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OF SCIENCE FRONTIER RESEARCH: C

## Biological Science

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Rate of Echinops Giganteus

Serum Biochemical Parameters

Highlights

Effect of Transplant Growth Stage

Range Extension of Micrurus Camilae

Discovering Thoughts, Inventing Future

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## Effect of Transplant Growth Stage on the Mortality Rate of *Echinops Giganteus*

By Anjah Mendi Grace, Christiana Ngyete Nyikob Mbogue,  
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**Abstract-** Transplant quality of *Echinops giganteus* depends on factors like: microclimate parameter, substrate, plant nutrition, and others. The growth stage is also an important index of its quality. The objective of this research was to determine the effect of transplants' growth stage on the mortality rate and quality of *Echinops giganteus* seedlings after transplant. The research work was carried out on nursery beds at the Research Institute of Agricultural Development (RIAD). The investigated transplant growth stages were seedling height, number of leaves and seedling age. Data collection began one month after the transplant, and the observations were done every week for eight weeks. The growth stages of *Echinops giganteus* transplants had no significant effect on the average yield, but the mortality rates were greatly affected by the transplant growth stages. From the results of this experiment, mortality rates were low when seedlings were transplanted with two leaves (17%) and at 12 cm (22%). When seedlings of *Echinops giganteus* were transplanted at an earlier growth stage, the mortality rates were lower than when they were transplanted at an older growth stage.

**Keywords:** *echinops giganteus*, growth stage, seedling transplant, the mortality rate.

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# Effect of Transplant Growth Stage on the Mortality Rate of *Echinops Giganteus*

Anjah Mendi Grace <sup>α</sup>, Christiana Ngyete Nyikob Mbogue <sup>ο</sup>, Nkemnkeng Francoline Jong <sup>ρ</sup>, Yanick Borel Kamga <sup>ω</sup> & Manekeu Tanetsa Amandine Elodie <sup>¥</sup>

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## I. INTRODUCTION

Plant productivity is influenced by properly grown transplants. Transplants quality is highly dependent on various factors such as light, temperature, CO<sub>2</sub>, air humidity, water supply, fertilization, substrate, cultivation methods, vegetable species or varieties (Damato and Trotta, 2000; Paul and Metzger, 2005; Brazaitytè *et al.* 2009; Juknys *et al.* 2011). One of their quality indices also is the age and growth stage of transplants. The duration of transplants growth affects plant development, vegetative mass, biochemical composition, output of standard transplants, growth after transplantation, resistance to unfavorable conditions, and labor expenses of transplant cultivation (Schrader, 2000; Handley and Hutton, 2003; Henare and Ravanloo, 2008). Research data indicated that the optimal transplant age and growth stage differs for each plant. It may be counted either in weeks, decades, or the appropriate number of leaves. Growers prefer planting young strong-growing transplants, and it is worth noting that the optimal choice of transplant age or growth stage plays a significant economic role.

The genus *Echinops* is of the Asteraceae family, and consists of about 120 species distributed worldwide (Garnatje *et al.*, 2004). *Echinops giganteus* has been designated a non-forest timber product (NTFP) in the Congo Basin and the part exploited is the root (Tchatat, 1999). The root have diverse uses spanning from medicinal, culinary to industrial (Noumi, 1984; Menut *et al.*, 1997). The root of this plant is used to treat heart, and gastric troubles (Tene *et al.*, 2004). The root has aromatic properties and has been collected, and distilled to obtain essential oils that are used in synergy with those from other plants to eradicate weevils in stored grains (Ngamo *et al.*, 2007; Pérez *et al.*, 2010). This species is also of interest to the fragrance and flavor sectors Menut *et al.*, 1997).

The main problem with *E. giganteus* is that, despite all its importance and its conservation status as a nearly threatened species, no implementation of conservation, management and sustainable use strategies have been put in place, due to the lack or insufficient scientific data on their regeneration. This general lack of information is related to a lack in the Sub-Saharan zone of expertise and infrastructures to carry out propagation experiments.

This research work is therefore designed to come out with the best method for the large-scale propagation of *E. giganteus* in the Western Highlands of Cameroon.

