the simulation for 15 times in each case.

5.2.1 SENDING RATIO

In a kind of attack, the attacker sends a large number of packets, so the sending rate among attackers nodes is high compared to others. Fig. 2 shows an analysis of the sending rate, we note that the average packet forwarding among attackers nodes is very large compared to normal nodes.

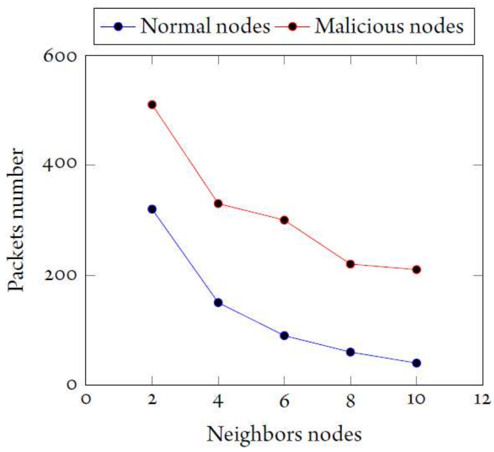

Fig. 2. Sending ratio

5.2.2 RECEPTION RATIO

In one type of attack, the attacker aims to get a large number of packages, so the receiving rate for this node has very high average. Note that the number of nodes was increased relative to other nodes. Fig. 3 shows an analysis of the rate of receipt of the network nodes; we see that the nodes that have been selected to carry out such attacks receives a greater number of packets than other nodes.

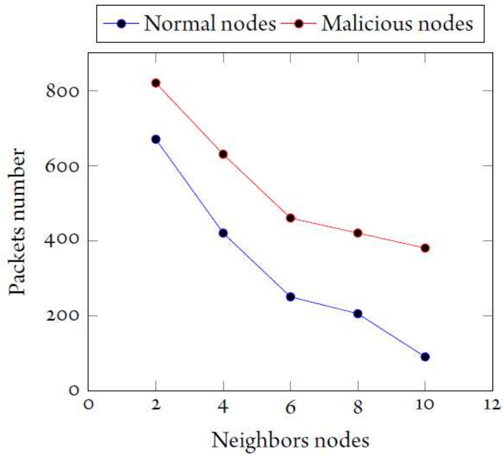

Fig. 3. Reception ratio

5.2.3 FORWARDING RATIO

There are attacks that aim to disrupt information exchanged in the network, like the non-forwarding of some packages, which generates false information. The attacking node records a lower average packet transfer to other nodes. Fig. 4 shows an analysis of the data rate; we note that the average forwarding of malicious nodes is less than that of other nodes.

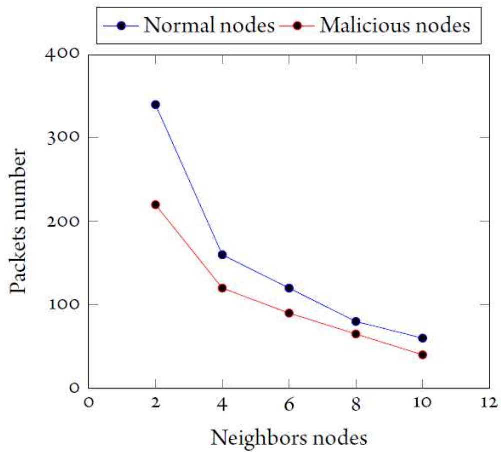

Fig. 4. Forwarding ratio

5.2.4 RETRANSMISSION RATIO

Unlike previous attacks, a kind of attack is to retransmit the same packet multiple times. Therefore, the transmission rate of the attackers is much more important than the other nodes. Fig 5 shows an analysis of the transmission rate; we note that the average retransmission among attacker nodes is more important than the other nodes.

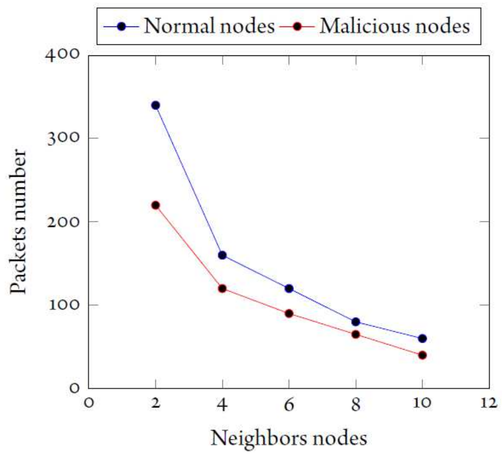

Fig. 5. Retransmission ratio

5.3 SIMULATION

We considered in the simulations of a network of sensors 40 static nodes deployed in a random manner in a square area of 100 x 100 m2. The simulation time was for 800 seconds. In the approach, where the NIDS agent determines in its radio coverage as an indicator of a neighboring node does not follow a normal distribution, the Euclidean distance on this behavior is calculated to detect the likely suspect node execute an attack. Our results show that IDS is running efficiently and accurately with a very low false positive rate of less than 10% and a high of more than 90% true positive rate (Fig. 6). Moreover, nodes generally consume less energy. As illustrated in the IDS model performance graph, the detection rate is almost 94% when the number of nodes IDS is high (more than 10 agents). However, we have noticed an increase in energy consumption when the number of nodes exceeds 20 IDS agents.

The combination of the detection based on indicators and the collaboration between nodes allows the model intrusion detection to achieve a high rate intrusion detection with a very small number of false alarms, when the number of IDS is large (i.e. greater than 10 agents). Thus, the use of our approach based on the normal distribution for intrusion detection can meet the requirement of the application in terms of detection rates of attacks and number of false alarms generated by IDS agents.

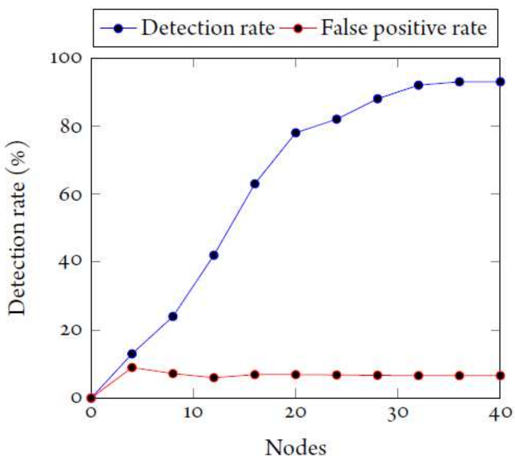

Fig. 6. Detection rate

5.4 ENERGY CONSUMPTION

About the energy, from energy consumption graph, it is clear that our detection model has low power consumption. This improvement is achieved by the fact that IDS agents generate a low charge of communication and computation (low overhead communication and computation). In addition, our detection modules involve energy consumption less than the techniques proposed in previous work (Fig. 7), based on the core protocols of the 6LoWPAN network and limiting the number of monitored nodes, and the context of our application implies a low density of nodes, which also has impact on energy consumption. Yet our detection frame has been evaluated and it has been shown to be effective, even when the density of the network is high. Therefore, we can say that our model improves the detection of network lifetime.

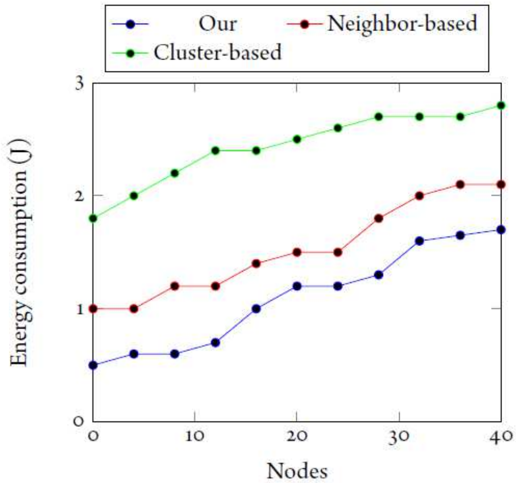

Fig. 7. Energy consumption evaluation

6 CONCLUSION

We proposed a new detection approach based on behavioral concept of neighboring nodes. This is based on the fact that the nodes that are in the same group have the same behavior. This is a new intrusion detection approach was recently proposed for the identification of malicious nodes in LoWPANs networks, it is based on the fact that the neighbor nodes tend to have the same behavior, that is to say, the same number of packets transmitted, received, and rejected, the same strength of the generated signal, etc. In addition, we have applied this concept to detect attacks that can cause significant damage in 6LoWPAN networks. In our approach, we assume that all nodes that are located in the same DODAG have the same behavior. Therefore, a node is considered an attacker if its behavior differs from its neighbor in the same DODAG.

We focus in our study about the most known attacks that can be detected by surveying the communications between the nodes and that are detectable only by an IDS. We determined the indicators of these attacks in order to determine the parameters to be monitored. Our IDS research problem in 6LoWPAN networks was in the use of intrusion detection policies by IDS agent and the location of these agents in the network nodes. In the first, two major detection techniques have been proposed in the literature; signature-based and anomaly-based detection. Each technique has advantages and disadvantages. Our idea was the use of the advantages of these techniques to counter attack with a maximum load limit of computing and communication generated by IDS agents. In the second point, we tried to place them optimally in the network to cover the entire network and have an overall view of the sensor nodes. This leads to the detection of all malicious packets generated by the attackers.

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L'apport de biodéchets améliore la croissance des cultures maraichères à Lubumbashi : signe d'une bonne qualité de biodéchets?

[The contribution of biowastes improves the growth of the market gardening in Lubumbashi: sign of a good quality of biowastes?]

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ABSTRACT: This study checks the hypothesis which the organic amended contain components alternatives according to their mode of obtaining and conservation. Their use in agriculture efficiently contributes to resolve the problem of infertility of the soil. Samples of biowastes were analyzed at the laboratory to determine the composition in major fertilizers. Four doses of biowastes and three doses of fertilizers were applied only or in combination in a device completely randomized to three repetitions. The observations on the onion and spinach plants related to the height of plants, the number of sheets and the weight of the useful product and the results obtained were subjected to the analysis of the variance. It emerges from the physical characterization that the biowastes contain more 95% of organic matter. The chemical composition as well with it showed as these biodéwastes contains content of major elements (N, P, K…) allowing their use in horticulture. The experimentation proved the effectiveness of their incorporation with fertilizers by the increase in output. A significant increase in output was obtained with the treatments amended compared to that no amended. This study constitutes an additional argument in the development of a chanels of management of waste, which passes by their valorization in agriculture, taking into consideration their capacity to improve quality of the soil.

KEYWORDS: caracterization, biowastes, fertilizer, market gardening, poor soil.

RESUME: Cette étude vérifie l'hypothèse selon laquelle les amendements organiques contiennent de composantes variantes en fonction de leur mode d'obtention et de conservation. Leur utilisation en agriculture contribue efficacement de pallier au problème d'infertilité du sol. Des échantillons de biodéchets ont été analysés au laboratoire pour déterminer la composition en éléments minéraux majeurs. Quatre doses de biodéchets et 3 doses d'engrais ont été appliquées seules ou en combinaison dans un dispositif complètement randomisé à trois répétitions. Les observations sur les plantes d'épinard et d'oignon ont porté sur la taille de plantes, le nombre de feuilles et le poids du produit utile et les résultats obtenus ont été soumis à l'analyse de la variance. Il ressort de la caractérisation physique que les biodéchets contiennent plus 95% de matière organique. La composition chimique quant à elle a démontré que ces biodéchets contiennent de teneur en éléments majeurs (N, P, K…) permettant leur utilisation en horticulture. L'expérimentation a prouvé l'efficacité de leur incorporation avec les fertilisants chimique par l'augmentation de rendement. Un accroissement significatif de rendement a été obtenu avec les traitements amendés comparativement à celui non amendé.Cette étude constitue un argument supplémentaire dans le développement d'une filière de gestion de déchets, qui passe par leur valorisation en agriculture, au regard de leur capacité à améliorer la qualité des sols.

MOTS-CLEFS: caractérisation, biodéchets, engrais chimiques, cultures maraîchères, sol pauvre.

1 INTRODUCTION

La démographie urbaine mondiale est de plus en plus galopante, avec une augmentation estimée à 3 milliards d'individus à l'horizon 2030 et cette augmentation concernera à 95 % les pays en voie de développement [1]. Celle de la ville de Lubumbashi particulièrement, a none triplé à moins d'un siècle, évaluée à 16180 habitants en 1923 est devenue de 1480152 habitants en 2009 [2]. En outre, cette situation d'accroissement de la population et d'urbanisation rapide, entraîne une demande de plus en plus croissante en denrées alimentaires parallèlement à une production des déchets par habitant [3].

L'agriculture dans la ville de Lubumbashi s'étend de plus en plus sur les Ferralsols, présentant une faible potentialité de production primaire au regard de leurs propriétés chimiques [4]. Les techniques de gestion de la fertilité pratiquées par les agriculteurs conduisent davantage à un épuisement rapide des sols [5]. Les éléments nutritifs exportés par les récoltes, dans des sols déjà pauvres, ne sont pas remplacés de manière adéquate [6]. Devenant de plus en plus infertiles, les sols de Lubumbashi et ceux de proximité exigent l'apport considérable de fertilisant pour y pratiquer une activité agricole rentable [7]. L'emploi des engrais chimiques est fort limité par leurs coûts relativement élevés par rapport aux revenus des agriculteurs [8]. Dans un contexte d'insécurité alimentaire, de réduction de la fertilité des sols, de fort taux de chômage causant la pauvreté de population et de la hausse des prix des engrais sur les marchés, il apparaît nécessaire d'utiliser pour l'agriculture les amendements disponibles et à faible coût [9]. Différents travaux ont prouvés que l'utilisation de biodéchets améliorée les propriétés des sols et permet l'accroissement des rendements de cultures [10]; [11]; [12]. Le compostage de biodéchets apparait comme l'une des techniques la plus intéressante pour valoriser cette matière organique [13-15]. En effet, Ce processus permet de transformer les déchets organiques en amendement organique très riche en éléments nutritifs. Et offre également des solutions très intéressantes permettant de transformer en ressource les déchets organiques [16,17]. Le présent travail a pour objectif de caractériser les biodéchets et d'évaluer leurs effets en cultures maraichères. Plus spécifiquement, il s'agira de (i) déterminer les différentes composantes de biodéchets ; (ii) déterminer la composition chimique majeure ; et (iii) comparer la croissance de végétative en fonction de quantité de biodéchets appliquée.

2 MATÉRIELS ET MÉTHODES

Deux légumes (épinard et oignon) ont été installés à la faculté des sciences Agronomiques, dans son champ expérimental. Ces légumes ont été retenus en fonction des habitudes alimentaires locales [18]. L'essai a été installé suivant un dispositif complètement randomisé et les traitements en trois répétitions comprenaient quatre doses de biodéchets (0 ; 1,75 ; 3,5 et 7 t/ha) et trois doses d'engrais minéral (0 ; 150 kg NPK + 100kg Urée et 300 kg NPK + 200 kg Urée) pour la culture d'oignon, et (0 ; 150 kg Urée et 200 kg Urée) pour l'épinard. Le poids de sol mis dans chaque unité expérimental (sachet) était de 2kg, arrosé jusqu'à saturation. Et les amendements étaient appliqués selon les traitements une semaine avant l'installation des cultures. 10 échantillons d'environ 20 grammes chacun ont été prélevés dans chaque sac de 50 kg. Par la suite, par type de biodéchets, les échantillons prélevés dans les différents sacs ont été mis ensemble pour former « un composite ». La caractérisation physique consistée, au séchage des échantillons de biodéchets, au triage et à la séparation de différents constituants de biodéchets. Les différents constituants physiques groupés en quatre types (métaux et plastiques, cailloux, sable et matières organiques ou fermentescibles) ont été pesés. Le pourcentage de chaque constituant de biodéchets a été trouvée par la formule suivante : Proportion du constituant = (poids du constituant/poids total de biodéchets)*100. Avant essai, les échantillons composites de sol et ceux de biodéchets ont été analysés au laboratoire de l'Office Congolais de Contrôle (OCC) pour déterminer la teneur en éléments chimiques majeurs. Les travaux ont débuté par la préparation des pots qui a consisté en la pesée et remplissage du sol dans les différents pots. Les biodéchets ont été appliquées une semaine avant le repiquage à différentes doses selon les traitements. Les graines d'oignon ont été semées à une profondeur de 1 cm. Pour l'épinard le semis c'est fait à une profondeur de 4 cm. Le repiquage est intervenu 45 jours après le semis pour l'oignon lorsque les plantes avaient 2 feuilles chacune et une hauteur de 120 mm par plante. Pour l'épinard le repiquage a eu lieu 30 jours après le semis dont le nombre des feuilles par plante était de 3 et 90 mm de taille par plante. Les observations ont porté sur le nombre de feuilles, la taille de plantes et le poids de feuilles ou de tubercules selon les cultures. Les données brutes sur les paramètres végétatifs observés ont été traitées par l'analyse de la variance (ANOVA) avec test post hoc (test de Tukey) pour la détermination des moyennes, à l'aide du logiciel Minitab 16.

3 Résultats

3.1 Caractérisation des biodéchets

Les résultats obtenus montrent que les biodéchets renferment une forte proportion de la matière organique, soit en moyenne 95%. Cependant, il encrés dans ces biodéchets en faible proportion de cailloux, du sable, de métaux et du plastique, et de teneurs non négligeables d'éléments chimiques majeurs y sont (tableau 1).

Tableau 1 : Composition physique et chimique du sol et de biodéchets

Eléments/Substrat	Cailloux	Métaux et plastiques	Sable	Matière organique	N	P	K
Sol	-	-	-	-	2,7	0,8	1,3
Fèces humaines	2%	0,4%	2%	95,6%	6	2,3	28,8
Fumiers de poules	0%	0%	3%	97%	6	5,71	0,57
Bouse de vaches	3%	0%	0%	97%	1,67	33,25	0,303
Déjections de porcs	7,2%	0,5%	0%	92,3%	3,68	44,92	2,172

3.2 Comportement de l'epinard et de l'oignon3.2.1. Comportement de l'épinard

Après analyse statistique, il ressort qu'une différence significative a été observée entre les traitements amendés et celui non amendé. Le nombre de feuille, la taille de plantes et le poids de feuilles ont variés proportionnellement à l'augmentation d'amendements (tableau 2).

Tableau 2. Résultats moyens la culture en pot de l'épinard

Traitements	Nombre de feuille	Hauteur (mm)	Poids de feuilles (gr)
T_0	3,33±0,57b	114,33±8,14b	4,33±0,58b
T_1	5,33±0,58ab	218,33±86ab	27±8,54ab
T_2	6,33±0,58ab	247,67±19,14ab	35,67±3,5ab
T_3	6,67±0,58ab	256,7±17,04ab	47,33±3,79ab
T_4	6±1a	294±11,14a	54±5,56a
T_5	8a	275±14a	72±6,55a
T_6	9,33±58a	305±16a	85,67±5,51
T_7	11a	320±16a	94,67±4,04a
T_8	7,33±0,57a	297,33±7,64a	67±8,18a
T_9	8,67±0,57a	286,67±13,43a	81,67±6,55a
T_{10}	10a	311,67±13,50a	89,33±4,51a
T_{11}	11,67±0,58a	328,33±7,64a	103±5,51a

Légende : T_0 : non amendé, T_1 : 1,75 t/ha de biodéchets, T_2 : 3,5 t/ha de biodéchets, T_3 : 7 t/ha de biodéchets, T_4 : 150 kg/ha d'urée, T_5 : 1,75 t/ha de biodéchets et 150 kg/ha d'urée, T_6 : 3,5 t/ha de biodéchets et 150 kg/ha d'urée, T_7 : 7 t/ha de biodéchets et 150 kg/ha d'urée, T_8 : 200 kg/ha d'urée, T_9 : 1,75 t/ha de biodéchets et 200 kg/ha d'urée, T_{10} : 3,5 t/ha de biodéchets et 200 kg/ha d'urée et T_{11} : 7 t/ha de biodéchets et 200 kg/ha d'urée.

3.2.1 Comportement de l'oignon

Le résultat obtenu après analyse, montre que le comportement de la culture dépendait des apports d'amendements. L'augmentation de nombres de feuilles et le poids de bulbes était fonction de dose croissante avec le faible niveau pour le traitement sans amendement. Pour la taille, le traitement avec 3,5 t/ha de biodéchets et 150 kg NPK + 100 kg/ha d'urée avait une élongation supérieure par rapport aux autres et le traitement sans amendement était toujours inferieur (tableau 3).

Tableau 3 : Résultats moyens sur la culture en pot de l'oignon

Traitements	Nombre de feuilles	Hauteur (mm)	Poids bulbes (gr)
T_0	3,66±0,57b	153,33±47,72b	6,67±1,15b
T_1	7±1ab	285,33±24,66ab	16±1,73b
T_2	7,33±0,57ab	323±28ab	23,33±3,06b
T_3	7,67±15ab	397,67±32,35ab	55,33±3,51ab
T_4	7,33±0,57ab	397±69,48ab	38±3b
T_5	8±2ab	481,67±83,19ab	61,33±7,02ab
T_6	11±1a	542±1a	95,33±17,39ab
T_7	11,67±1,53a	485,67±112,27ab	66,33±3,78a
T_8	9,67±0,57a	492,33±4,93ab	95±8,89ab
T_9	9,33±2,08a	481±82,61ab	113,67±4,16a
T_{10}	11±1a	503±55ab	117,67±8,02
T_{11}	12±1,73a	475±87,89ab	121,33±7,67a

Légende : T_0 : non amendé, T_1 : 1,75 t/ha de biodéchets, T_2 : 3,5 t/ha de biodéchets, T_3 : 7 t/ha de biodéchets, T_4 : 150 kg/ha de NPK + 100 kg/ha d'urée, T_5 : 1,75 t/ha de biodéchets et 150 kg/ha NPK + 100 kg/ha d'urée, T_6 : 3,5 t/ha de biodéchets et 150 kg/ha NPK + 100 kg/ha d'urée, T_7 : 7 t/ha de biodéchets et 150 kg/ha NPK + 100 kg/ha d'urée, T_8 : 300 kg/ha NPK + 200 kg/ha d'urée, T_9 : 1,75 t/ha de biodéchets et 300 kg/ha NPK + 200 kg/ha d'urée T_{10} : 3,5 t/ha de biodéchets et 300 kg/ha + 200 kg/ha d'urée et T_{11} : 7 t/ha de biodéchets et 300 kg/ha NPK + 200 kg/ha d'urée.