## II. MATERIALS AND METHODS

### a) Study Site

The germination and transplant experiments were carried out in Dschang situated in the Menuoa Division in the Western Region of Cameroon (Figure 1). It has geographic coordinates, latitude 5° 26'N, longitude 10° 26'E and an altitude 1,400 m. According to the data of the meteorological station of the IRAD of Dschang, there is an equatorial climate characterized by an average annual temperature of 20.1°C and Annual rainfall is 2000 mm on average (Aghofack-Nguemezi and Tatchago, 2010).

The vegetation consists, to a large extent, of savannah grassland, with the Poaceae forming the main vegetation layer, interspersed with a few other annuals, biennials and perennials trees (Ngwa, 1979). According to Aswingnue (2003), the vegetation of this region is both natural, and cultivated. The cultivated vegetation

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consists of planted trees like *Cola accuminata*, *Eucalyptus globulus*, *Raphia hookeri*, and other fruit trees. *Eucalyptus globulus* lies mostly in the low lying plains, while woody valley and natural forest exist in the watershed area (Helvetas, 2001).

The soil texture is silt-clay-loam making it very fertile for agricultural activities in the area (Suh *et al.*, 2015). The soil fertility is as a result of humus, which is a dark volcanic soil from the uplands/hilly areas that have been washed down from the hills and deposited on river banks or beds of streams (Helvetas, 2001).

b) *Presentation of the plant material: Echinops giganteus* CD Adams



c) *Seeds collection, selection and preparation*

Seeds were collected from the Western Region of Cameroon, in fields where it grows naturally. Mature fruits were collected from the mother plant growing in the wild, dried for two weeks under natural sunlight then matured seeds with healthy grains were selected for germination (Figure 2). Some seeds were randomly selected for viability test by the floatation method. The seeds were placed in a bucket of water at room temperature (Wamegni, 1991; Schaal, 2000). The seeds that sank were classified as viable seeds, while those floating were classified as non-viable.

d) *Nursery construction*

The field was cleared using a cutlass and plowed with a hoe. Nursery beds measuring 1m by 4 m were established with a distance of 50 cm apart. The entire nursery site was shaded with palm fronds. The seed sowing method was by line broadcast. The Blocks were 1 m apart for each nursery site. Nursery beds were monitored and watered every after one day (Figure 3).

e) *Preparation of transplanting sites*

The transplanting site was equally being cleared with a cutlass and plowed using a hoe. This space was of total area 20 m x 15 m, further sub-divided into blocks of 6 m x 7 m (Figure 3). Each sub-block had nine units of 1.5 m x 2.5 m each, and on each unit, 20 seedlings were transplanted at a spacing of 50 cm apart as follows:

i. *Shoot height*

The heights included: 10 cm [TH10], 12 cm [TH12] and 14 cm [TH14]. Each height class had three repetitions of 20 seedlings each. Hence, 180 seedlings for parameter shoot height.

ii. *Number of leaves*

Off rooting was done at two leaves (TL2), four leaves (TL4) and six leaves (TL6). Each off-rooted seedling had three repetitions of 20 seedlings each. Hence, 180 seedlings for parameter shoot height.

iii. *Age of seedlings*

Seedlings were off-rooted six weeks after germination (TA6), eight weeks after germination (TA8) and ten weeks after germination (TA10). Each off-rooted age had three repetitions of 20 seedlings each. Hence, 180 seedlings for parameter shoot height (Figure 5).

f) *Data Collection*

The parameters measured were: height of shoot (H) using a meter rule from the base of the stem to the apex of the stem, the number of leaves (NL) counted on the stem and collar diameter measured 10cm above the ground using a calliper. Thirty seedlings were randomly selected in each treatment and tagged for data collection throughout the experiment. Thus a total of 270 plants were tagged.

g) *Data processing and analysis*

Data were presented using tables and figures. Data on early growth parameters were subjected to Analysis of Variance (ANOVA) using the statistical program XLSTAT, where the least significant differences (LSD) between the mean was detected and separated using the Duncan's New Multiple Range Test (DNMRT) at  $p \leq 0.05$ .