4 DISCUSSION DES RÉSULTATS

Les résultats montrent que les différents biodéchets contiennent une forte teneur en matière organique, résultat concordant avec ceux de nombreux chercheurs évaluant la teneur de la matière organique entre 40-90% [19]. Les fortes teneurs en matière organique que renferment les biodéchets constitue une opportunité pour leur utilisation en agriculture [20]. Les faibles teneurs de matière plastique, cailloux et métaux non élucidées par d'autres chercheurs tels que [21] pourrait s'expliquer par le fait que ces biodéchets étaient recueillis dans de lieux exposés à l'érosion et à leur exposition à l'air libre. Les quantités des éléments minéraux qu'ils contiennent permettent leur utilisation dans l'agriculture urbaine [22] et principalement celle de régions tropicales [23]. Le choix de cultures légumières était motivé par le fait que leur pratique est plus intéressante financièrement et sont activement consommées dans la zone de Lubumbashi [24]. En effet, le maraichage se caractérise par l'utilisation des variétés locales, un potentiel de rendement par unité de temps et par unité de surface très élevé [25]. Avec une croissance rapide, une valeur marchande élevée et des qualités nutritionnelles supposées meilleures à la santé par la diversification des aliments [26, 27] . Les deux cultures ont montré une meilleure adaptabilité aux apports de biodéchets eu égard à leurs produits utiles. L'explication pourrait être l'apport sélectif supplémentaire de fertilisant chimique selon les cultures [15]. En effet, la combinaison de doses d'engrais minéraux à celles d'amendements organiques favorise l'activité biologique du sol qui libérerait une quantité importante d'azote, qui contribue à l'augmentation de rendement [28, 29]. Il est vrai que, les ressources locales comme les déchets organiques et les roches naturelles, appliquées aux sols tropicaux pauvres et acides peuvent fournir les éléments nutritifs nécessaires pour l'alimentation et la croissance des plantes et par conséquent, accroître le rendement des plantes cultivées [30]. Dans le contexte de pauvreté de sols tropicaux, l'utilisation des biodéchets deviennent une nécessité compte tenue de leurs potentiels fertilisants permettant leur intégration en horticulture urbaine [31]. Leur combinaison aux fertilisants inorganiques permet une bonne valorisation de biodéchets et augmente le rendement [32]. Cette combinaison facilite la minéralisation de la matière organique, rendant ainsi les éléments minéraux disponible aux cultures [32].

5 CONCLUSION

Les résultats obtenus ont montré que les biodéchets, produits de l'assainissement, présentent des teneurs élevées en matières organiques (plus de 95%). En revanche, les résultats sur la caractérisation chimique montrent qu'ils sont potentiellement de bons fertilisants. Et peuvent tant soit peu pallier à l'épineux problème de faible productivité de sols tropicaux. Leur apport seul ou en combinaison avec les engrais minéraux permet à la fois de réduire le coût de production dû à l'utilisation d'amendement inorganique seul et améliore les qualités physico-chimiques de sols. L'utilisation de ces biodéchets apparait comme solution palliative au double problème d'insalubrité de villes Africaines et manque de denrée alimentaire suite à l'infertilité de sols.

Ces résultats confirment davantage le rôle capital que jouent les déchets ménagers dans la fertilisation des sols. Quelle que soit la culture et pour tous les paramètres étudiés, les résultats ont montré l'intérêt de la valorisation des biodéchets en agriculture en vue d'accroître les rendements des cultures.

Toutefois, le traitement préalable des biodéchets avant leur valorisation agronomique constitue un moyen sécurisé pour l'augmentation de la production des cultures maraîchères dans l'agriculture urbaine et périurbaine.

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Note préliminaire sur l'écologie et mesure de biomasse de *Prioria balsamifera* dans les Stations forestières de l'INERA de Luki et Kiyaka en RD Congo

[Preliminary note of ecology and biomass of the Station of Luki and Kiyaka, Democratic Republic of Congo Kinshasa]

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ABSTRACT: Some ecologycal parameter of natural planting of *Prioria balsamifera*, Fabaceae/ *Caesalpinioideae* is studed in Luki and Kiyaka Reserve forest of Agronomie national Institute of Studie and Seart. The floristic inventory, allometrie measures (at dbh) of all individuals of *Prioria balsamifera* and somes climatic factors, e.g annual mean of rain, temperature, atmosphic humidity, physiography and soil texture are studed. This resultants indique that 194 individuals/ha at Luki and 5 individuals/ha at Kiyaka; 190 individuals stems are arranged in the 10-40 cm diameter arrange and distinguished dead of any individuals of same diameter arranging at Kiyaka Station. The space distribution of *Prioria balsamifera* is aggregative at Luki Station and aleatory at Kiyaka Station. This terrial area gives 1144, 77 m^2 /ha at Luki Station and 6,08 m^2 /ha in Kiyaka. This 10-40 cm dbh diameter, whereas all individuals of this class of diameter are remarkably absent. An estimation of aerea biomass elevate at 75,45t/ha and 37,72t/ha carbon stock with 127t/ha at Luki Station and 42,6t/ha of aerial biomass: 21,30t/ha of the carbon stocked and 71,74t/ha at Luki of carbon equivalent at Kiyaka Station.

KEYWORDS: ecology, biomass, *Prioria balsamifera*, Station, Luki-Kiyaka, DR Congo Kinshasa.

RESUME: Les peuplements de *Prioria balsamifera* (*Fabaceae/ Caesalpinioideae*) ont été étudiés dans les Réserves forestières de Luki et de Kiyaka, Stations de l'Institut National d'Etude et Recherche Agronomiques. Les inventaires floristiques, les mesures allométriques au dbh (à 1,30 m) de tous les individus de diamètre égal ou supérieur à 10 cm ont été faites. Quelques paramètres écologiques dont densité, surface terrière, structure diamètrique, biomasse aérienne, stock de carbone et les pyramides d'âges ont été étudiés. Autres les variables climatiques dont les précipitations et les températures moyennes annuelles, l'humidité atmosphérique, le relief et les sols ont été également analysés. Les résultats obtenus indiquent 194 individus/ ha à la Station de Luki et 5 tiges / ha à la Station de Kiyaka. Les mesures de surface terrière donnent 1144,77 m^2 /ha à Luki et 6,08 m^2 /ha à Kiyaka. Les classe de diamètre 10-40 cm à Luki, tandis que tous les individus de cette classe de diamètre sont remarquablement absents. L'estimation de biomasse s'élève à 75,45t/ha ; le stock de carbone 37,72t/ha et l'équivalent carbone 127,02t/ha à Luki et 42,61t/ha de biomasse aérienne ; 21,30t/ha de carbone stocké et 71,74t/ha d'équivalent carbone à Kiyaka. La distribution spatiale de *Prioria balsamifera* est de type agrégative à Luki et elle est aléatoire à Kiyaka. Pour expliquer ce double comportement nous évoquons les paramètres écologiques : facteurs climatiques dont les moyennes annuelles de précipitation, humidité relative, le nombre des brouillards et édaphiques : relief, texture et humidité du sol.

MOTS-CLEFS: Ecologie, biomasse aérienne, carbone, *Prioria balsamifera,* Réserve de Biosphère de Luki, Station INERA Kiyaka.

1 INTRODUCTION

Prioria balsamifera (Synonyme de *Gossweilerodendron balsamiferum*) est une essence forestière d'intérêt commercial, médicinal, très exploitée comme bois de construction et en menuiserie. L'espèce est présente dans la Cuvette centrale congolaise et dans le Mayombe. Dans ces deux zones, l'espèce affiche deux comportements. Elle forme de peuplements parfois purs [1] [2] et une essence semi-caducifoliée, tandis qu'à Kiyaka, en forêt galerie et dans la Cuvette centrale congolaise, *Prioria balsamifera* présente une distribution spatiale aléatoire et un feuillage sempervirent [3].

Cette note se propose d'étudier la densité, la structure diamétrique, la surface terrière, les mesures de biomasse aérienne, le stock de carbone et les facteurs climatiques et édaphiques susceptibles d'élucider le double comportement de cette essence.

2 MILIEU D'ETUDE

La Réserve de biosphère de Luki est située dans la Province du Bas-Congo, au sud- ouest de la République Démocratique du Congo, à ± 120 km de la côte Atlantique, elle couvre la quasi-totalité du bassin hydrographique de la rivière Luki et son affluent : la Ntosi, qui ensemble se jettent dans la rivière Lukunga qui est l'un des affluents du fleuve Congo. Elle constitue la pointe méridionale extrême du massif forestier guinéo- congolais. Elle est située à 13°10' et 13°15' de longitude Est et 5°35' et 5°43' de latitude Sud, l'altitude varie entre 150 et plus de 500 m rarement 600 m [4] [5] [2].

Par contre, la Station de Recherche Agronomique de Kiyaka est située à 605 km à l'est de la ville de Kinshasa et à 75 km de la ville de Kikwit, dans la province de Bandundu. Latitude est 018° 58' 50.9'' ; longitude sud 05° 33' 59.9'' et l'altitude varie entre 400-504 m au niveau de la vallée et 735 m au plateau. La figure 1 indique la localisation géographique des sites d''étude.

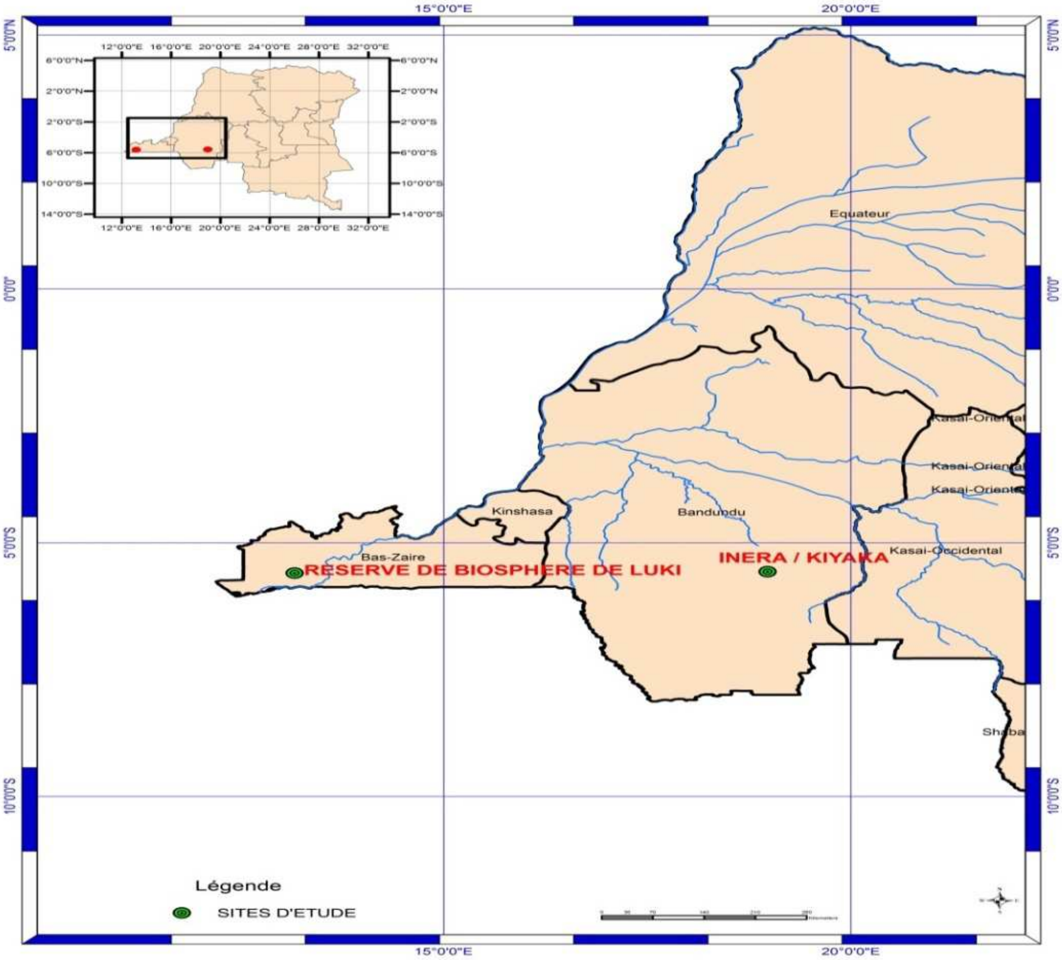


Figure 1. Localisation géographique des sites d'étude dans la carte de la RD Congo

3 MATERIEL ET METHODES

Le matériel botanique rassemblé a fait l'objet d'identification scientifique à l'aide des Flores d'Afrique Centrale, et des Flora of West. Tropical Africa. D'autres échantillons ont été identifiés par comparaison avec le matériel entreposé à l'Herbarium de l'Université et INERA. Les espèces ont été identifiées selon la révision actuelle de la taxonomique de l'APG II et III .

Un dispositif d'inventaire d'un hectare a été délimité par site pour mesurer tous les individus de l'espèce étudiée ayant un diamètre égal ou supérieur à 10 cm de dbh. Le dispositif était subdivisé en 5 bandes de 100 m x 20 m, distantes de 50 cm chacune dans une forêt à *Prioria* balsamifera. La parcelle d'inventaire réalisé a été établie selon le modèle décrite par [6]. La figure 2 indique le dispositif installé.

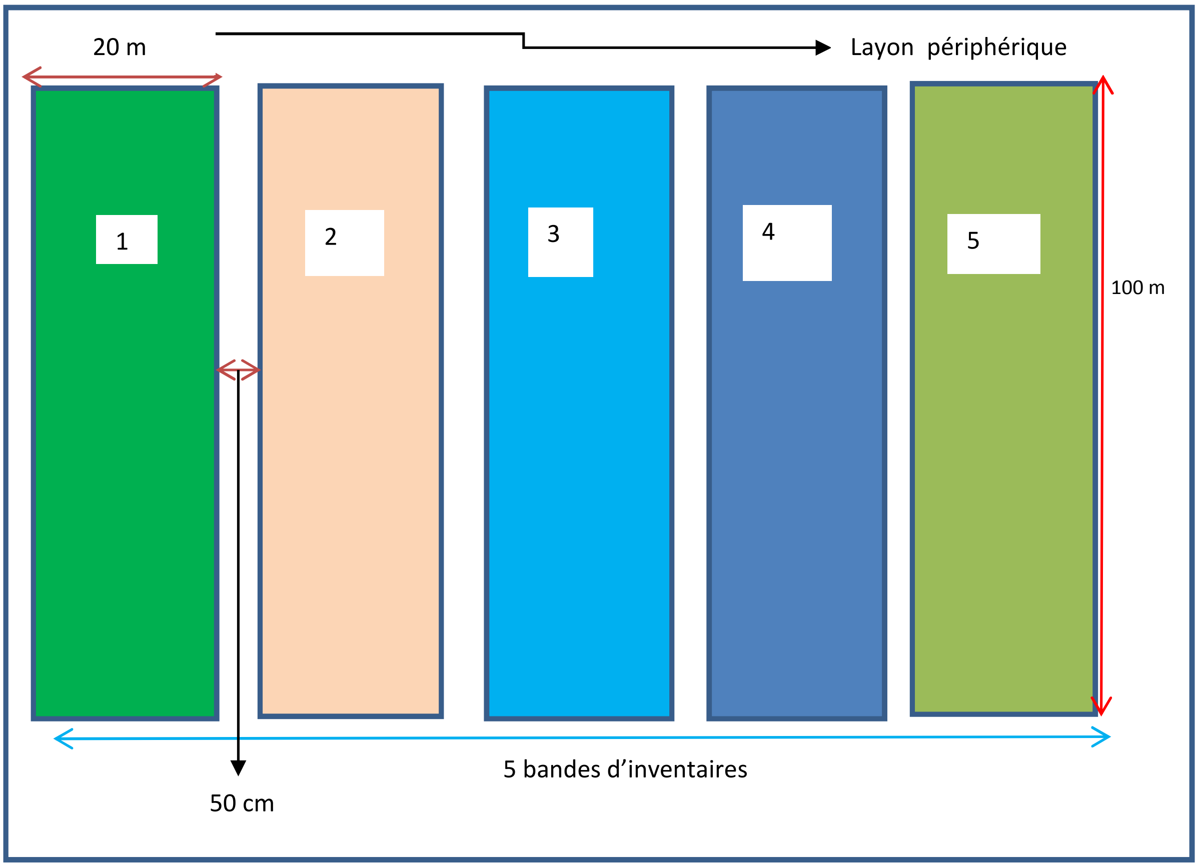


Figure 2. Dispositif d'inventaire installé dans les deux Stations étudiées

La densité du peuplement, limitée aux seuls arbres dont le diamètre au dbh a été calculé.

Les diamètres obtenus ont permis de calculer la surface terrière des arbres mesurés. La surface terrière révèle la surface du tronc d'arbre à 1,3m de sol. Elle est exprimée en m^2/ ha. Elle est calculée de manière suivante :

G = πdhp2 /4.

Où : G = surface terrière ; dhp= diamètre à 1,3m du sol de l'arbre; π (pie) = 3,14 [7] [8] [9] [10] [6].

L'estimation de mesure de biomasse aérienne a été faite à l'aide d'un seul paramètre dendrométrique qui est le diamètre à la hauteur de poitrine (dhp) tel que propose [11] [12] Ainsi la formule suivante donne le modèle mathématique pour calculer la biomasse aérienne des arbres.

AGB = exp (-0,37 + 0,333* ln (dbh) +0,933ln (dbh) 2 -0,122*ln (dbh)] [11] [13] .Domaine de validité (cm) de 5 dhp 156.

Le stock de carbone accumulé dans les arbres est obtenu à l'aide de la formule suivante : B.A x k. Avec BA = biomasse aérienne ; k = constant (0,47) [14] [3]. Pour évaluer la quantité de l'énergie contenue dans les arbres, le groupe du [15] [16] propose une formule pour calculer l'équivalent carbone. Ainsi l'Eq C= C x k ; où Eq C= équivalent carbone ; k = constant (3,667).

Pour estimer l'âge approximatif moyen des individus inventoriés dans la parcelle d'étude, nous avons inspiré de la formule proposé par [17] sur l'accroissement annuel moyen de l'espèce étudiée. L'accroissement annuel moyen (AAM) de *Prioria balsamifera* est de 0,5/ an. Ainsi pour déterminer l'âge des individus rassemblés dans le milieu naturel, la formule utilisée est la suivante :

Age = R/AAM.

Avec R= rayon de l'arbre (cm) ; AAM = accroissement annuel moyen 0, 5/an [17] .La valeur obtenue est l'âge approximatif de l'individu considéré.

Les mesures ponctuelles ont été également effectuées pour évaluer la densité des gousses par m^2 selon la distance entre la plante semencière et le lieu où les fruits ont été déposés. Des échantillons des sols prélevés ont fait l'objet des analyses au laboratoire de Pédologie du Centre Régional d'Etudes Nucléaires de Kinshasa (CREN-K). L'analyse granulométrique a été faite par gravimétrie, suivi de l'hydrométrie à chaîne telle que décrit par [18] [19] [20]. Les données climatiques ont été enregistrées dans les deux Stations. La période considérée est celle de 2002 à 2013.

Les résultats obtenus ont faits l'objet de l'analyse statistique par le test de corrélation de Pearson. Ces analyses ont été faites à l'aide du logiciel Origin version 8, et l'Analyse en Composante Principale (ACP) à l'aide du logiciel XLSTAT 2014. Le seuil de probabilité utilisé est de 5%. Le test de corrélation nous a permis de vérifier la relation qui existe entre le diamètre, le rayon et l'âge approximatif des arbres mesurés. L'Analyse Composante Principale quand à lui permet de mette en évidence les paramètres tels que le diamètre, la surface terrière, la biomasse aérienne, le stock de carbone, l'équivalent carbone et l'altitude afin de nous permettre de définir les variables corrélées.

4 RESULTATS

4.1 DENSITE

L'inventaire de la florule a permis d'identifier 194 individus par hectare de *P.balsamifera* à Luki et 5 tiges dans la Station de Kiyaka. *P. balsamifera* est fréquent et émergente à Luki et forme de peuplement. La figure 3 donne la densité de l'espèce étudiée par hectare entre les aires étudiées.

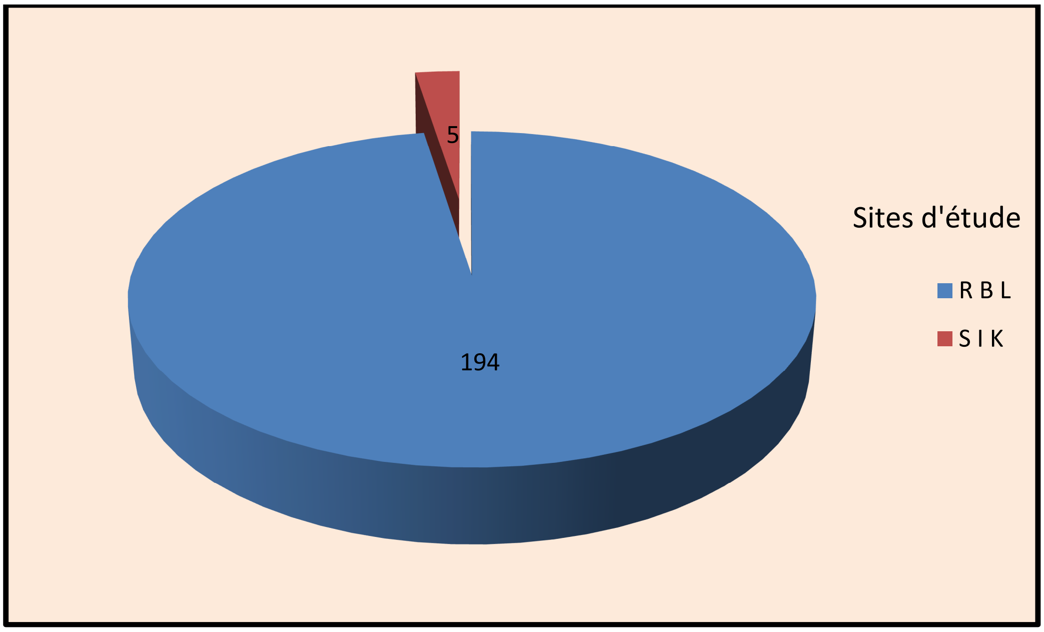


Figure 3. Densité de Prioria balsamifera par hectare selon le site d'étude.

Légende : R B L = Réserve de Biosphère de Luki ; S I K = Station de l'INERA Kiyaka.

Il ressort de cette figure que la Réserve de Biosphère de Luki compte 194 individus par hectare et 5 tiges à Kiyaka. L'espèce étudiée a une distribution agrégative et forme de peuplements dans la flore et la végétation de Luki dans le Mayombe Kinshasa.

4.2 GROUPES ECOLOGIQUES

La forêt à *Prioria balsamifera* à Kiyaka se caractérise par la fréquence et la dominance de trois espèces. Parmi lesquelles, figurent *Anonidium mannii* , *Scorodophloeus zenkeri* et *Chrysophyllum lacourtianum*. Par leur occupation spatiale et leur dynamisme, les espèces assurent à cette forêt une stabilité. Par contre, *Hylodendron gabunense* constitue le fond floristique de l'association dans la Réserve de Biosphère de Luki. La figure 4 donne la densité de principales espèces /hectare dans la Station Kiyaka.

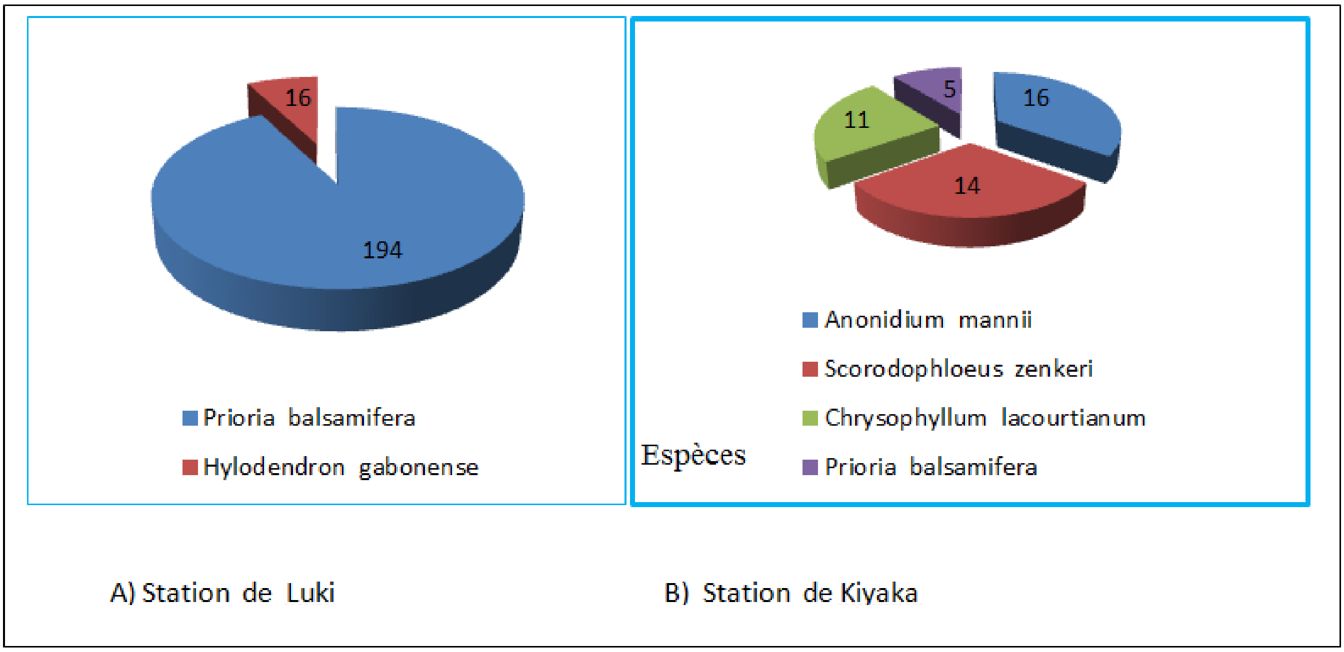


Figure 4. Principales espèces identifiées et leur densité par hectare à Luki et Kiyaka.

4.3 STRUCTURE DIAMETRIQUE DE *PRIORIA BALSAMIFERA*

Les individus identifiés n'ont pas la même structure de diamètres. Les valeurs obtenues mettent en évidence la dominance des tiges dans la classe de 10-40 cm soit 190. Les classes de 81-120 cm et 121-160 cm sont très peu fournies en individus. Le jeune peuplement montre une structure en « cloche » avec un pic dans la classe de 10-40 cm à Luki. Tandis que les valeurs enregistrées à Kiyaka, ont permis d'identifiées un seul individu dans la classe 10-40 cm ; 41-80 cm ; 81-120 cm et 2 tiges dans la classe de 121-160 cm de diamètre. Les classes mentionnées ont une mortalité très élevée, due au manque de la lumière pour permettre à la croissance de jeunes pousses. La figure 5 reprend le nombre de tiges par classe de diamètre selon le site.

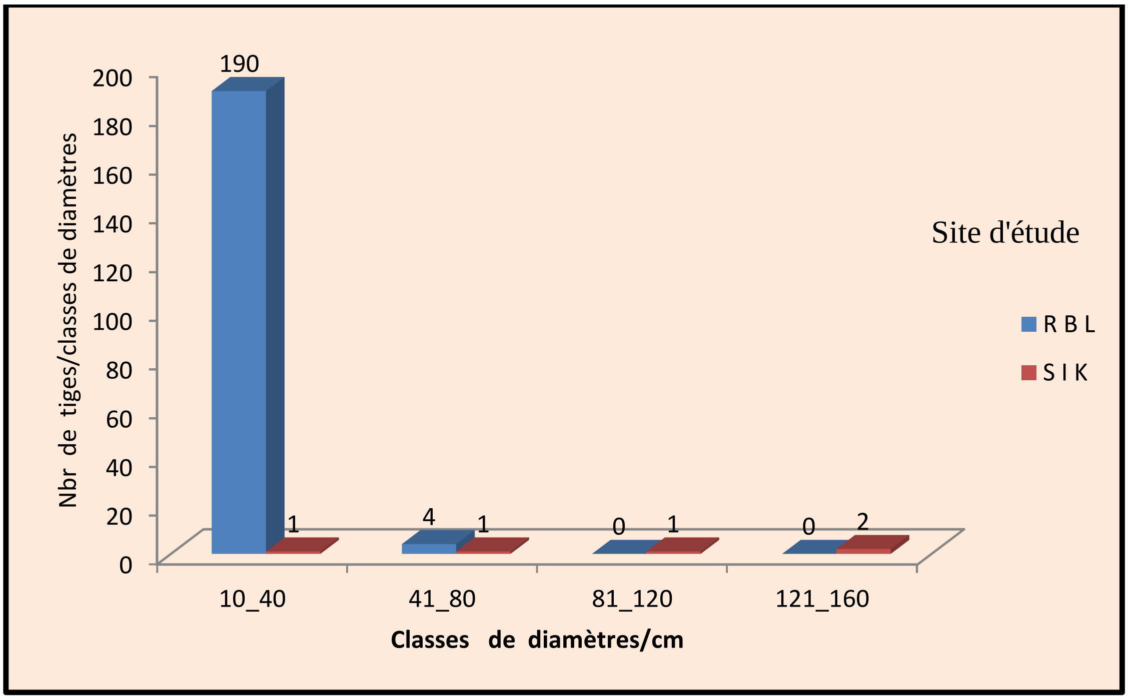


Figure 5. Nombre de tiges de Prioria balsamifera par classes de diamètres selon le site d'étude.

Légende

RBL : Réserve de la Biosphère de Luki ; SIK : Station de l'INERA Kiyaka.

4.4 Mesures Ponctuelles

La densité des fruits récoltés varie selon la distance et le site. Luki 5,03 % de fruits à l'intervalle de 0-5 m et Kiyaka 3,03 % à la même distance. La valeur supérieure est observée à Luki soit 30,15 % des gousses et 28,28 % à Kiyaka à la distance de 31-35 m. Le couvert végétal et le vent exercent une influence sur le mode de la dissémination de diaspore. Plus la physionomie est fermée moins que le vent assure la dispersion plus vaste. Moins que le couvet végétal est ouvert , plus que le vent transporte les diaspores à une grande distance. Les fruits de *Priria balsamifera* sont ailés et capables d'être emportés par le vent. La figure 6 indique le pourcentage des fruits récoltés par distance.

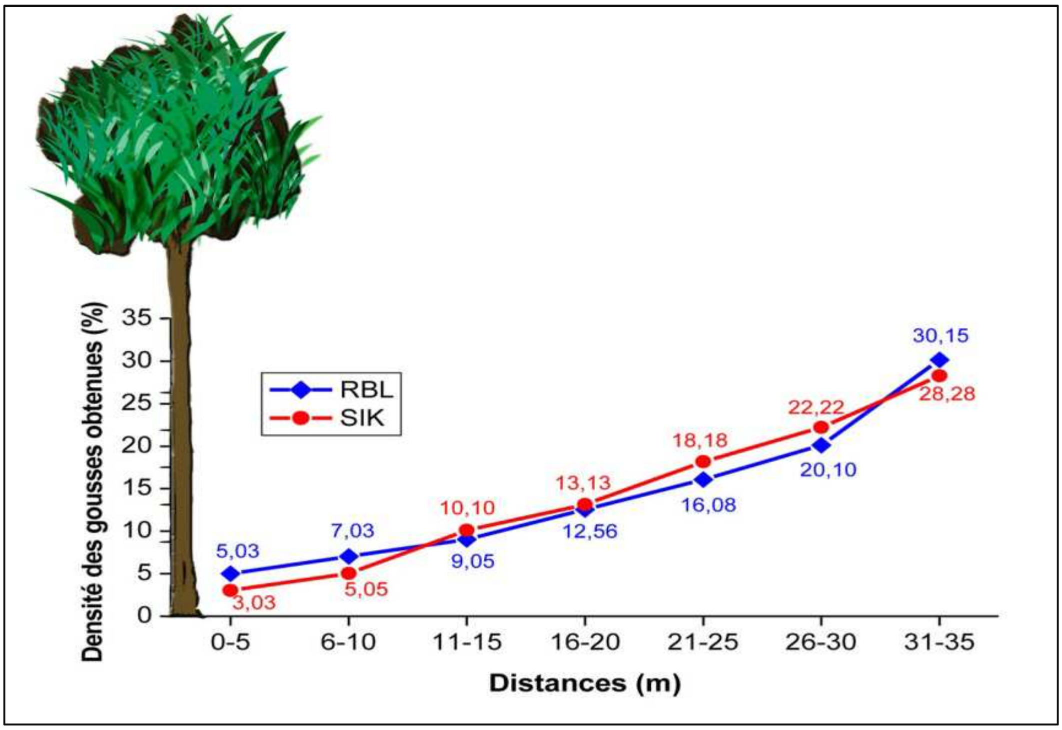


Figure 6. Densité des gousses obtenues selon la distance en %.

Légende

RBL : Réserve de la Biosphère de Luki ; SIK : Station de l'INERA Kiyaka.

4.5 ECOCLIMAT DE LUKI ET DE L'INERA KIYAKA

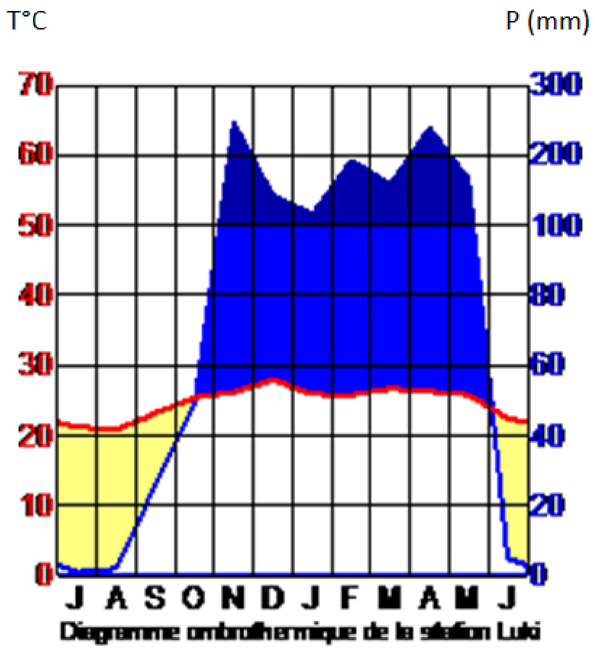
Les éléments d'appréciation de l'écoclimat proviennent des observations enregistrées entre 2012-2013 dans les deux Stations. Le tableau 1 donne la comparaison des éléments climatiques de Luki et de l'INERA Kiyaka entre 2002-2013.

Tableau 1. Comparaison des données climatiques enregistrées (2002-2013)

Facteurs climatiques	**Sites d'étude**	
	Réserve de Biosphère de Luki	Station de l'INERA Kiyaka
Type de climat	AW4	AW3
Types de saisons	2 saisons (humide et sèche)	2 saisons (humide et sèche)
Durée de saison humide	8 mois	9 mois
Durée de saison sèche	4 mois	3 mois
Mois secs	Juin, juillet, août, septembre	Juin, juillet, août,
T° moyenne annuelle	24,3°C	24°C
T° maximum	32,6 °C	28 à 35 °C
T° minimum	18,03 °C	21 à 18,30 °C
X annuelle de précipitation	1155,4 mm	1720mm
Humidité relative x annuelle	79,9 %	89 %
Brouillards matinaux	44jours	20 jours
Altitude à vallée	400 m	400-505 m
Altitude au plateau	Rarement 600 m	600-735 m

Luki est caractérisé par un climat subéquatorial avec 8 mois de saison humide et 4 mois climatiquement secs (juin, juillet, août et septembre). L'humidité relative moyenne annuelle s'élève à 79,9 %. Luki reçoit moins des pluies. Les précipitations moyennes annuelles enregistrées sont de 1155,4 mm pour les années concernées. Le déficit de précipitation est compensé par les brouillards matinaux du à l'influence de la mer. La présence des brouillards provoque la formation des gouttelettes et créer ainsi des précipitations occultes qui sont immesurables.

A l'inverse, Kiyaka jouit un climat subtropical avec 9 mois de saison humide et 3 mois climatiquement secs (juin, juillet, août). L'humidité relative moyenne obtenue est de 89 %. Les pluies sont abondantes. Les précipitations moyennes annuelles enregistrées sont supérieures à celles de Kiyaka, soit 1720 mm. L'altitude à la vallée 400 m et 600 à 735 m au plateau. Les figures 7 et 8 présentent les diagrammes ombrothermiques de deux Stations pour la période de 2012-2013.



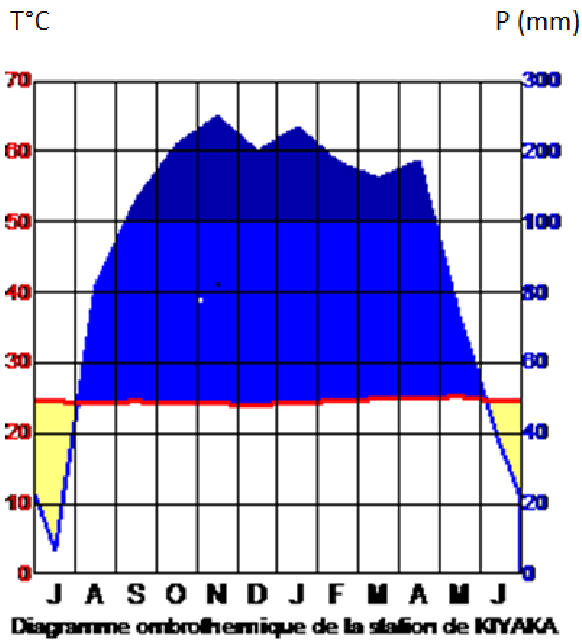


Figure 7. Diagramme ombrothermique de la Station de Luki à Figure 8. Données des précipitations et des températures de l'INERA Kiyaka (période de 2002-2013).

De cette figure, Luki est caractérisé par 8 mois de saisons de pluies et 4 mois secs. Kiyaka jouit 9 mois de saisons humides et 3 mois de secs.

4.6 Caracteristiques Edaphiques

Les résultats de l'analyse chimiques et physiques des sols prélevés dans les sites d'étude, ont permis de montrer que le sol est sableux ou sablo-argileux, contiennent assez de matières organiques mais pauvre en cations échangeables. *Prioria balsamifera* s'adapte mieux sur le sommet de collines où des pentes rarement dans les vallées où très souvent le sol est riche et humifère. Grâce a son abondance de production des fruits ailés, les fruits sont disséminés par le vent et à son caractère hémi- sciaphile, l'espèce forme parfois des peuplements à Luki . Les types des reliefs rencontrés dépendent du site. Luki est caractérisé des pentes légères, des collines, des vallées hautes ou basses et de petites montagnes. Par contre, Kiyaka est formé des plateaux, des pentes assez légères, des collines peu profondes, des vallées basses et moins profondes.

4.7 Mesure De Biomasse Aerienne, De Stock De Carbone Et D'equivalent Carbone

Les mesures de biomasse donnent 75,45t/ha ; 31,72t/ha de stock de carbone et 127,02t/ha d'équivalent carbone à Luki. Les valeurs obtenues à Kiyaka s'élèvent à 42,61t/ha de biomasse aérienne; 37,72t/ha de stock de carbone et 71,74t/ha d'équivalent carbone. La figure 9 illustre les détails des valeurs calculées.

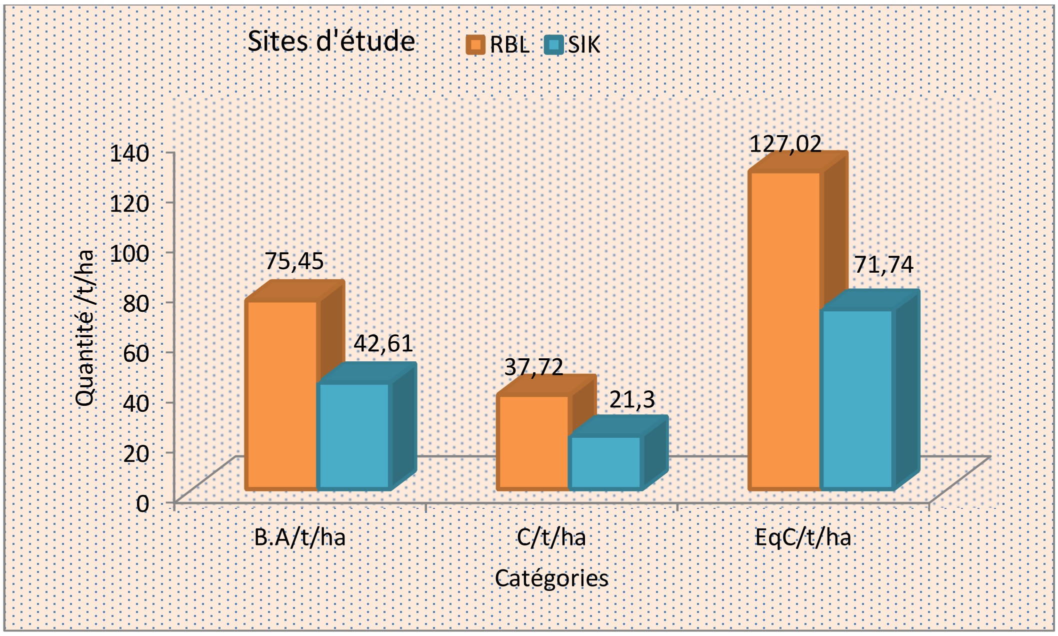


Figure 9. Détails de mesure de biomasse aérienne et de stock de carbone dans la forêt à Prioria balsamifera à Luki et Kiyaka.

Légende
RBL : Réserve de la Biosphère de Luki ; SIK : Station de l'INERA Kiyaka.
B.A=biomasse aérienne tonne par hectare ; C/t/ha= carbone tonne par hectare ; Eq/t/ha= équivalent carbone tonne par hectare.

4.8 Analyse En Composantes Principales

Les coefficients de corrélation de Pearson R, entre l'altitude et les variables dont la densité, le diamètre, la surface terrière, la biomasse aérienne et l'équivalent carbone sont donnés dans le tableau 2.