### III. RESULTS

a) *Influence of leaf number on the transplant of E. giganteus seedlings*

The result of this experiment shows that when seedlings were transplanted with two leaves, they regenerated better than when they were transplanted with four and six leaves (Table: 1). The mean value for number of leaf gotten after transplant for seedlings that were transplanted with two leaves was 11.281, with the highest number of leaf being 30. Still on seedlings transplanted with two leaves, the mean value for stem collar diameter was 1.063, with the highest diameter being 1.8. According to ANOVA Newman-Keuls XLSTAT 2014, the mean values obtained when seedlings were transplanted with two, four or six leaves, had no significant difference.

The result showed that when seedlings were transplanted with two leaves, they had the lowest mortality rate as compared to when they were transplanted with four leaves and with six leaves (figure 6). Seedlings transplanted with two leaves had the

lowest mortality rate of 17% (10 seedlings dead out of 60 transplanted) and the highest mortality rate of 33% came from seedlings transplanted with six leaves (20 seedlings dead out of 60 transplanted).

b) *Influence of seedling height on the transplant of E. giganteus seedlings*

Table 2 shows that when seedlings were transplanted at ten centimeters, they produced the highest number of leaves, and at the same time they had the smallest mean value for stem collar diameter. The mean value for number of leaf gotten after transplant for seedlings that were transplanted at ten centimeters was 11.0208, with the highest number of leaf being 25. The mean value for stem collar diameter was 0.936, with diameter values as low as 0.4. Statistically, according to ANOVA Newman-Keuls XLSTAT 2014, the mean values obtained when seedlings were transplanted at ten, twelve of fourteen centimetres had no significant difference.

Contrary to the results of early growth parameters on transplanting height, the mortality rate was lowest when seedlings were transplanted at twelve centimetres (figure 7). Seedlings transplanted at twelve centimetres had the lowest mortality rate of 22% (13 seedlings dead out of 60 transplanted). The highest mortality rate of 38% came from seedlings transplanted at fourteen centimetres (23 seedlings dead out of 60 transplanted).

c) *Influence of the seedling age on the transplant of E. giganteus seedlings*

As shown in Table 3 below, when seedlings were transplanted at eight weeks after germination (WAS), they had the highest number of leaves. The mean value for number of the leaf gotten after transplant for seedlings that were transplanted at ten centimetres was 11.625, with the highest number of the leaf being 30. The mean highest value for stem collar diameter was 0.943, with diameter value as high as 2.0. Statistically, according to ANOVA Newman-Keuls XLSTAT 2014, the mean values obtained when seedlings were transplanted at ten, twelve of fourteen centimetres had no significant difference.

At this age of transplant, we experienced a very high mortality rate of more than 50%. Of the 180 seedlings that were transplanted for the observation of this parameter, just 60 seedlings survived, giving a survival percentage of 35%, while 110 of the transplanted seedlings did not survive, giving a mortality rate of 65% (Figure 8).

#### IV. DISCUSSION

Many factors determine transplant quality, including leaf area leaf number, root to shoot ratio, root volume, fertilization, height, transplant age and shipping (Cantliffe, 1993). Our results were contrary with those of

Khatun *et al.* (2002) and Alam *et al.* (2002), who reported decreasing grain yield with the decrease of seedling age. This could be because of reasons that if *E. giganteus* is left for too long before transplant, its roots will penetrate very deep into the soil and most of them will cut and be destroyed during uprooting, hence high mortality rate after transplant. According to our research data, the number of leaves, seedling age and height affected the mortality rate of the plant. According to our data, *E. giganteus* had a lower mortality rates when transplanted at an earlier stage and with fewer leaves. According to Palamakumbura *et al.*, 1987, vegetable transplanted at 30 days were taller than those transplanted at 15 days. Older transplants begin to flower faster. It is confirmed by other researchers (Salik *et al.*, 2000; Khatun *et al.*, 2002) and our research data. This is normal because, after transplant, the plants that survive continue to grow. With younger transplants having more chlorophyll in their leaves, the specific leaf area values and a relative growth rate may have a more efficient photosynthetic system than older transplants (Leskovar and Cantliffe, 1990. The age of transplants is one factor affecting the vegetable yield (McCraw and Greig, 1986; Weston, 1988). The vegetables cultivated from older transplants produce earlier yields (Liptay, 1988). Various researchers state that the age of vegetable transplants affects the early and total yield not of all vegetables. Vavrina *et al.* (1993) indicated that watermelon transplant age did not affect the early and total yield of these vegetables. Nesmith (1993) investigated the effect of 2, 4, 6 and 8-week muskmelon transplants age on their productivity. Researchers' data indicate that the transplants age affected neither their early nor their total yield. In the experimental work on agricultural elements by various researchers the effect of the transplant age on cucumber yield was also studied (Junior *et al.* 2004). It is estimated that planting 29 and 34 day transplants their cucumber yield was less than that from the vegetables whose transplants were 19 or 24 days old (Junior *et al.* 2004). According to Liptay (1988), notwithstanding the fewer yields of younger cucumbers, the total yield of different age vegetables is similar. Hasandokht and Nosrati (2010) present the data that the older the cucumber transplants, the larger their total yield. Some researchers state that the yield of tomato transplants ranging from 3 to 6 weeks old increased linearly with age (Weston and Zandstra, 1989). The others say that the transplant age has no impact on tomato yield (Leskovar *et al.* 1991). In our tests, the transplant growth stage had no significant effect on growth parameters that were measured after transplant. Lopes and Goto (2003) present their data that the younger tomato transplants the more the fruit weight.