Tableau 2. Tableau des valeurs propres et pourcentages d'inertie

	Valeur propre	Variabilité (%)	% cumulé
F1	**5,949**	**84,991**	**84,991**
F2	0,978	13,977	98,968
F3	0,072	1,031	99,999
F4	0,000	0,001	100,000

Seul le premier axe factoriel est interprété, car exprimant plus de 84% de l'inertie totale. Cet axe met en évidence une corrélation positive entre la quantité du carbone, l'équivalent carbone, la surface terrière, la biomasse aérienne, le diamètre et l'âge approximatif des arbres mesurés. En revanche, aucune corrélation significative n'est établie entre toutes ces variables et l'altitude. Les valeurs calculées sont consignées dans la figure 10.

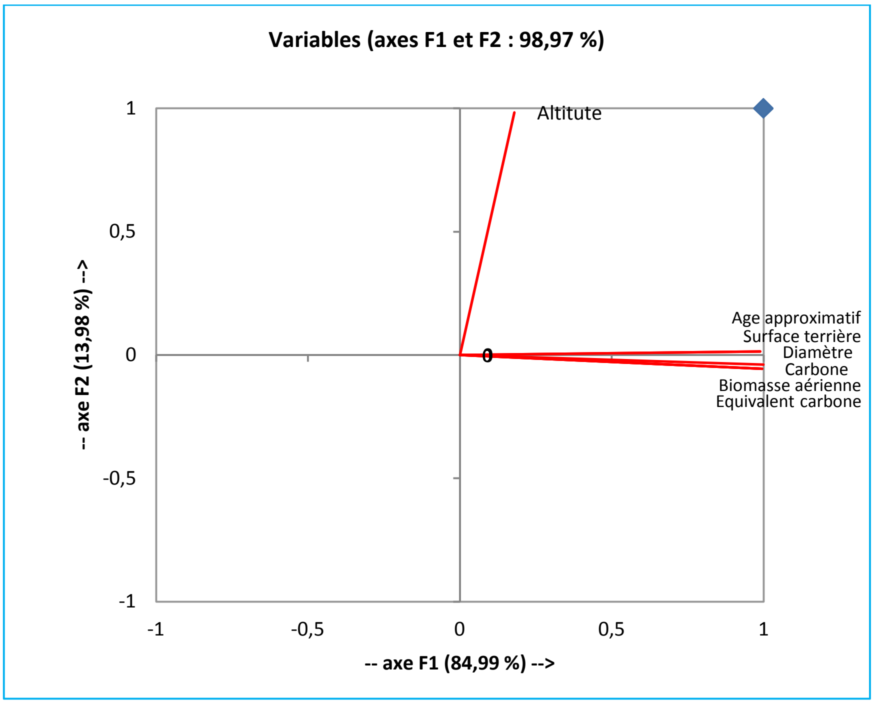


Figure 10. Représentation des paramètres sur l'espace défini par les deux premiers axes de l'ACP

4.9 Pyramides Des Ages Des Arbres Mesures

Après inventaire des arbres, nous avons reconnu 14 tranches d'âges qui sont : 10-20 ; 21-30 ; 31-40 ; 41-50 ; 51-60 ; 61-70 ; 71-80 ; 81-90 ; 91-100 ; 101-120 ; 121-130 ; 131-140 ; 141-150 ; 151-160 ans. L'âge de chaque individu calculé représente l'âge approximatif. La pyramide (a) est en forme de T à Luki. L'ordre indiqué est décroissant 118 > 51> 21> 4 respectivement pour les classes de 10-20 > 21-30>31-40> 41-50 ans. Le reste des classes sont dépourvues d'arbres à Luki. Ceci montre que le peuplement de *P.balsamifera* est jeune, en pleine croissance et développement. Par contre celle de Kiyaka(b) est en T renversé. L'ordre indiqué est croissant : 2 > 1=1=1 correspondent aux classes de 151-160 > 141-150 = 81-90 = 20-30 ans. Ainsi la distribution des individus par catégories d'âges, nous permet à définir 14 générations. La figure 11 donne les pyramides d'âge des individus mesurés à Luki et Kiyaka.

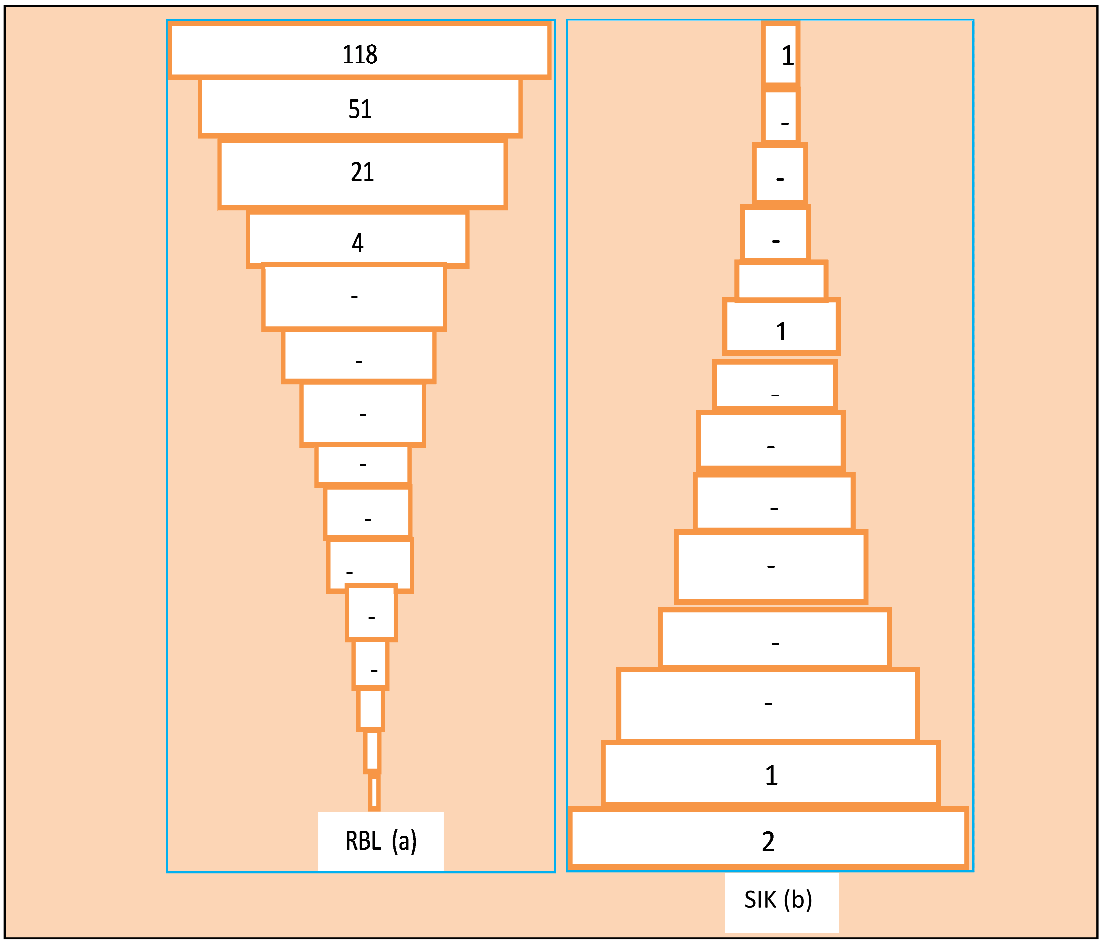


Figure 11. Pyramides montrant la distribution d'arbres par classes d'âges (an) dans les deux Stations.

RBL (a) : Réserve de la Biosphère de Luki ; SIK (b): Station de l'INERA Kiyaka.

4.10 Correlation Entre Le Rayon Et L'age Approximatif Des Arbres Mesures

Le test de Pearson appliqué montre qu'Il existe une corrélation positive très hautement significative entre le rayon et l'âge approximatif ($r = 0{,}9163$; $p < 0{,}001$). La figure 12 donne les détails de l'analyse.

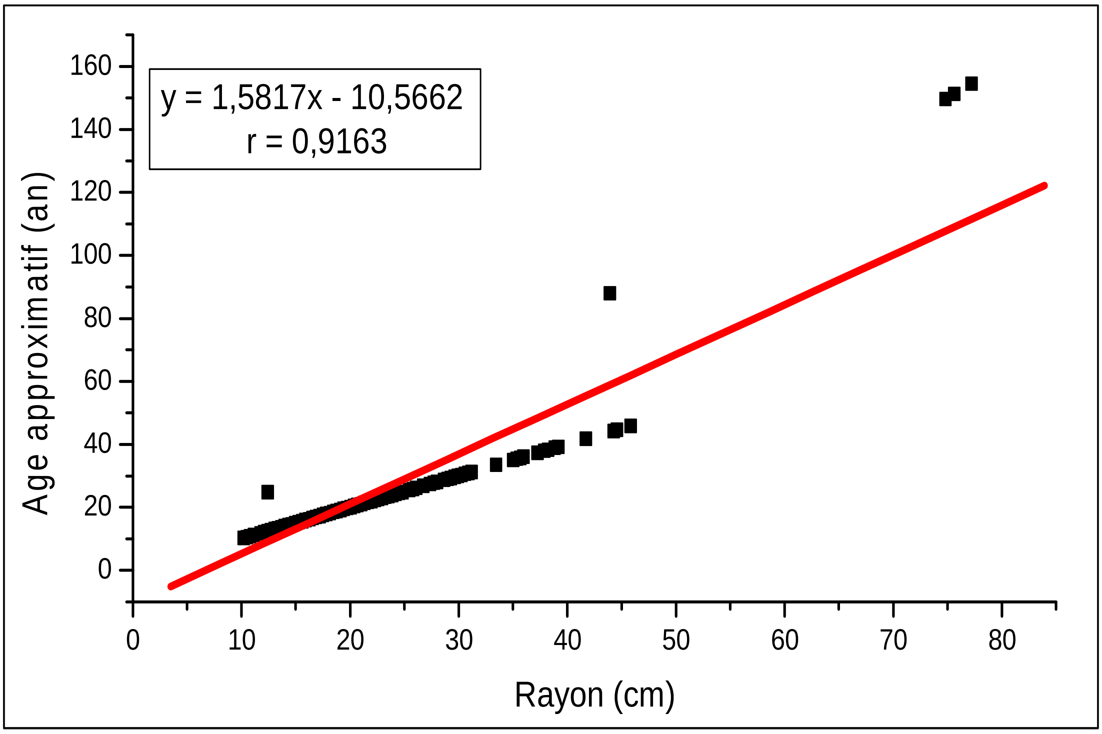


Figure 12. Représentation graphique de corrélation entre l'âge approximatif et le rayon des arbres mesurés.

5 DISCUSSION

La densité de l'espèce étudiée montre que *Prioria balsamifera* a une distribution agrégative à Luki et aléatoire à Kiyaka. Le nombre de tiges s'élève 194 individus par hectare à Luki et 5 tiges à Kiyaka. On note la prédominance des individus avec une occupation spatiale à Luki. [2] obtient 125 individus par hectare dans la Réserve de biosphère de Luki. *Prioria balsamifera* forme de peuplements parfois purs à Luki [1] [12] [2]. Les co-variables environnementales ont des influences sur la flore et la végétation de Luki. Les principaux éléments sont le climat et le relief (voir tableau 1). Les précipitations, les brouillards, la nébulosité, la variation de saison humide et sèche, le relief sont parmi les facteurs climatiques et édaphiques qui favorisent le comportement grégaire de l'espèce à Luki. Les travaux de [2] ont montré que le fléchissement des pluies est provoqué, soit par le déplacement vers l'ouest de la partie méridienne de l'équateur météorologique, soit par le renforcement de l'anticyclone sud-africain incurvé vers le nord par la trajectoire des perturbations qui est normalement Est-Ouest. Les brouillards se produisent dans la matinée. Ils sont brefs, mais au sommet des collines, ils peuvent durer jusque tard dans la matinée. Après une averse, les brouillards se produisent promptement au sommet des collines et dans les vallées. Durant la saison sèche, les brouillards atténuent quelque peu la sécheresse de l'air. Il s'agit d'une compensation écologique. En l'absence prolongée de pluies (4 mois), les brouillards constituent une source d'humidité que potentialisent les végétaux durant toute la période de sécheresse. les observations menées sur le terrain montrent que de peuplements *Prioria balsamifera* sont rencontrés sur les pentes dont le degré d'inclinaison varie entre 40 à 50 % où sur le sommet de collines. Les individus sont rares dans les vallées.

[22] affirme que le peuplement de l'espèce est du sous l'influence de caractères climatiques propres au milieu auquel, elle est adaptée. Les facteurs climatiques ont un lien de causalité entre le milieu et l'aspect de la végétation et de la flore d'une contrée. Les travaux de [23] [2] ont permis de classer *Prioria balsamifera* parmi les espèces de forêts climaciques. Ceci traduit un renouvellement du peuplement par la régénération naturelle [24]

Les mesures ponctuelles effectuées ont permis d'obtenir les valeurs divergentes. Luki, 10 - 60 fruits par m^2 ont été rassemblés à une distance de 0-35 m de porte graine et 5-28 gousses à Kiyaka. [2] récolte 61 gousses par m^2 à un intervalle de 30 m de l'arbre semencier. En raison de son fruit ailé et samaroide, d'ample gousses qui tombent germent et se fixent au fur et à mesure qu'on s'éloigne de la distance, les fruits sont ramenés par le vent. [24] classe *Prioria balsamifera* dans le groupe des essences héliophiles modérées. Au Gabon le semis de Tola s'installe préférentiellement dans le sous bois jusqu'à ce que leur croissance soit inhibée par le manque de lumière.

L'estimation de mesure de phytomasse aérienne calculée s'élève à 75,45t/ha ; le stock de carbone accumulé 37,72t/ha et 127,02t/ha d'équivalent carbone à Luki. Les valeurs enregistrées à Kiyaka font état de 42,61t/ha de biomasse aérienne ; 21,30t/ha de carbone correspondant à 71,72t/ha d'équivalent carbone. Ceci s'explique par la densité des arbres à Luki. Dans la région de Kisangani [25] les mesures de phytomaase aérienne calculées 19,7 t /ha de matière sèches dans une jachère. [26] estiment respectivement 76,7 t/ha ; 47,9 t/ha et 35,9 t/ha de matières sèches dans la forêt secondaire jeune. [25] dans la même région 12 ,7 t/ha, la production primaire nette 30,6 t/ha. [6] dans un îlot forestier à Kinshasa dominé par le peuplement forestier à *Pentaclethra eetveldeana* ; la phytomasse aérienne des arbres s'élève à 12,91 t/ha et la masse de carbone emmagasiné 6,05 t/ha de carbone.

6 Conclusion

Une note préliminaire sur l'écologie de *Prioria balsamifera* a été effectuée à Luki et Kiyaka. Les résultats obtenus mettent en évidence les rôles des facteurs climatiques sur la densité de l'espèce étudiée. Cette étude est une démarche visant à déterminer la densité de cette espèce, afin de fournir aux gestionnaires de forêts-environnement des données et des suggestions sur les mesures de gestion et de permettre la mise en œuvre des solutions alternatives nécessaires pour une meilleure exploitation durable de la ressource. Ce note ouvre la voie de combler les lacunes sur la connaissance de l'écologie de l'espèce étudiée dans son aire de répartition géographique en Afrique Centrale en générale et en République Démocratique du Congo en particulier.

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One bath cationization and dyeing of cotton fabric with Brazilwood natural dye

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ABSTRACT: Cotton fabrics were cationized with a cationic agent (Chromatech9414) then dyed with Brazilwood natural dye using ferric chloride as a mordant in one bath at three stages by exhaustion method. This process successes to impart cationic sites on cotton fabrics surface which improve its substantivity to natural dye beside save energy and water. The effect of (Chromatech9414) concentration on the nitrogen content was studied. Factors affected the dyeing stage such as dye conc., pH value, temperature and time of dyeing were investigated.The effect of cationic agent concentration and ferric chloride conc. on the colour strength of dyed cotton fabric with Brazilwood natural dye were observed. The best results were obtained at 8% Brazilwood natural dye, pH6 , 60 min., 60^{o}C for dyeing stage at 6%(Chromatech9414) and 8g/l ferric chloride. The effect of mordant, dyeing pH and cationic agent concn. on the colour hue were also investigated .The wettability and the fastness properties of dyed samples were assessed.The changes in the fiber surface, by cationization ,were evaluated using scanning electron microscopy(SEM).

KEYWORDS: Cotton fabric, *Brazilwood*, cationization, dyeing, one bath, colour strength, colour hue, colour fastness properties.

1 INTRODUCTION

Natural dyes are known for their beautiful, soft and multi-hued shades. There is a considerable current interest in the dyeing of textile fibers with natural dyes on account of their compatibility with the environment and because of their generally lower toxicity and allergic reaction. [1]

Nevertheless, dyeing with natural dyes has some problems such as low reproducibility, low dye exhaustion and poor fastness. In order to improve the dye uptake and color-fastness, most of the dyeing processes were conducted by adding metal-based mordants. There are several reports in the literature pertaining to the application of natural colorants and evaluation of their dyeing properties on various fibers using mordanting [2-9]

There are only few reports available on the chemical modifications of cotton textiles for the improvement of their dyeability with natural dyes [10]

The pre-cationization of cotton fabrics with different cationic agents was studied in many researches to enhance its substantivity to natural dyes. [11-14] The combination effects of dyeing with a vegetable mordant dyes and pretreatment with a cationic agent for deep dyeing on the cotton material were investigated. [15]

Brazilwood (often known simply as “brazil”) is a tropical hardwood of the family Leguminosae whose core yields a brilliant red pigment ideal for dyeing cloth.Brazilwood is a creamy color when first cut, but once it has been reduced to sawdust and soaked in water for several weeks, the dyestuff leeches into the solution and can be used to produce the fashionable red clothing particularly favored in the French court.

Although the name is of uncertain origin, “brazil” is thought by some to be derived from brasa, the Portuguese word for a red-hot coal. More likely the term was adopted from the common name for an East Indian dyewood called “bresel wood” which was first imported to Europe in the Middle Ages. [16]The chemical structure of brazilwood presented in **Figure (1):**

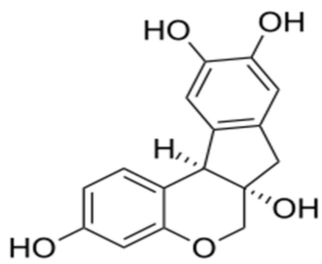


Fig. 1. C.I.Natural Red 24 (brazilin natural dye)

The driving force behind the chemical finishing of cotton during the next 10 years is anticipated to comprise several factors. Of these factors, mention is made of the following: (i) chemical finishes which maximize the added value; (ii) chemical finishes which are friendly with the environment; (iii) methods which are convenient for application, and (iv) the need for better quality and minimum use of water and energy.[17]

This work is aimed to improve the dyeability and the fastness properties of cotton fabrics dyed with brazilwood by using cationic agent (chromatech 9414) and ferric chloride as a mordant at the same bath in three stages. Using convenient dyeing method with saving water and energy by the integration of the three steps(cationization- dyeing-mordanting) in one bath.

2 EXPERIMENTAL

2.1 MATERIALS

2.1.1 FABRIC

A scoured and bleached 100% knitted cotton fabrics (260 gm/m^2) were received from Delta Textile Egypt Company, Cairo, Egypt and used throughout this study.

2.1.2 NATURAL DYE

Brazilwood natural dye used in this study is a commercial product in powder form imported from Toblamas Co.,USA.

2.1.3 CHEMICALS AND AUXILIARIES

Cationic agent: (Chromatech 9414) is a modified polymeric cationic compound produced by Chromatech Co., England.

Dispersing agent: (Ebcasperse RJL) is a solution of fatty acid ester and nonionic dispersing agent produced by Egyptian British Co., Egypt.

Mordant: Ferric chloride ($Fe\ Cl_3$) from Morgan Chemical Ind.Co., Egypt.

Non ionic detergent: (Chromatech 3QJ) supplied by Chromatech Co. England .

2.2 METHODS

2.2.1 DYEING PROCESS

Exhaust dyeing method was used in this study by using laboratory-beaker dyeing machine- Rapide- China. Cotton fabrics were dyed with Brazilwood natural dye after cationizing with (chromatech 9414) and then were mordanted with ferric chloride in one bath through three sequence stages as follows:

First stage (cationization): cotton fabrics were introduced into the bath which contained (chromatech 9414) 0-10% o.w.f at L R 1:50, the pH was adjusted at 6.The treatment was started at 40^{o}C where the temperature was gradually raised to 60^{o}C within 10 minutes. The cationization stage was continued for 30 min.

Second stage (dyeing): the Brazilwood natural dye (2-10% o.w.f) and the 2g/l dispersing agent were added to the bath at pH (6-9), temperature (60-90^{o}C) and the dyeing process was continued for (30-90min.)

Third stage (mordanting):ferric chloride was added to the bath at different conc. (2-10 g/l) at pH6 after which, the dyeing was continued for another 30min. at 60°C.

After dyeing the samples were removed and soaped at 50 °C , for 15 min with 1g/l non-ionic detergent. Further, the samples were rinsed with hot and cold water and air dried.

The three stages (cationization- dyeing – mordanting) were carried out according to process presented in **Figure (2)**.

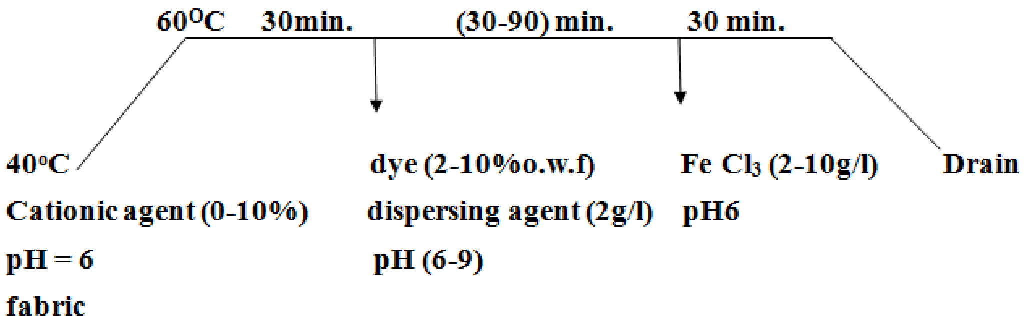


Fig. 2.

2.3 Measurements and testing

2.3.1 Colour measurements

The colour strength of dyed cotton samples were measured by using reflectance spectrophtometer model Datacolor Spectrophotometer SF600+Datacolor Company, U.S.A.

The colour strength expressed as K/S values was assessed by applying the Kubelka Munk equation: [18]

$$K/S= (1- R)^2/2R$$

Where K and S are the absorption and scattering coefficient respectively, and R is the reflectance of the dyed fabric.

2.3.2 Determination of nitrogen content percentage

Nitrogen content of the cationized fabrics was determined according to kjeldahl method[19].

2.3.3 Determination of wettability of cotton fabrics

This test was intended for use in determining the effect of cationic agent conc. on the rate of absorption of cotton fabric. This test was carried out by putting drop of water on the fabric surface and calculating the passed time until the fabric absorbed the water drop.

2.3.4 Scanning electron microscope analysis

Fibers samples previously coated with gold in vacuum coating unit were viewed under scanning electron microscope (JE 100 s), at different magnification .Control fabric was also examined for comparison.

2.3.5 Colour fastness

Fastness properties of dyed samples were tested according to ISO standard methods. The specific tests were: ISO-X12(1987), colour fastness to washing; and ISO 105-E04, colour fastness to perspiration. The dyed samples were subjected to tests, for fastness to light by AATCC test method 16-1993.

3 RESULTS AND DISCUSSION

3.1 EFFECT OF CATIONIC AGENT CONCENTRATION ON NITROGEN CONTENTS

To obtain the effect of cationic agent concentration on the nitrogen contents of cotton fabric , tests were carried out for samples cationizedwith different concentrations of cationic agent ranging from (zero to10% o.w.f) .The results obtained were cited in **Table(1)**. It was found from the results that the nitrogen content was gradually increased as the concentration of cationic agent increased resulting in the formation of cationic sites on the surface of cotton fabrics which fit directly proportional with the cationic agent concentration .The increase in the nitrogen content of the fiber was accompanied with an appreciable increase in colour strength of dyed fabric.

Table 1. Effect of cationic agent concentrations on the nitrogen content

Cationic agent conc. %(o.w.f)	Nitrogen content
zero	Zero
2%	0.05
4%	0.07
6%	0.25
8%	0.26
10%	0.21

3.2 EFFECT OF CATIONIC AGENT CONCENTERATION ON COLOUR STRENGTH

To evaluate the effect of (Chromatech 9414) concentration on the colour strength(K/S) of dyed cotton fabric with Brazilwood natural dye, three stages of cationization , dyeing and mordanting were applied in one bath using various concentrations of cationic agent ranging from 0to10% o.w.f at constant conditions of dyeing and mordanting processes ,the results were cited in **Figure (3)**. It was found from the results that the colour strength increased as the concentration of cationic agent increased till reach 8% after which the K/S was slightly decreased . The decrease in K/S as a result of increasing the concn. of cationic agent over 8% may be attributed to the electrical repulsion between the excess concn. of cationic agent in the bath and the positively charged fabric surface. The presence of excess cationic agent in the bath enhances the attraction between some natural dye and the cationic agent leading to minimizing the rate and degree of dye exhaustion.

Cationization of cotton made the fabric receptive to the natural dye which usually has low or no affinity for cellulosic materials. The color strength was found to increase from (4.53) for the uncationized fabric to (8.09) for cationized cotton when dyeing with brazilwood natural dye. This great change in the dyeability is attributed to the introduction of amine groups in the structure of cotton which play an essential role in determining the rate and magnitude of dye exhaustion. Therefore, the sorption of the ionized natural dyes by the cationized cotton fabric will be dependent on the number of bound amine nitrogen available for ionic attraction between positively charged nitrogen atoms and the negatively charged dye anions. [20,21]

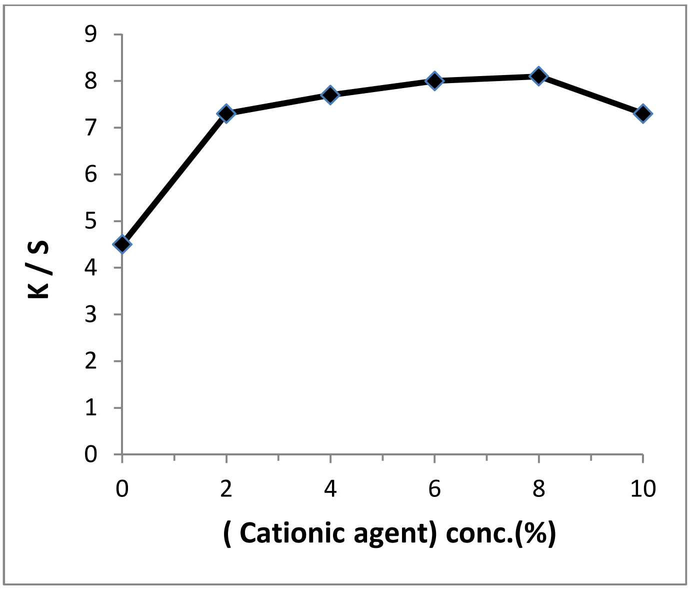


Fig. 3. ***Effect of cationic agent conc. on the color strength of cotton fabric dyed with Brazilwood natural dye.***

Dye bath contents:4% dye concn.– x% cationic agent –5g/l mordant – temp.60^{o} C- time 30/60/30min. (which represent the time of each one of the three stages) – pH 6 – L.R 1:70.

The rate and degree of ionic attraction between dye and fibre will depend to great extent on the following factors:

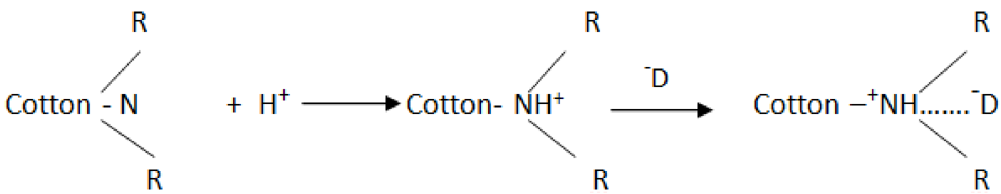
1- The hydrophilicity and magnitude of negative charges on dye molecules (No. of ionized –OH groups)

2- The molecular weight of dye molecule.

3- The number of cationic sites on the fibre available for ionic attraction with the natural dye.

4- The degree of protonation of nitrogen atoms on cationized cotton fabric.

The great enhancement in the dyeability of cationized cotton towards the natural dye under the dyeing condition is essentially attributed to ionic attraction along with the physical forces of attraction.



3.3 FACTORS AFFECT THE DYEING STAGE

3.3.1 EFFECT OF DYE CONCENTRATION

Cotton fabrics were dyed with different concentration of Brazilwood dye, i.e 2-10% (owf) to determine the effect of dye concentration on the color strength(K/S)of dyed cationized cotton fabric. The dyeing were carried out under fixed condition of cationic agent conc., pH, temperature, time, ferric chloride conc. , liquor ratio and the results are cited in **Figure(4)**.

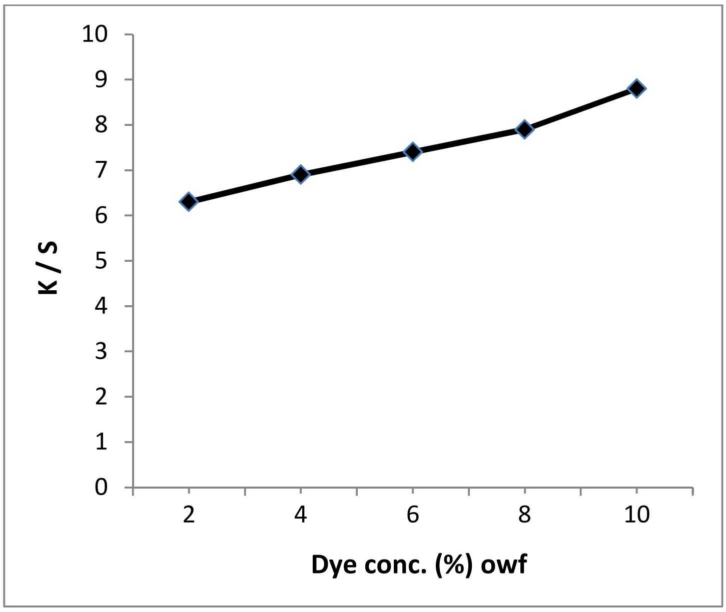


Fig. 4. Effect of Brazilwood natural dye conc. on the color strength (K/S) of dyed cotton fabrics

Dye bath contents: x % dye conc. -6% cationic agent 5g/l mordant – temp.60^{o} C- time 30/60/30min. – pH 6 – L.R 1:50.

It can be observed from **Figure(4)** that the color strength (K/S) increases as the concentration of dye increases which may be attributed to greater attraction between the positive charge on cationized cotton fabric and the anionic Brazilwood dye which depends on the hydroxyl groups found in its structure .Increasing of dye conc. In the dye bath means the existence of greater number of dye molecules available of adsorption on fibre surface to occupy the positively charged dye - sites with formation of ionic bonding .This increased number of dye on cotton fabric results in realizing higher color yield (K/S). It is clear that presence of cationic groups on cationized cotton fabrics lead to more attractive sites of sorption for anionic dye by electrostatic attraction.[20, 21]

The degree of saturation of these positive sites on fibre surface will depend on the dye conc. in the dye bath and the exhaustion percentage.

3.3.2 EFFECT OF PH VALUES

The dyeing properties of any substrate depend on its physical and chemical properties. The physico- chemical properties of the dyeing process such as, dyeing equilibrium ,degree of exhaustion and rate of dyeing are pH- dependent

The cationized cotton fabrics have a number of functional groups such as hydroxyl and amine groups which are very sensitive, during their dyeing, to variation of pH of the dye bath.

In order to investigate the influence of pH on the adsorption capacity of cationized cotton fabric using 8% Brazilwood dye, experiments were conducted under different pH values from 6 to 9 to evaluate the effect of pH on the dyeing stage during continuous operation of cationizing, dyeing and mordanting. The results are presented in **Figure (5)**.

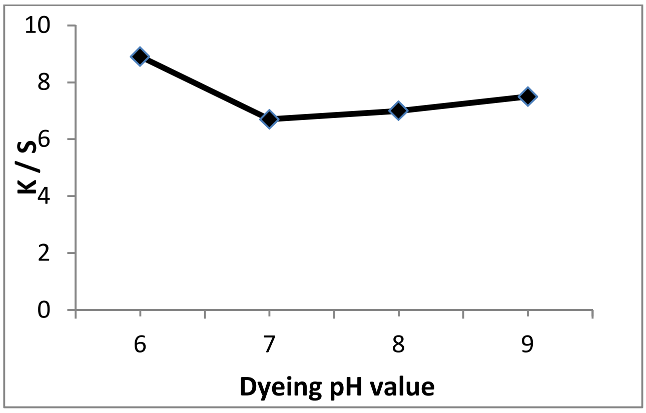


Fig. 5. Effect of pH of dyeing on the color strength (K/S) of cotton fabrics dyed with Brazilwood dye

Dye bath contents: 8% dye conc. – 6% cationic agent – 6 g/l mordant– temp.60^{o} C- time 30/60/30min. – pH x – L.R 1:50

It was found that the highest adsorption capacity of cationized cotton fabrics was achieved at pH 6 .Basically, the mechanism of dyeing with Brazilwood natural dye is associated with ionic interactions between dye anions and positively charged basic groups present in the cationized cotton fiber .The highest dyeability of cationized cotton in acidic medium arises from an increase in the protonation sits on the fabric surface, to be capable of attraction with ionized Brazilwood dye.Therefore under slight acidic condition there was high electrostatic interaction resulting in achieving maximum color strength [22].

It was found that the adsorption capacity decreased clearly by increasing the pH of dyeing. This observation indicates that at pH > 6, there is reduction in electrostatic interaction between dye molecules and cationized cotton fabrics due to the presence of few protonated binding sites on cotton surface.

3.3.3 Effect of dyeing temperature:

Temperature plays an important role in dyeing because at high temperatures dyes may undergo chemical degradation and at low temperatures, incomplete dyeing may occur. Moreover the dyeing equilibrium may also be altered under the action of variation of temperature. The effect of temperature on the dyeability of the cotton fabrics dyed with Brazilwood natural dye was conducted at different temperatures 60-90°C and the results of K/S measurements are illustrated in (**Figure 6**).

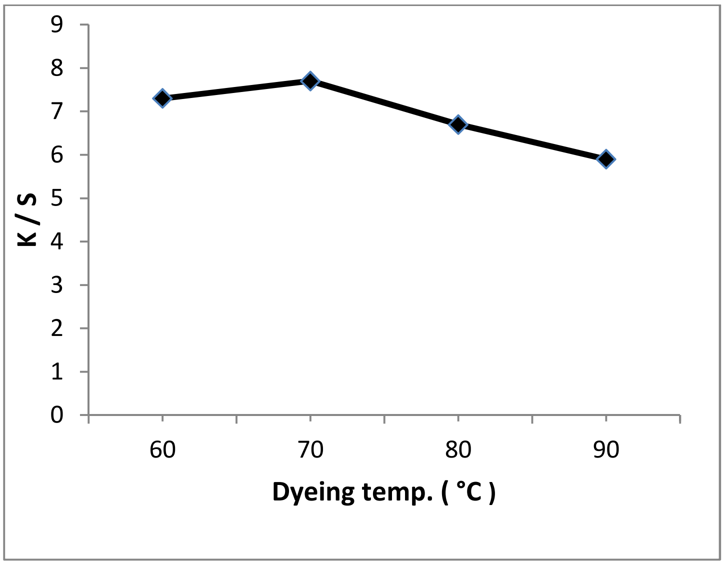


Fig. 6. Effect of dyeing temperature on the colour strength (K/S) of cotton fabrics dyed with Brazilwood dye

Dye bath contents: 8% dye conc. – 6% cationic agent – 6 g/l mordant-temp. x ° C-time 30/60/30min. – pH 6 – L.R 1:50 .

It was noticed, from Fig. 6, that the dye uptake and subsequently the K/S increases with raising the temp. and reaching its maximum value at 70°C beyond which a such decrease in K/S is carried out.

At 70°C the affinity of dye molecules to the cellulosic fabric was maximum and even dyeing was observed .However, the decline in shade depth after 70^{0}C of dyeing temperature could be due to the loss of affinity for substrate with the increase in temperature as a result of desorption of some cationizing agent to the dyebath specially with the presence of dispersing agent.Raising the dyeing temp.may function also as a disaggregating factor for natural dyes, enhancing their solubilities in the aqueous solution and accelerate their rates of diffusion and adsorption on the fibre surface .The chosen temperature for dyeing stage was 60^{0}C .

3.3.4 EFFECT OF DYEING TIME

Time of dyeing process is very important parameter because long- and short-time dyeing gives the same effect as the variation of temperature.During constant heat for a long-time, decomposition of the dye material might occur while short-time causes incomplete dyeing. [23] The influence of dyeing time on the color strength values of dyed cotton fabric with Brazilwood displayed in **Figure (7)** . The higher color strength was observed at 75min. that because a longer time provides better opportunity for better contact among the reactants and, therefore, a higher extent of reaction, but 60 min. was chosen to save time.The decline in the dyeability after 75 min. may be attributed to the desorption of the dye molecules as a consequence of long dyeing time .

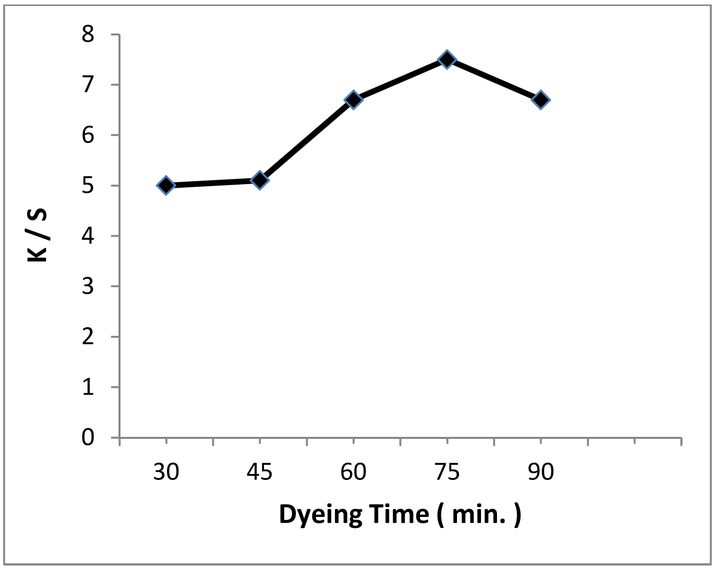


Fig. 7. Effect of dyeing time on the color strength (K/S) of cotton fabric dyed with Brazilwood dye.

Dye bath contents: 8% dye conc. – 6% cationic agent – 6g/l mordant – temp. 60 °C- time 30/ x / 30min. – pH 6 – L.R 1:50.

3.3.5 EFFECT OF MORDANT CONCENTRATION

Mordants play an important role in natural dyeing because they usually have substantivity for both the fiber and the colorants. They form coordination bonds with fiber and at the same time, form insoluble chelate with the dye.

Chemically, mordants are defined as polyvalent metallic compounds that can form coordinate and covalent complexes with certain dyes and fibers. Thus, the metal atom typically forms both a covalent bond with oxygen of hydroxyl or carboxyl groups on the dye (or fiber) and a coordinate bond with an adjacent lone pair of electrons on a double-bonded oxygen. Mordants can chelate several dye molecules together to create a larger complex and provide a link between the dye and fiber. [24]

For studying the influence of mordant conc.on the obtained colour strength which will be altered as a result of metal complexation reaction inside the fibre, different mordant concns. were added to the dyebath (after dyeing for 60 min.).The mordanting was carried out for 30 min. at constant conditions of pH and temperature.

From the results in Fig. 8, it is observed that mordanting or fixing agents, resulting in greater depth of shade and colorfastness specially at 4% of ferric chloride, after this concentration the value of K/S almost constant. In the case of simultaneous dyeing and mordanting method, some of the dye is lost because of the formation of an insoluble complex in the dyebath itself. On the other hand, during post-mordanting some of dye is stripped out in the bath and subsequently forms an insoluble complex with metal ions in the solution. These phenomena lead to a decrease in the effective dye concentration in the dyebath [25].

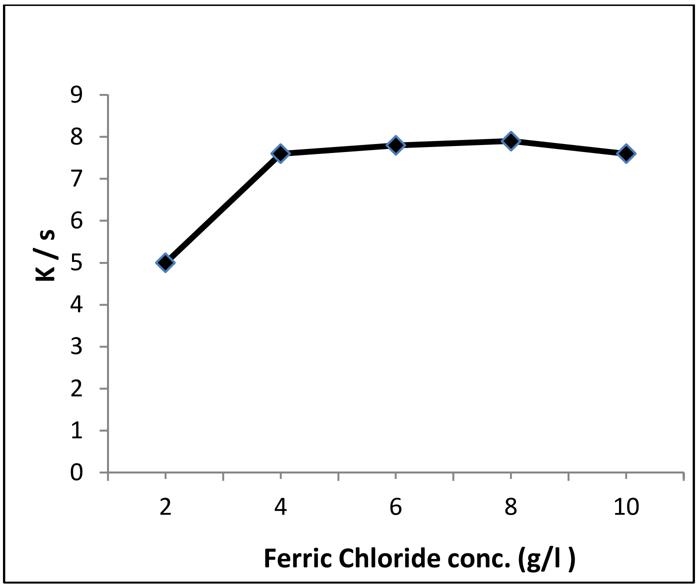


Fig. 8. Effect of mordant conc. on the colour strength (K/S) of cotton fabrics dyed with Brazilwood dye.

Dye bath contents: 8% dye conc. –6% cationic agent – x g/l mordant –temp.60^{0}C- time 30/60/30min. – pH 6 – L.R 1:50

3.4 COLOR HUE VARIATION

One of the problems encountered during the dyeing with natural dyes is their high sensitivity to some parameters, which may affect the obtained colour hue.