## V. CONCLUSION

From the study, it is observed that mortality rates varied significantly due to variation in seedling age, number of leaves, and seedling height after transplant. It is revealed from the results that seedlings transplanted with fewer number of leaves, at a younger growth stage performed better than when they were transplanted at an older stage. In conclusion, it can be said that seedlings transplanted at their juvenile stage could be used to attain higher yield.

### Competing interests

The authors have declared no competing interest

### Authors' contributions

Christiana Ngyete Nyikob Mbogue carried out this work under the supervision of Anjah G. M. Anjah G.M. designed the experiment and supervised the experiment to the end.

Christiana Ngyete Nyikob Mbogue collected the data on the field with Nkemnkeng Francoline Jong, Yanick Borel Kamga and Manekeu Tanetsa Amandine Elodie. We all worked with the statistician to analyse the data. All the authors participated in formatting the paper.

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## REFERENCES RÉFÉRENCES REFERENCIAS

- Aghofack- Nguemezi J., Tatchago V., 2010. Effects of Fertilizers Containing Calcium and/or Magnesium on the Growth, Development of Plants and the Quality of Tomato Fruits in the Western Highlands of Cameroon. *International Journal of Agricultural Research*. 5: 821-831.
- Alam M., Ahmed M., Alam M., Haque M., Hossain M., 2002. Performance of seedling ages and seedling raising techniques on yield and yield components of transplant amam rice. *Pakistan Journal of Biological Science*. 5(11): 1214-1216.
- Aswingnue L., 2003. Human adaptation to physical environment, case study: Tubah Subdivision. A DIPES II research project. University of Yaounde I. 1-46.
- Brazaitytė A., Duchovskis P., Urbonaviūtė A., Samuoliene G., Jankauskienė J., Sakalauskaitė J., Šabajevienė G., Sirtautas R., Novičkovas A., 2010. The effect of light-emitting diodes lighting on the growth of tomato transplants. *Žemdirbystė-Agriculture*. 97 (2), 89–98.
- Cantliffe D., 1993. Pre- and postharvest practices for improved vegetable transplant quality. *Acta Horticulture*. 220: 203–210.
- Damato G., Trotta L., 2000. Cell shape, transplant age, cultivars and yield in broccoli. *Acta Horticulturae*. 533:145–152.
- Garnatje T., Valle J., Garcia S., Hidalgo O., Sanz M., Canela M., Siljak-akovlev S., 2004. Genome size in *Echinops* L. and related genera (Asteraceae Cardueae): karyological, ecological and phylogenetic implications. *Biological Cell*. 96 (2):117-24.
- Handley D., Hutton M., 2003. Effect of seeding date, transplant size and container on growth and yield of pickling cucumbers. *American Journal of Society and Horticultural Sciences*. 38: 672.
- Hasandokht M., Nosrati S., 2010. Effect of transplant age and fruit pruning on earliness and total yield of greenhouse cucumber (*Cucumis sativus* L. cv. Sultan). *Plant Ecology and physiology*. 2: 21–25.
- Helvetas Cameroon., 2001. Tubah rural council monographic study.
- Henare M., Ravanloo A., 2008. Effect of transplanting stage and planting depth of seedling on growth and yield of tomato. Book of abstracts. IV Balkan Symposium on Vegetables and Potatoes. Plovdiv, 96.
- Juknys R., Duchovskis P., Sliesaravičius A., Šlepetys J., Januškaitienė I., Brazaitytė A., Ramaškevičienė A., Lazauskas S., Dėdelienė K., Sakalauskaitė J., Juozaitytė R., Kadžiulienė Ž., Dikšaitytė A., 2011. Response of different agricultural plants to elevated CO<sub>2</sub> and air temperature. *Žemdirbystė-Agriculture*. 97 (2), 89–98.
- Junior S., Gadum J., Cardoso A., 2004. Effect of tray cell size and seedling age on cucumber.
- Khatun A., Mollah M., Rashid M., Islam M., Khan A., 2002. Seasonal effect of seedling age on the yield of rice. *Pakistan Journal of Biological Science*. 5(1): 40-42.
- Leskovar D., Cantliffe D., Stoffella P., 1991. Growth and yield of tomato plants in response.
- Liptay A., 1988. Field survival and establishment of tomato transplants of various age and size.
- Lopes M., Goto R., 2003. Influence of seedling stage and grafting on tomato, Momotaro hybrid production. *Hortic Bras*. 21(3):553–557.
- McCraw B., Greig J., 1986. Effect of transplant age and pruning procedure on yield and fruit- set of bell pepper. *Horticulture Science*. 21: 430–431.
- Menut G., Lamaty P., Weyerstahl H., Marschall S., Amvam -Zollo P., 1997. Aromatic plants of tropical Central Africa. Part XXXI. Tricyclic sesquiterpenes from the root essential oil of *Echinops giganteus* var.lelyi C. D. Adams. *Flavour Fragrance Journal*. 12(6): 1026- 1099.