During this study a serious trial is made to shed light on the relationship between some parameters and variation of the received color hue. Hue is defined as the quality of color described such as green or red. The colour component of the dyed cotton samples were measured since the values of a*, b* were determined since a* indicates the degree of redness-greenness while b* is the indicative of the degree of yellowness- blueness. The increased values of a*, and b* define more reddish, and more yellowish, respectively, the a*, b* values can explain the difference in each shade. [26]

Some factors can affect the color hue of cotton fabrics such as using mordant, pH of dyeing and cationic agent concentration. The results of measurement of a* and b* are illustrated in **Figures (9-11).**

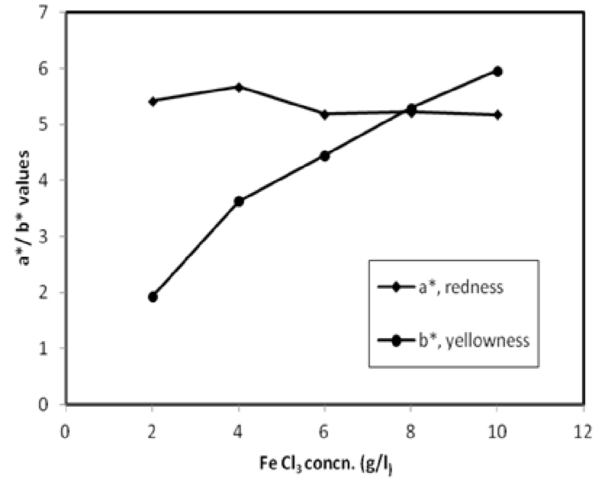


Fig.(9): Effect of Fe Cl_3 concn. on the colour hue of cotton fabric dyed with Brazilwood dye

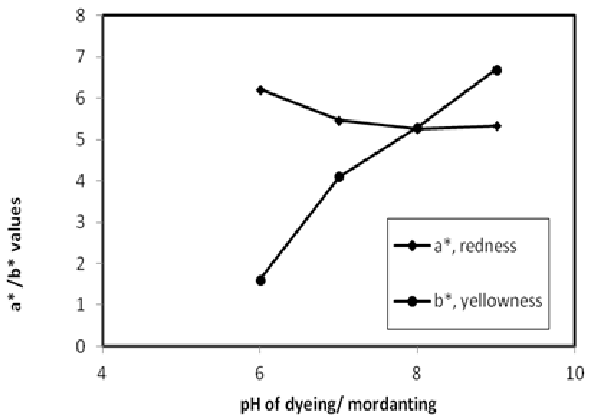


Fig. (10): Effect of pH value of dyeing on the colour hue of cotton fabric dyed with Brazilwood dye

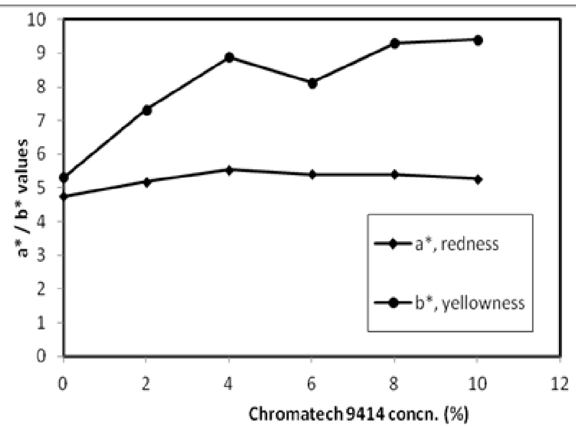


Fig. (11): Effect of Chromatech 9414 concn. on the colour hue of cotton fabric dyed with Brazilwood dye

It can be noticed from the figures that the b* value was increased as increasing of the three factors which means more yellowness, while a* value was increased by increasing of cationic agent concentration with more redness , but it was decreased with the other two factors .

3.5 DETERMINATION OF THE WETTABILITY OF COTTON FABRIC

To evaluate the effect of cationic agent conc. on absorbability of cotton fabric, the wettability of the treated fabrics with cationic agent were carried out at different concentration (0-10% owf) comparing the result with the blank (scoured and bleached sample). The data are illustrated in **Table 2**, the wettability of blank cotton fabrics was high compared with the treated samples which showed decreasing in the wettability as the concentration of cationic agent increase and that may be because of the cationic agent coat the surface of the fabric which affect its wettability. On cationically modified cotton fabrics, water retention value is minimally reduced because cationization occurs mainly on primary hydroxyl groups of C-6 atom of cotton cellulose, so certain number of functional groups is blocked for water molecules. The formation of a layer of cationic polymer on the outer fiber surface will also suggested to prevent the ease penetration of water molecules inside the polymer chains of cotton fiber resulting in slight decrease in wettability.

Probably, the fabric pore structure is slightly changed, resulting also in slightly reduced water retention values. Very small change of hydrophilicity of cationized samples cannot negatively affect cotton fiber swelling during dyeing. [20]

Table 2: Effect of the cationic agent conc. on the wettability of treated cotton fabric

Cationic agent conc.%	Wettability (absorption time of water drop)
0	1 sec.
2	5 sec.
4	8 sec.
6	19 sec.
8	27 sec.
10	28 sec.

3.6 SURFACE MORPHOLOGY OF COTTON FIBRES:

The microscopic examination by scanning electron microscopy was carried out seen to confirm the cationization action on the surface of cotton fabrics. The observed morphological changes can be seen in **Figure 12 (a-b).**

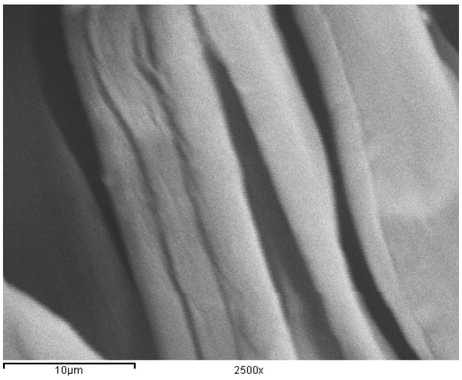


Figure (12a): untreated cotton sample

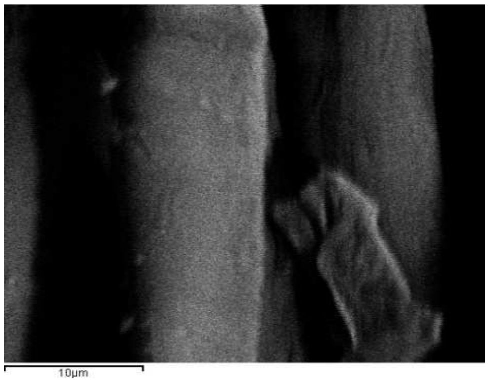


Figure (12b): treated cotton sample

Figure 12(a) shows a micrograph of untreated cotton fiber surface where Figure 12(b) depict micrograph of cationized fiber surface. It can be noticed, based on these micrographs, that there are some changes in surface morphology, though the cationized fiber surfaces are slightly rougher than that of untreated cotton fiber,due to the formation of polymer film on fibre surface as shwon in figures (a-b).

3.7 EVALUATION OF THE NEW ONE- BATH METHOD

To evaluate the efficiency of the new process, the concns. of materials and application conditions that were used in the one – bath process were applied by the conventional two – baths process in which cationization was performed in a separate bath and dyeing in a second fresh bath.

The obtained results of K/S were (7.85) for one – bath and (7.9) for the conventional two – baths. These results confirm the high efficiency and applicability of the new one – bath method compared to that of the conventional two – baths method.

3.8 FASTNESS PROPERTIES

The color fastness properties of cationized cotton fabrics dyed with Brazilwood in one bath and in two separate baths are evaluated **.**The results of wash-fastness (WF), perspiration (PF) andlight fastness (LF) of dyed fabric with and without cationic agent are shown in **Table 3.** The fabrics were compared with grey scale to obtain the color change compared with fabric before testing. The specimens of dyed fabrics were attached with multifiber fabric consisting of wool, polyester, polyamide, acrylic, cotton, and cellulose acetate. The color changes of the dyed samples as well as the staining of the multifiber fabrics were assessed using the grey scale and the results are shown in **Table 3**.Prespiration and light fastness for dyed cationized and uncationized samples show results ranges from very good to excellent. Washing fastness for dyed cationized and uncationized samples show very good fastness. The explanation of these results is the metal ions can chelate several dye molecules together, thus creating a larger complexes and providing a link between the dye and fiber [27]. The formation of these insoluble complexes within the fiber resulting in increasing depth of shade and fastness of color. [28]

Table 3: Color fastness properties of cationized cotton fabrics dyed with Brazilwood

<table>
<tr><th colspan="9">Perspiration</th></tr>
<tr><th colspan="2" rowspan="2">Samples</th><th rowspan="2">Color Change</th><th colspan="6">Staining</th></tr>
<tr><th>Wool</th><th>Polyester</th><th>Polyamide</th><th>Acrylic</th><th>Cotton</th><th>Cellulose acetate</th></tr>
<tr><td rowspan="2">Alkaline</td><td>Cationized dyed cotton (Two baths)</td><td>4-5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4-5</td><td>5</td></tr>
<tr><td>Cationized dyed cotton (one bath)</td><td>4-5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4-5</td><td>5</td></tr>
<tr><td rowspan="2">Acidic</td><td>Cationized dyed cotton (Two baths</td><td>4-5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4-5</td><td>5</td></tr>
<tr><td>Cationized dyed cotton (one bath)</td><td>4-5</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4-5</td><td>5</td></tr>
<tr><th colspan="9">Light</th></tr>
<tr><th colspan="2">Samples</th><th colspan="7">Color Change</th></tr>
<tr><td colspan="2">Cationized dyed cotton (Two baths)</td><td colspan="7">4</td></tr>
<tr><td colspan="2">Cationized dyed cotton (one bath)</td><td colspan="7">3-4</td></tr>
<tr><th colspan="9">Washing</th></tr>
<tr><th colspan="2" rowspan="2">Samples</th><th rowspan="2">Color Change</th><th colspan="6">Staining</th></tr>
<tr><th>Wool</th><th>Polyester</th><th>Polyamide</th><th>Acrylic</th><th>Cotton</th><th>Cellulose acetate</th></tr>
<tr><td colspan="2">Cationized dyed cotton (Two baths)</td><td>2</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4</td><td>5</td></tr>
<tr><td colspan="2">Cationized dyed cotton (one bath)</td><td>2-3</td><td>5</td><td>5</td><td>5</td><td>5</td><td>4</td><td>5</td></tr>
</table>

4 CONCLUSION

The purpose of this study is to carry out cationization, dyeing and mordanting cotton fabric in one bath at three stages to save energy and water using Brazilwood natural dye.Cationization can improve colour intensity of cotton because it provides a cationic dye sites rather than untreated fabrics .The optimum conditions of dyeing stage were investigated which showed best results at8% Brazilwood natural dye, pH6 , 60 min., 60^{o}C and the best colour strength was observed at 6%(Chromatech9414) , 8g/l ferric chloride. The obtained results offer an option of one – bath, cationization and dyeing process, replacing the water and energy consuming two – baths method and conventional dyeing process.Fastness properties were ranged from very good to excellent for perspiration and from fair to good for washing.

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Sphingomonas and *Pneumocystis jirovecii* opportunistic infection in HIV–TB infected child: A case report from Western Maharashtra

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ABSTRACT: The human immunodeficiency virus (HIV) infection leading to Acquired Immunodeficiency Syndrome (AIDS) causes progressive decline in immunological response in people living with HIV/AIDS making them susceptible to a variety of and opportunistic infections which are responsible for morbidity and mortality.
HIV patients are at high risk of opportunistic infection(OI).Among them Tuberculosis is common, *Pnemocystis jirovecii* pneumonia (PJP) is common with low CD4 count. Here we are describing a case of HIV-1 positive patient having low CD4 count. With multiple OI, it include PJP, Pulmonary tuberculosis and secondary bacterial pneumonia with *Sphingomonas paucimobilis.*

KEYWORDS: HIV, Pnemocystis jirovecii pneumonia, Sphingomonas paucimobilis , Tuberculosis.

INTRODUCTION

HIV/ AIDS is a pandemic disease. The first case of AIDS in India was reported in 1986 and now India is a country with the second largest population of HIV infected individuals [1].

In India, HIV not only in the high-risk groups but it is common among the general population.

This RNA virus, plays a very significant role in weakening the immune system of its host. The CD4+ lymphocytes are to be attacked first, which leads to progressive reduction in the number of CD4 cells. Reduced CD4 count leading to reduced host immunity. When host immunity weakens opportunistic infections come in picture.

OIs are the main reasons for hospitalization and substantial morbidity in HIV infected patients. OIs are bacterial, fungal, parasites. In Bacterial infection are like TB, & many other bacterial infection, in fungal infection *Pneumocystis* pneumonia (PJP),*Candiadiasis, Cryptococosis, penicillum* species, *Aspergillus* infection are common. Many parasitic infection like cryptosporidium, Toxoplasma infection are common. [2] Among them HIV and TB are common co infection in India.[3]

PJP is caused by *Pneumocystis jirovecii*, classified as a fungus but also shares biologic characteristics with protozoa. This common opportunistic infection in western world. [4]

Sphingomonas paucimobilis is aerobic,gram negative rods, nonfermerter commonly affecting immunocompromised individuals. Sphingomonas, a bacterial genus defined in 1990, (includes at least 12 species) of which *Sphingomonas paucimobilis* is considered to be of the highest clinical importance.It is frequently isolated from environmental sources such as soil and water, and it is found on hospital equipment such as ventilators, nebulizers, etc[5]*S. paucimobilis* is rarely causes infection in humans. [6,7]

CASE REPORT

A10 year old HIV-1 positive boy on antitubercular treatment was admitted to Intensive Care Unit, with chief complaint of fever, cough ,dyspnoea since 15 days. Fever was continuous, high grade not relieved by antipyretics. Cough was dry, non-productive. He was diagnose as pulmonary tuberculosis 3 months back... Patient was on Anti-Retroviral Therapy (ART) since he was 2 years old. After detailed history mother told that he was not taking ART medication since last 6 months. On X ray PJP was suspected and induced sputum sample was sent for the same. On positive report from microbiology department, patient was treated as PJP. Patients condition continued to detoriate, he was put on ventilator. Patient was not improving ,on suspicion of secondary bacterial infection endotracheal secretion was sent, which showed growth of *Sphingomonas paucimobilis.*It was sensitive to meropenem.

Despite of all vigorous attempts, patient did not survive.

ON EXAMINATION

He was oriented, febrile, tachypneic and had tachycardia.Patient had respiratory distress with respiratory rate 35 breaths per minute with shallow character. Pallor and oral thrush were present. On auscultation, bronchial breathing, creptation and rhonchi present bilaterally in lower zone. Other systemic examination was normal.

MICROBIOLOGICAL WORK UP

1) Blood sample was sent for CD4 count .

2) Induced sputum for Giemsa staining.

3) Endotracheal secretion for bacterial culture sensitivity.

RESULTS

1) Blood sample was sent for CD4 count -11 cells/mm3 by Flowcytromery method.

2) Induced sputum for Giemsa staining- revealed pleuomorphic trophozoites of size 1-5 µm under oil immersion field suggestive of *P. jerovecii*

3) Endotracheal secretion for bacterial culture sensitivity- Yellow coloured smooth colonies as shown in figure (a) were present on blood agar plate after 18 hours incubation, no growth on MacConkey agar.

Colonies were catalase positive, oxidase positive, gram negative, non sporing, nonmotile rods.

Identified as *Sphingomonas paucimobilis* on detailed biochemical test as shown in table 1. [koneman]

Table No-1-Biochemical characteristics of S.paucimobilis

Biochemical reaction	Results
Indole	Not produced
Methyl red	Negative
Voges proskauer	Negative
Citrate	Not utilised
Urease	Not reduced
Triple sugar iron	Alkali/no change
Bile esculine	Hydrolysed
DNase	Hydrolysed
ONPG	Positive
OF Glucose	Utilised
OF Xylose	Utilised
OF Maltose	Utilised
OF mannitol	Utilised
Growth on MacConkey	No growth
Nitrate reduction	Not reduced

Figure a-Yellow pigmented colonies of Sphingomonas paucimobilis on Nutrient agar.

ANTIMICROBIAL SUSCEPTIBILITY TESTING

It is done on Mueller Hinton agar by Kirby bauer disc diffusion method .[CLSI]

It was resistant to amikacin,ciprofloxacin,ampicillin,cefotaxim,cotrimoxazole ,cefotaxim-clavulunic acid. It was sensitive to meropenem.

OTHER INVESTIGATION

1) X-ray chest- showed prominent bronchovascular marking with bilateral interstitial pneumonia in lower and middle zone.

Other investigation-Reports of other investigation as shown in table no 2.

Table no 2-Reports of other investigation of the patient.

Test	Results
Blood sugar level	92mg%
Blood urea nitrogen level	26 mmol/lit
Serum creatinine	0.7 mg/dl
Serum sodium	135 mEq/lit
Serum Pottasium	3.0 mEq/lit
Complete CBC Count	
Haemoglobin	7.1 gm%
WBC	5000 /mm^3
Lymphocyte	19 %
Monocyte	2%
Neutrophil	*79%*
Platelet count	4,20000/µl
ESR	25 mm/hour

TREATMENT HISTORY

On admission patient was administered amikacin and levofloxacin for 5 days.After the Microbiological report patient was put on Trimethoprim-Sulphamethaxazole with dose of 15 mg/kg/day. Meropenem was added to regimen on antimicrobial sensitivity testing report for *Sphingomonas paucimobilis* .

DISCUSSION

TB affects adults more than children. At present, worldwide over one million children are infected with tuberculosis (TB) and 630,000 by HIV annually.[8] In patients HIV- TB co-infection immunity rapidly downgrade. TB infection increases viral load six to seven fold in HIV patients. This leads to high mortality rate [10] In this co-infection, pulmonary TB is most common presentation. It is present in about 75% of all HIV infected patients with TB. [9] In our case patient was on ART since 2 years of age,he was not taking medication since six month. This could possibly the reason of patient developing tuberculosis.

P.jerovecii pneumonia (PJP), it is the commonest infection in the Western world.[4]

Very few Indian studies have reported PJP in HIV. The reported incidence of PJP is about 4% of opportunistic infections in HIV patients and three cases have been reported from Delhi. [13] Similar co-infection is found in 10 patients from Andrapradesh in [N. Usha Rani et al study and about 0.8% patients from Iran[18] This probably could be explained by the extensive use of cotrimoxazole in the prophylaxis of PJP in HIV.[14,15] In India, the incidence of HIV infection is rapidly increasing in recent years, but very few case reports available in Indian literature. [16]

PJP predominantly occurs in individuals with previously undiagnosed HIV disease or those not currently receiving HIV care [17] 90% of PJP cases occurred in patient with CD4 count <200 cell/mm3.Risk factor for PJP are CD4 count <14%, previous episodes of PCP, oral thrush, recurrent bacterial pneumonia, unintentional weight loss, and higher plasma HIV RNA levels.[19]

The low CD4 count and discontinued ART for long ,might explain the probable cause of PJP in our patient.

The Centre for Disease Control/Communicable Disease Surveillance Centre (CDC/ CDSC) criteria allow presumptive diagnosis of PCP in HIV seropositive presenting with (i) dyspnoea on exertion / non-productive cough of recent onset, (ii) chest X-ray showing diffuse bilateral interstitial infiltrates, iii) arterial hypoxemia and (iv) no evidence of bacterial pneumonia.[20] 50-90% of patients of PJP presents with the development of diffuse, bilateral interstitial or alveolar infiltrates as most common X –ray finding .[21-23] Lobar or segmental consolidation, solitary pulmonary nodule with or without cavitation, these are some atypical X-ray findings in PCP .[24,25] The X-ray findings we got in our patient was typical of PJP.

For diagnosis of PJP, samples like induced sputum,bronchoalveolar lavage,biopsy material are used. Selective staining methods like Silver methamine ,Giemsa,Toludine blue are used routinely,for biopsy material Papaninicolaou is used.In all staining technique Immunofluorescence staining using monoclonal antibodies is most accurate technique and used in most of the study.

DNA amplification technique,PCR are most sensitive molecular techniques used for diagnosis of PJP.In our setting ,due to unavailability of molecular technique,we used Giemsa staining for diagnosis .This is easily available and 80% sensitive in positive cases.[21,16]

Second bacterial opportunistic infection in our patient after TB is *Sphingomonas paucimobilis*. *S.paucimobilis* infection generally occur with malignancy, immunosuppressant therapy, diabetes mellitus and acquired immunodeficiency syndrome. Our patient is immunocompramised and stayed long in hospital,this might be the reason behind development of nosocomial infection by this organism.[9] It is responsible for two types of human infections: community-acquired infection and nosocomial infection .[7] Although human infections caused by S. paucimobilis are generally rare ,these infections appear to have increased in humans in recent years. [26]

The strains of *S. paucimobilis* are usually resistant to penicillins and first generation cephalosporins due to the production of chromosomally encoded beta-lactamase production.[27] Previous reports suggested that third generation cephalosporins or aminoglycosides were best choice of treatment of *S.paucimobilis* infections. other study showed that Imipenem alone or an aminoglycoside plus a third-generation cephalosporin could effectively treat infections. There are no definitive guideline exists for the treatment of this organism.[5,28]

The *S.paucimobilis* isolates in this study exhibited different antibiotic susceptibility trends from those in other studies. It is sensitive to meropenem . This changing trends may be due to the liberal and empirical use of antibiotics. Non fermentative gram negative bacilli have emerged as important health care-associated pathogens.

CONCLUSION

This case once again highlights the importance of compliance in ART & the fatal consequences it can lead to if the treatment is not taken regularly. HIV is a dreadful disease and can land up a patient in a bunch of OIs. Hence early diagnosis and treatment of OIs may improve survival and reduce the risk of transmitting the infection to others.

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EVALUATION DE L'ACTION COMBINEE DE LA CHLOROQUINE ET D'OLAX SUBSCORPIOIDEA SUR DES SOUCHES DE PLASMODIUM FALCIPARUM CHLOROQUINORESISTANTES EN CULTURE IN VITRO

[ASSESSMENT OF THE COMBINED ACTION OF CHLOROQUINE AND OLAX SUBSCORPIOIDEA ON PLASMODIUM FALCIPARUM STRAINS RESISTANT IN VITRO CULTURE]

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ABSTRACT: Chloroquine has been widely used in the treatment of uncomplicated *Plasmodium falciparum* malaria.
Unfortunately, because of chemoresistance emergence and its spread worldwide since the 1960's, substitute medicines were compulsory to fight against malaria efficiently.
Therefore, current priority of the fight against malaria is to search for substances capable to improve back chloroquine efficacy.
The present work highlights life threatening action of *Olax subscorpioïdea* ethyl acetate fraction, a plant used traditionally against malaria, on *Plasmodium falciparum*. It has been successfully used both on chloroquine sensitive strains and chloroquinoresistant strains with respective IC_{50} values of 32.47±0.31µg/mL and 28.16±0.5µg/mL, justifying its usage in traditional medicine.
In addition, when 12 µg/mL of *Olax subscorpioïdea* fraction C is associated with chloroquine, resistant strain FCB1 average IC_{50} diminishes from 105.05±2.87nM to 43.5±1.5nM, thus allowing chloroquine to recover efficiency against *Plasmodium falciparum.*

KEYWORDS: Ethyl acetate, Chloroquine, *Olax subscorpioïdea*, *Plasmodium falciparum*, chloroquino-resistant strains.

RESUME: La chloroquine était autrefois un produit très efficace dans le traitement du paludisme à *Plasmodium falciparum*. Malheureusement, depuis l'apparition des souches résistantes dans les années 60, la chloroquinorésistance s'est étendue dans le monde entier posant un problème, d'autant plus que peu d'autres antipaludiques sont disponibles à l'heure actuelle pour combattre efficacement le paludisme.
Par conséquent, la recherche de substances potentialisant l'action de la chloroquine nous apparait comme une voie de recherche dans la lutte contre le paludisme.
Le présent travail nous a permis de mettre en évidence l'action antiplasmodiale de la fraction d'acétate d'éthyle d'*Olax subscorpioïdea* (olsu)*,* une plante utilisée traditionnellement contre le paludisme, aussi bien sur la souche chloroquinosensible (F32) que les souches résistantes (FCB1 et K1) avec des CI_{50} moyennes respectives de 32,47 ± 0,31 µg/ml

et 28,16 ± 0,5 µg/ml. De plus la CI_{50} moyenne de la chloroquine sur souche résistante FCB1 de l'ordre de 105,05 ± 2,87 nM, est passé à 43,5 ± 1,5 nM, lorsqu'on associe une concentration de 12 µg/ml de cette fraction de olsu à la chloroquine.
La fraction acétalique d'*Olax subscorpioïdea* a donc une action potentialisatrice sur la chloroquine.

MOTS-CLEFS: Acétate d'éthyle, Chloroquine, *Olax subscorpioïdea*, *Plasmodium falciparum*, souches chloroquinorésistantes.

1 INTRODUCTION

La chimiothérapie du paludisme a commencé avec l'utilisation de l'écorce du quinquina par les indiens du Pérou vers les années 1500. Ne connaissant pas l'agent pathogène, ils avaient observé que certaines fièvres étaient guéries par les écorces de cette plante. C'est en 1820 que Pelletier et Caventou isolent l'alcaloïde actif, la quinine, de l'écorce du quinquina.

La thérapeutique du paludisme a évolué très peu jusqu'à la fin des années 1930 où des recherches conduites simultanément en France, en Grande-Bretagne, en URSS, aux Etats-Unis et en Allemagne, ont permis la synthèse des amino-4-quinoléines [1], [2]. Cette famille de médicaments dont le plus utilisé est la chloroquine a révolutionné le traitement du paludisme.

La chloroquine était autrefois très efficace dans le traitement des accès palustres à *Plasmodium falciparum*. C'était un antipaludique idéal en raison de sa sécurité, de son efficacité par voie orale, son action rapide, sa longue demi-vie et surtout son faible coût.

Malheureusement, depuis l'apparition des souches résistantes dans les années 60, la chloroquinorésistance ne cesse de s'étendre dans tous les pays africains sub-sahariens dont la Côte d'Ivoire [3], [4], [5], [6].

Compte tenu de la place de choix qu'occupait la chloroquine dans la thérapie du paludisme en Afrique sub-saharienne, la recherche d'autres molécules capables de lui donner un regain d'intérêt est devenue une autre voie de recherche [7].

Ainsi c s'est développée la recherche des potentialisateurs de la chloroquine. Ces produits appartenant à diverses familles chimiques : bloqueurs calciques, antidépresseurs ou antihistaminiques tricycliques, anthraquinones, sont capables de reverser le mécanisme de la résistance probablement en s'opposant à l'efflux de la chloroquine hors du *Plasmodium* [8], [9], [10].

Notre programme de recherche en chimiothérapie antipaludique comporte deux volets à partir de la flore spécifique de Côte d'Ivoire :

1- la recherche de nouvelles molécules antipaludiques à longue durée d'action.
2- la recherche de nouveaux potentialisateurs de la chloroquine.

Après la mise en évidence de l'activité antiplasmodiale *in vitro* de l'extrait méthanolique de *Olax subscorpioïdea* (olsu) [11], nous nous sommes intéressés aux autres groupes de composés issus de cette plante. En effet, le décocté de cette plante est utilisé par certaines populations du centre de la Côte d'Ivoire soit seule comme fébrifuge, soit comme traitement antipaludique.

Pour vérifier sa deuxième utilisation, nous rapportons dans ce présent travail, l'activité antiplasmodiale *in vitro* de la chloroquine associée à l'ensemble des composés contenus dans la fraction d'acétate d'éthyle de cette plante.

2 MATÉRIEL ET MÉTHODES

2.1 MATÉRIELS

Le matériel végétal utilisé est constitué de l'extrait éthanolique et des fractions de *O. subscorpioïdea*, une plante traditionnellement utilisées dans le traitement du paludisme.

Quant au matériel biologique, il est constitué de sang humain parasité par des souches de *Plasmodium falciparum* de laboratoire : FCB1 et K1 (souches résistantes à la chloroquine) et F32 (souche sensible à la chloroquine).

Le milieu de culture utilisé pour les tests *in vitro* est le RPMI 1640 (Roswell Park Memorial Institute 1640) complémenté de 25 mM d'HEPES, d'une solution de bicarbonate de sodium à 5% et de sérum humain à 10%.

2.2 MÉTHODES

2.2.1 PREPARATION DE L'EXTRAIT ET DES FRACTIONS DE OLSU

Cinquante grammes (50g) de poudre de feuilles séchées de olsu sont macérés pendant 24 h dans 300 ml d'éthanol. Après filtration, évaporation et séchage on obtient l'extrait éthanolique (fraction A). Une partie de l'extrait éthanolique va subir le fractionnement suivant :

dix grammes de l'extrait est dissout dans 100 mL d'eau distillée auquel on ajoute 100 ml de cyclohexane et on laisse décanter 30 min. Après décantation la phase de cyclohexane est séchée pour donner un extrait noté fraction B. La phase aqueuse est reprise dans 100 mL d'acétate d'éthyle suivie d'une nouvelle décantation de 30 min. La phase acétalique est séchée et on obtient la fraction C. La phase aqueuse est de nouveau reprise par 100 mL de n-butanol. Après décantation on obtient deux phases, phase n-butanol et phase aqueuse, qui sont séchées pour donner l'extrait n-butanol (fraction D) et l'extrait aqueux (fraction E).

A partir de l'extrait et des fractions obtenues nous avons préparé par dilution dichotomique des gammes de concentrations variant de 125 à 0,97 µg/mL.

La chloroquine est aussi diluée par dichotomie pour donner une gamme de concentration variant de 1600 à 6,25 nM.

2.2.2 TESTS *IN VITRO*

Pour la culture *in vitro* de *P. falciparum*, nous avons utilisé la variante isotopique du micro-test (plaque de 96 puits) de Rieckmann adopté par l'O.M.S [12]. Elle permet de mesurer et de quantifier la capacité des doses croissantes d'une drogue à inhiber la croissance de *P. falciparum* au stade trophozoïte.

Dans cette technique, les souches diluées dans le milieu de culture sont incubées à 37°C dans un environnement appauvri en oxygène et enrichi en dioxyde de carbone avec une humidité d'environ 95%.

Après 24 heures d'incubation, les plaques sont sorties et l'on ajoute de l'hypoxanthine tritiée concentrée à 0,5 µCi/puits. Les plaques sont à nouveau remises dans l'incubateur pour 24 heures supplémentaires.

La radioactivité est mesurée à l'aide d'un compteur Wallac MicroBeta. Tous les résultats sont exprimés à la fin du comptage et les listings permettent l'exploitation des résultats

2.2.3 RECHERCHE DES EFFETS DE L'ASSOCIATION DE LA FRACTION D'ACETATE D'ETHYLE DE OLSU SUR L'ACTIVITE ANTIPLASMODIALE DE LA CHLOROQUINE

Une série de concentrations la fraction d'acétate d'éthyle sont choisies autour de la CI_{50} moyenne des souches chloroquinorésistantes.

Chacune de ces concentrations est associée à une gamme de doses de la chloroquine allant de 12,5 à 1600 nM.

Les CI_{50} résultant de l'association des deux molécules sont recherchées sur des plaques de culture comme précédemment.

Les CI_{50} résultant de l'association chloroquine-fraction C de olsu sont exprimées en pourcentage des CI_{50} de chaque molécule mesurées isolement.

Ces fractions de CI_{50} sont reportées sur les axes d'un graphe appelé isobologramme permettant d'exprimer l'activité résultant de l'action simultanée de la chloroquine et des alcaloïdes totaux de olsu.

Par convention, on exprime en abscisse les fractions de la chloroquine et en ordonnées celles du produit associé (fraction d'acétate d'éthyle). Sur chaque axe la valeur 1 représente la CI_{50} de chaque produit isolé.

Pour chaque concentration de l'association, les deux pourcentages obtenus définissent des coordonnées d'un point sur le graphe. La courbe joignant les différents points est comparée à la diagonale joignant les points unité sur les deux axes.

Dans le cas où la courbe suit la diagonale, l'action des deux produits associés est indépendante, chacun agit comme s'il était seul en cause.

Si la courbe est convexe et se situe au-dessus de la diagonale, cela indique la présence d'un antagonisme. Il y a donc suppression mutuelle des activités

Si la courbe est par contre concave et se rapproche des axes, il y a potentialisation ou synergie d'action entre les deux composés.

Ensuite l'index de la potentialisation du pouvoir schizonticide de la chloroquine (ou AEI pour "Activity Enhancement Index") est calculé en divisant la CI_{90} de la chloroquine seul par la CI_{90} de l'association de la chloroquine et de l'agent potentialisateur pour une analyse rapide de l'effet synergique du composé [13]. On considère arbitrairement qu'un agent potentialisateur est efficace à une concentration qui augmente le pouvoir schizonticide de la chloroquine par AEI ≥ 2.

3 RÉSULTATS

3.1 ACTIVITE ANTIPLASMODIALE INTRINSEQUE DES FRACTIONS DE OLSU

Les CI_{50} des trois souches aux différentes fractions de olsu sont résumées dans le Tableau 1

Tableau 1 : Sensibilité des souches aux fractions de olsu

Fractions de olsu	CI_{50} (µg/ml) n = 3		
	F32	**FCB1**	**K1**
A	46,47 ± 0,25	47,72 ± 0,64	> 50
B	> 50	> 50	> 50
C	32,47 ± 0,31	28,19 ± 0,22	28,14 ± 1,01
D	> 50	> 50	> 50
E	> 50	> 50	> 50

***A** : extrait éthanolique* ***B** : extrait cyclohexane* ***C** : extrait acétate d'éthyle*
***D** : extrait n-butanol* ***E** : extrait aqueux résiduel*

3.2 EFFETS DE LA FRACTION DE OLSU SUR L'ACTIVITE ANTIPLASMODIALE DE LA CHLOROQUINE

Les concentrations 6, 12, et 30 µg/mL, prises au tour de la CI_{50} moyenne de la fraction acétalique sur les souches chloroquinorésistantes (28,16 µg/mL) et associées aux différentes gamme de concentrations de la chloroquine (12,5-1600 nM) sur les souches FCB1 dont la CI_{50} moyenne est 105,05 nM, nous a permis de constater que les concentrations de valeur 12 et 30 µg/mL font baiser la CI_{50} de la chloroquine à 43,5 et 21,87 nM respectivement (Tableau 2).

Tableau 2 : Activité in vitro de la chloroquine associée à la fraction acétalique sur la souche chloroquinorésistantes FCB1

Composés	**Activité antiplasmodiale de la chloroquine (nM) n = 3**		
	FCB1		
	CI_{50}	CI_{90}	AEI
Chloroquine (CQ)	105,5±2,8	380 ± 1,47	----
CQ + 6 µg/mL	101,5 ± 1,3	350 ± 0,5	1,09
CQ + 12 µg/mL	43,5 ± 1,5	175 ± 0,4	2,17
CQ + 30 µg/mL	21,87 ± 0,8	85,3 ± 0,1	4,46

n = nombre de tests réalisés

Le tracé de l'isobologramme (figure 2), nous donne une courbe concave se rapprochant des axes.

L'indice de potentialisation (AEI) de la chloroquine comprise entre 1,09 et 4,46 avec une AEI moyenne de 2,57 atteste de la bonne potentialisation de la chloroquine par la fraction acétalique d'olsu à la concentration minimale de 12 µg/mL.

4 DISCUSSION

L'efficacité sélective de la chloroquine est liée à sa concentration élevée atteinte dans les érythrocytes parasités par rapport aux érythrocytes non parasités. La chloroquinorésistance est donc étroitement liée à la diminution de l'accumulation de la chloroquine à l'intérieur des érythrocytes parasités par P. falciparum résistant [14].

Ce phénomène d'efflux de médicament serait lié à des mutations ponctuelles au niveau des gènes pfcrt (*P. falciparum* chloroquine resistance transporter) situé sur le chromosome 7 dont le produit d'expression est une protéine transmembranaire localisée dans la membrane digestive de la vacuole du parasite [15], [16].

Il apparaît que dans nos conditions expérimentales, la fraction d'acétate d'éthyle de olsu a une action sur les isolats chloroquinosensibles et résistants. En effet il n'y a pas de différence significative entre les CI_{50} moyenne entre le deux types de souche. Ces résultats expliqueraient l'utilisation de cette plante par des populations ivoiriennes dans le traitement des accès palustres.

Mais ce qui parait particulièrement intéressant concernant cette fraction, c'est son action potentialisatrice des effets de la chloroquine sur *P. falciparum* résistant comme on peut le constater sur le tableau 1. En effet, la CI_{50} de la chloroquine de 105,05 nM en raison de la chloroquinorésistance de FCB1 s'abaisse rapidement par association d'une concentration de 12 et 30 µg/ml de la fraction acétalique pour atteindre les valeurs des souches sensibles 43,5 et 21,87 nM (< 100 nM). En d'autres termes, en présence de cette fraction, il y a donc une restauration de l'efficacité de la chloroquine.

La fraction d'acétate d'éthyle de olsu pourrait agir très probablement sur le site d'action de la chloroquine et favoriser son accumulation à l'intérieur de la vacuole en limitant l'efflux. L'ensemble des composés contenus dans cette fraction de olsu permettrait d'élever la quantité de la chloroquine à une concentration létale pour le *Plasmodium*. Une fois accumulée, cette amino-4-quinoléine retrouve son activité antiplasmodiale.

Il faut noter que la notion de potentialisation des antipaludiques, plus spécifiquement de la chloroquine, a été conçue par Martin et al. [7] qui ont montré que les bloqueurs calciques associés à la chloroquine reversent *in vitro* la chloroquinorésistance chez *P. falciparum*.

Ces résultats nous ont amenés à calculer l'AEI, afin de pouvoir quantifier et comparer l'effet bloqueur de l'efflux par la fraction d'acétate d'éthyle de olsu.

Ainsi, la concentration 12 µg/mL de la fraction d'acétate d'éthyle de olsu est la plus petite concentration qui, sur tous les souches résistantes, permet de bloquer l'efflux de la chloroquine avec un AEI égal à 2,17.

5 CONCLUSION

Du fait de leur activité spécifique sur les souches chloroquinorésistantes et de leur action potentialisatrice de la chloroquine, nous pensons que l'utilisation de la fraction d'acétate d'éthyle de olsu associée à la chloroquine pourrait redonner à celle-ci la place de choix qu'elle occupait autrefois dans la thérapeutique des pays d'endémie palustre.

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Nouvelle approche de la gestion des fils d'attente pour la transmission de la vidéo dans les réseaux sans fil

[New approach to the management of queues for the transmission of video in wireless networks]

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ABSTRACT: Solve the problem of the quality of multimedia traffic in wireless networks is a very lively topic in the field of scientific research.
In this article, we present a solution to optimize the transmission of video in IEEE 802.11 wireless networks by changing the behavior of the MAC layer for video traffic; a breakdown of the latter on various types of access is proposed.
The platform operates using both improving the wireless standard IEEE802.11e and the inter-layer model proposed to improve the streaming media in wireless networks.
A test bench was performed to simulate this solution, using open source NS2 network simulator; the results obtained show that our solution improves visibly the most important indicators of multimedia transmission

KEYWORDS: wireless network; 802.11; EDCA; Evalvid; MAC layer.

RESUME: Résoudre le problème de la qualité du trafic multimédia dans les réseaux sans fil est un sujet très vif dans le domaine de la recherche scientifique.
Dans cet article, nous présentons une solution pour optimiser la transmission de la vidéo dans les réseaux sans fil IEEE 802.11 en modifiant le comportement de la couche MAC pour le trafic vidéo; une ventilation de ce dernier sur les différents types d'accès est proposée.
La plate-forme fonctionne en utilisant à la fois l'amélioration de la norme sans fil IEEE802.11e et le modèle inter-couche proposé pour améliorer la diffusion multimédia dans les réseaux sans fil.
Un Banc de test a été réalisé pour simuler cette solution, en utilisant le simulateur de réseau open source NS2; les résultats obtenus montrent que notre solution améliore visiblement les indicateurs les plus importants de la transmission multimédia.

MOTS-CLES: réseau sans fil; 802,11; EDCA; Evalvid; couche MAC.

1 INTRODUCTION

Bien que la norme des réseaux sans fil 802.11e prenne en charge un certain degré de qualité de service pour la transmission des données multimédia, mais beaucoup de points reste à améliorer.

Plusieurs travaux de recherche ont été proposés pour améliorer la qualité de service dans les réseaux sans fil, surtout focalisés sur l'optimisation des paramètres relatifs à chaque catégorie d'accès des fils d'attente relative à la couche MAC à savoir:

CW (contention windows) [1]

AIFS (Arbitration Inter Frame Space) [2]

TXOP (Transmission Opportunity) [3]

Dans cet article, nous étudions les performances de la transmission de la vidéo MPEG4 sur un réseau local sans fil utilisant le protocole évolué de la couche MAC 802.11e. Nous proposons et évaluons une nouvelle approche de gestion des fils d'attente du protocole MAC, afin d'améliorer la qualité de la vidéo transmis. Nous comparons les résultats de notre solution avec le standard existant.

2 MECANISME EDCA D'ACCES AU CANAL DANS 802.11E

Le mécanisme EDCA (Enhanced Distributed Channel Access) fournit un accès au support sans fil différencié, répartis pour les QSTAs (QoS-enabled Station) utilisant les huit priorités UP (User priorities). Le mécanisme EDCA définit quatre catégories d'accès AC (Acces category), AC-VO (pour le trafic voix), AC−VI (pour vidéo trafic), AC−BE (pour Best-effort trafic) et AC−BK (pour Background trafic) La figure 1 illustre les différentes catégories d'accès [4].

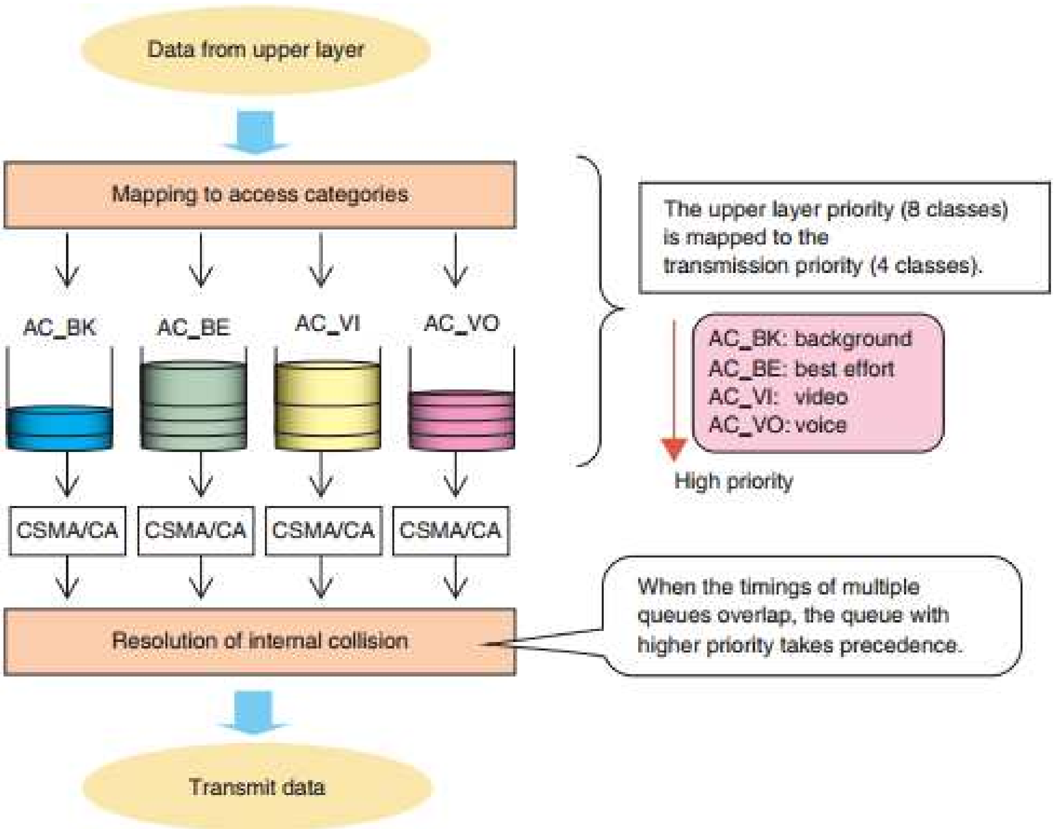

Fig.1 Les différentes catégories d'accès IEEE802.11e

AC−VO possède la priorité la plus haute et AC−BK la priorité la plus basse. Chaque AC a son propre fil d'attente et son jeu de paramètres. Ces paramètres EDCA sont la fenêtre de contention minimale (CWmin), la fenêtre de contention maximale (CWmax), la durée de l'espace inter-frame arbitraire AIFS (Arbitration Inter-Frame Space), el la limite de la durée de l'opportunité de transmission (TXOPlimit).la fenêtre CW est définie à CWmin au début et après chaque transmission avec succès. Au lieu d'un DIFS, un noeud sans fil doit différer la transmission d'AIFS. La différenciation des priorités entre les AC est réalisée en définissant des valeurs différentes aux paramètres, qui sont le Numéro AIFS (AIFNS), la taille de la fenêtre de contention CW et l'opportunité de transmission (TXOP) limite. La figure 2 illustre l'espace inter-frame utilisé dans les mécanismes DCF et EDCF.

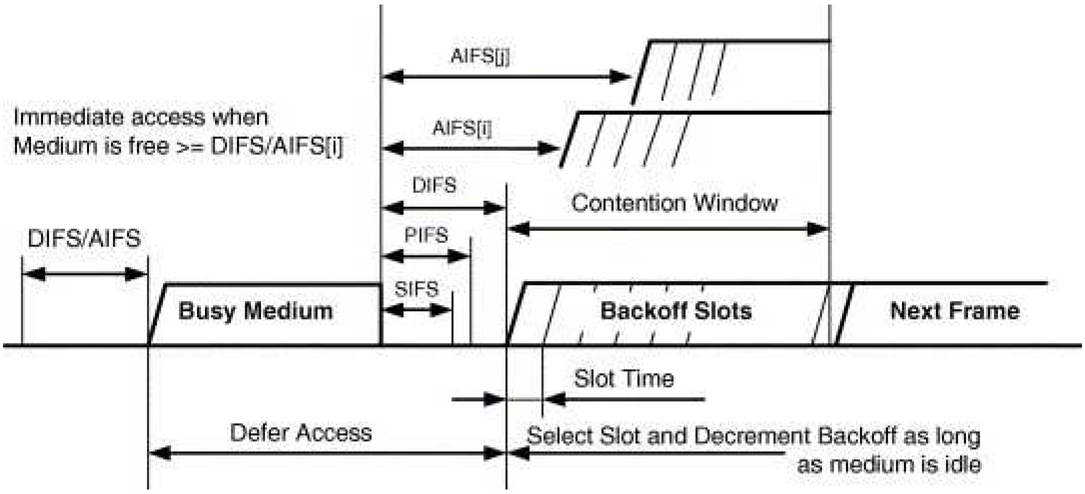

Fig2. Relation inter-frame entre le mécanisme DCF et EDCA

3 NOTRE PROPOSITION POUR L'ACCES AU CANAL SANS FIL

On exploitant les fils d'attente des autres AC autre que celle de la vidéo on a montré dans notre première publication l'amélioration des indicateurs de la qualité de service au niveau du gain PSNR d'environ 1 dB et du délai de transmission d'environ 30% [9].

Dans notre dernière approche on a analysé le choix de la meilleure combinaison des fils d'attente pour l'envoi du flux vidéo avec l'outil d'évaluation de la vidéo Evalvid [5].

4 APERÇU SUR EVALVID

Le framework EvalVid [6] est un ensemble d'outils qui évaluent la qualité de la vidéo transmise sur un réseau de communication réel ou simulé.IL permet de mesurer des paramètres de la qualité de service du réseau tel que le délai, la gigue, le taux de perte des paquets et le PSNR. Actuellement H.264, MPEG-4 et H.263 sont supportés [6].

La figure 3 illustre l'interfaçage entre l'outil Evalvid et le simulateur réseaux NS2

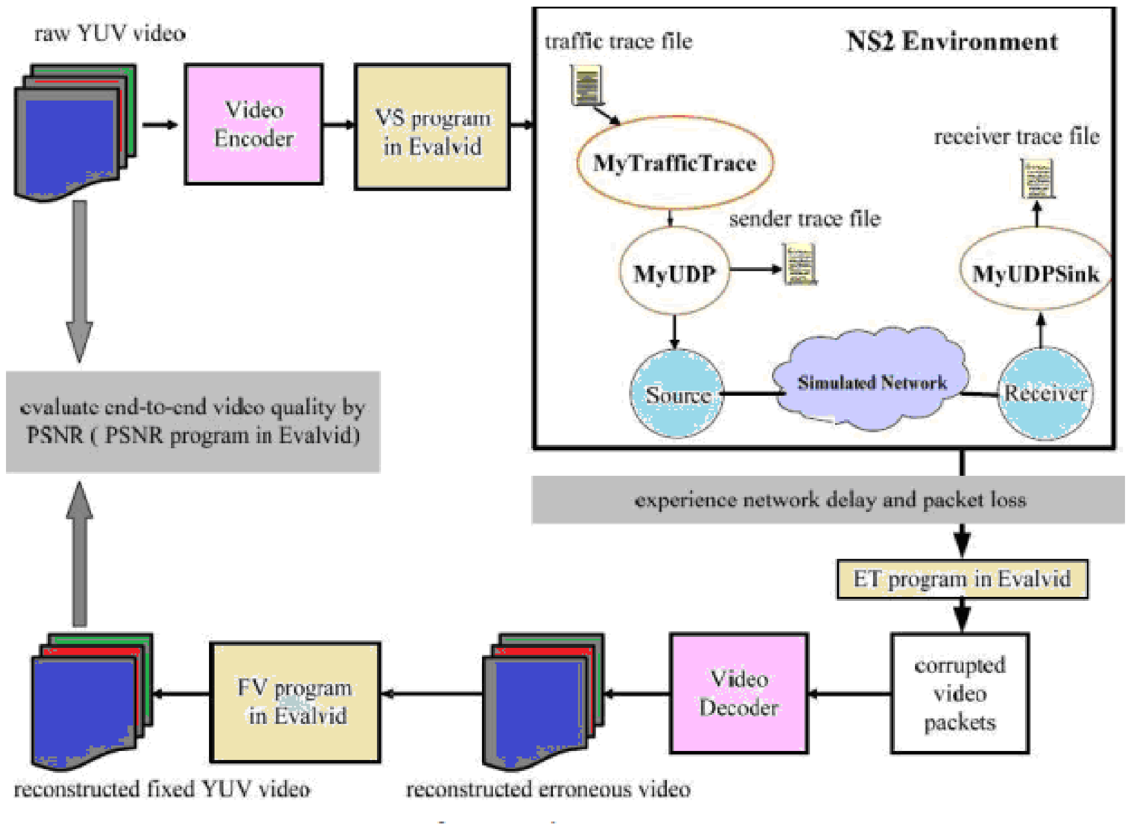

Fig3. Interfaces entre EvalVid et NS2

5 BANC DE TEST

La simulation est effectuée avec le simulateur NS2 [7]. Le réseau test est formé d'un nœud émetteur sans fil de flux multimédia (un flux voix IP, trois flux vidéo, un flux CBR et un flux Best effort TCP) et d'un nœud récepteur sans fil. Le seuil optimal minimal du fil d'attente est fixé à 10 paquets et le seuil optimal maximal est fixé à 40 paquets.

L'algorithme ci-dessous a été introduit dans la couche MAC 802.11e pour différencier l'utilisation des fils d'attente suivant la situation des seuils pour le rejet des paquets :

```
case 1:
        int(pri_[2].getavgLen()< threshold1);
        pri_[2].target_handle(target_);
        pri_[2].recv(p,h);
        done=1;
        break;
case 2:
        int(pri_[2].getavgLen()< threshold2) && int(pri_[2].getavgLen()> threshold1);
        pri_[1].target_handle(target_);
        pri_[1].recv(p,h);
        done=1;
        break;
case 3:
        int(pri_[2].getavgLen()> threshold2);
        pri_[0].target_handle(target_);
        pri_[0].recv(p,h);
        done=1;
        break
```

6 LA MISE EN ŒUVRE DU SIMULATEUR

Cette section décrit comment la conception du simulateur est réalisée du point de vue du langage de programmation.

6.1 ENVIRONNEMENT DE PROGRAMMATION

Le protocole réseau 802.11 est mise en œuvre en C ++ dans le cadre du noyau du simulateur NS2. Les scénarios de la simulation sont générés en utilisant un langage de script Tcl. (Tool command language) héritant de la nature de NS2, l'outil permet l'interaction entre ces deux milieux d'échange de données et la configuration de l'algorithme.

Du point de vue de script de simulation, Tcl est couramment utilisé pour générer des topologies de réseau spécifiques et pour configurer des protocoles et des applications que nous utilisons pour la simulation.

Les avantages de ce langage est son syntaxe simple, la richesse de son interface graphique et sa flexible pour l'intégration avec d'autres langages.

6.2 GENERATION DES ENTREES ET DES FICHIERS TRACES

Dans cette section, nous expliquons comment générer la trace du fichier vidéo pour la conduite de la simulation. Le processus essentiel est développé dans [8].

Par exemple, nous allons prendre en charge les vidéos échantillons foreman_qcif.yuv et football_cif.yuv

Les trois étapes suivantes sont réalisées pour fournir à l'entrée le fichier trace des données pour les simulations à laide des outils ffmpeg ; MP4Box et MP4trace:

Étape 1: encodé le fichier vidéo brut yuv en utilisant ffmpeg [9] avec le codec MPEG4, Le fichier de sortie est nommé a01.m4v, avec un taux de 30 images par seconde, 64 kbps de débit binaire et le GOP (group of pictures) à une longueur de 30 images :

ffmpeg -s cif -r 30 -b 64000 -bt 3200 -g 30 -i a01_cif.yuv -vcodec mpeg4 a01.m4v

Étape 2: préparation de a01.mp4 pour RTP / RTSP

Lors de la transmission ; la taille maximale du MTU est 1024 octets y compris en-tête RTP. Le fichier de sortie est enregistré au format .mp4 avec 30 fps.

MP4Box -hint -mtu 1024 -fps 30 -add a01.m4v a01.mp4

Étape 3: Envoyer a01.mp4 à la destination spécifiée 192.168.1.55 via le port 12346 (cette destination et le port peuvent être sélectionné de façon aléatoire) en mode de trame.

Cette étape crée un fichier trace st_a01 qui est nécessaire pour reconstruire la vidéo reçu plus tard.

mp4trace -f -s 157.159.16.148 12346 a01.mp4 > st_a01

6.3 RÉSULTATS DE LA SIMULATION:

6.3.1 SÉQUENCE FOREMAN QCIF

On analysant la transmission des flux vidéo avec notre mécanisme combinant les différents types des fils d'attente sachant que AC_VO=AC0, AC_VI=AC1, AC_BE=AC2 et AC_BK=AC3; on a déduit que l'utilisation de la combinaison [AC1 AC0 AC2] donne le meilleur rendement de réception de 658 paquets envoyés par chaque flux vidéo.

Voir tableau ci-dessus :

	Mode 802.11e	%	Mode AC1 AC2 AC3	%	Mode AC1 AC0 AC3	%	Mode AC2 AC1 AC0	%	Mode AC1 AC0 AC2	%
VIDEO1	578	0,88	597	0,91	578	0,88	442	0,67	**630**	0,96
VIDEO2	521	0,79	545	0,83	521	0,79	340	0,52	**610**	0,93
VIDEO3	441	0,67	479	0,73	441	0,67	258	0,39	**581**	0,88

On remarque que le taux de perte des paquets a été réduit considérablement en utilisant la combinaison (AC1 AC0 AC2).

Le calcul du PSNR (Peak Signal to Noise Ratio) a déduit les résultats ci dessous :

Mode	PSNR (dB)
802.11e	33.280596
AC1 AC2 AC0	33.599161
AC1 AC0 AC2	34.279349

Ce qui confirme que la meilleure combinaison des catégories d'accès des fils d'attente pour la transmission de la vidéo est celle de la succession [AC1 AC0 AC2].

Le calcul des délais de transmission des paquets a déduit le graphique ci-dessous :

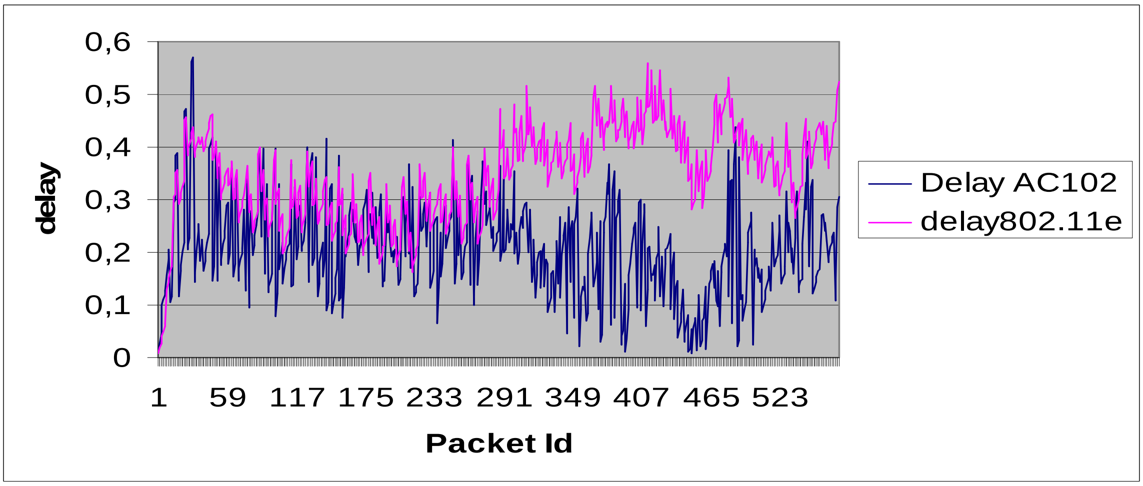

Fig4. Comparaison des délais de transmission entre notre solution et celle du 802.11e

On a retenu que l'utilisation de notre solution a améliorée considérablement les délais de transmission des paquets en moyen d'environ 40%, mieux que notre première solution proposé en [10] (amélioration des délais de 30%)

De même l'extraction de quelques images de la vidéo reçue s a montré que notre solution a engendré une qualité visuelle meilleure :

Figure5 : comparaison de l'image 148 reçu avec notre solution et celle reçu avec 802.11

Figure6 : comparaison de l'image 256 reçu avec notre solution et celle reçu avec 802.11

6.3.2 SÉQUENCE FOOTBALL CIF

1. De même on a simulé d'autre échantillon de vidéo de qualité supérieur,et où il y à plus de mouvement tel que la scène Football_cif.mp4, les résultats ont été satisfaisant.

Le calcul du nombre de paquets reçus -après l'envoi de 1598- paquets est illustré ci-dessous :

	Mode 802.11e	%	Mode AC1 AC0 AC2	%
VIDEO1	1256	0,78	1459	0,91

Le calcul du PSNR a donné les résultats ci-dessous :

Mode	PSNR (dB)
802.11e	16.757651
AC1 AC0 AC2	23.130811

On constate une évolution du PSNR de 6,37 dB

Les images ci-dessous illustrent l'amélioration de la qualité de la vidéo reçus avec notre solution à gauche par rapport à celle du 802.11e à droite:

Figure7 : comparaison de l'image 75 reçue avec 802.11e et celle reçue avec notre solution

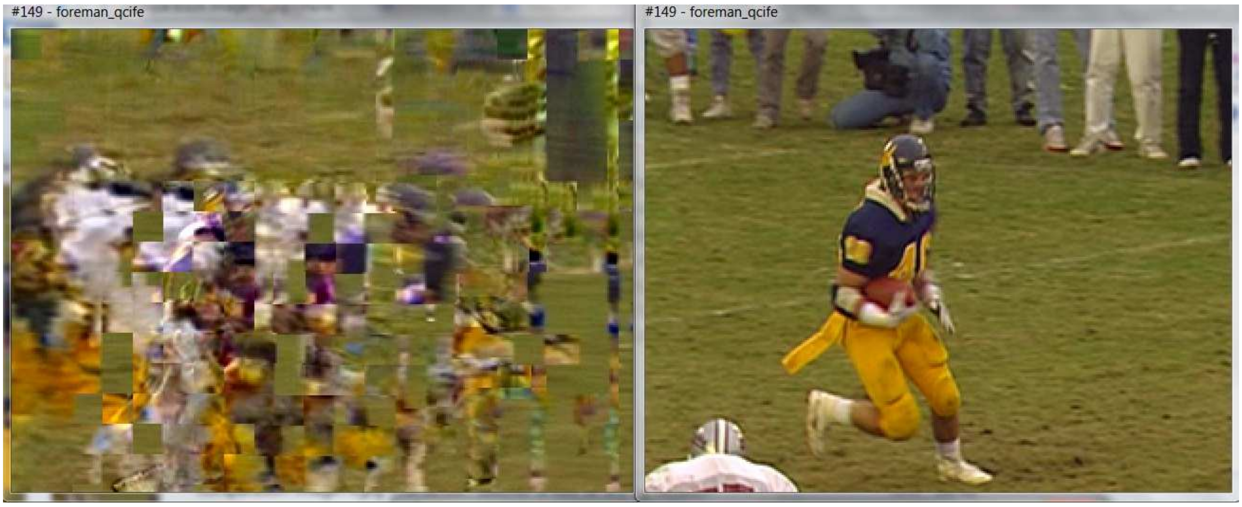

Figure8 : comparaison de l'image 149 reçue avec 802.11e et celle reçue avec notre solution

Le calcul des délais de transmission a permis de faire la comparaison ci-dessous ;

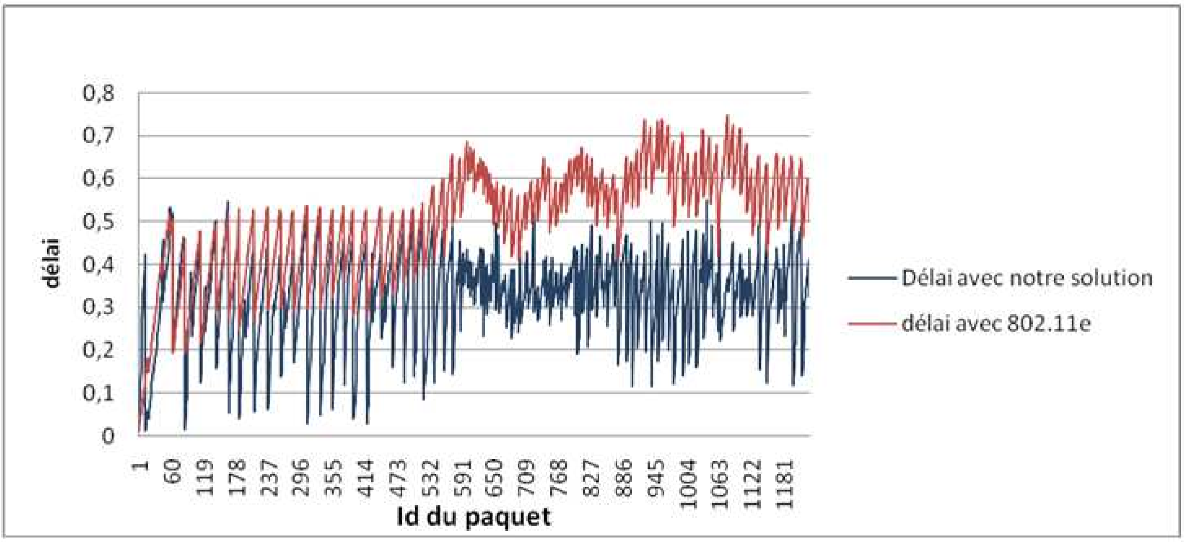

Figure9 . Comparaison des délais de transmission avec notre solution et 802.11e

Ce qui montre une amélioration du délai moyen de transmission des paquets d'environ 36%

7 CONCLUSION

Notre nouvelle approche pour la gestion des fils d'attente des catégories d'accès a révélé que notre solution donne un rendement meilleur pour les indicateurs de la qualité de service multimédia par rapport à ceux de l'amendement 802.11e.

La nouvelle distribution des fils d'attente de la couche MAC a permis la démunissions du taux de perte des paquet de plus de 14%, l'indicateur de la qualité de la vidéo reçue PSNR est améliorée de plus de 6 dB, de même le délais de la transmission moyen a été réduit d'environ 40%

Le banc de test a révélé une qualité perceptuelle meilleure des images de la vidéo reçue avec notre solution.

Nous projetons dans nos prochaines recherches d'améliorer encore mieux notre solution avec l'intégration des autres paramètres de la couche MAC et d'intégrer également les améliorations apportées dernièrement à la couche physique

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