20. Nesmith D., 1993. Transplant age influence summer squash growth and yield. *Horticulture Science*. 28(6): 618–620.
21. Ngamo T., Ngatanko I., Ngassou M., Mapongmestem P., Hance T., 2007. Insecticidal efficiency of essential oils of 5 aromatic plants tested both alone and in combination towards *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). *Research Journal of Biological Science*. 2 (1): 75-80.
22. Ngwa J., 1979. A new geography of Cameroon. Longman group Ltd London.1-200.
23. Noumi E., 1984. Les plantes à épices, à condiments et à aromates du Cameroun. Thèse de Doctorat en Sciences Biologiques, Université de Yaoundé. 22-24.
24. Palamakumbura A., 1987. Effect of seedling age and spacing on tomato growth and yield. Training reports, TOP/AVRDC 1987. 118–126.
25. Paul L., Metzger J., 2005. Impact of vermicompost on vegetable transplant quality. *Horticultural Science*. 40 (7): 2020–2023.
26. Pérez S., Ramos-López M., Zavala-Sánchez M., Cárdenas-Ortega N., 2010. Activity of essential oils as a biorational alternative to control coleopteran insects in stored grains. *Journal of Medicinal Plants Research*. 4 (25): 2827-2835 production. *Hortic. Bras*. 22 (3): 610–613.
27. Salik M., Muhammad F., Pervez M., 2000. Relationship between age of seedlings on productivity of tomato (*Lycopersicon esculentum* L.) grown under plastic tunnel. *Pakistan Journal of Biological Science*. 3(8): 1260–1261.
28. Schaal B., 2000. 'Reproductive capacity and seed size in *Lopiumtexasensis*. *American Journal of Botany*. 6:703-709.
29. Schrader W.L., 2000. Using transplant in vegetable production. Univ. Calif. Div. Agr. Natural Resources. Publ. 8013.
30. Suh C., Meka S., Ngome A., Neba D., Kemngwa I., Sonkouat A., Njualet D., 2015. Effects of organic and inorganic fertilizers on growth and yield of potato (*Solanum tuberosum* L.) in the western highlands of Cameroon. *International Journal of Development and Research*. 5 (2): 3584-3588.
31. Tchatat M., 1999. Produits Forestiers Autres que le Bois d'œuvre (PFAB): place dans l'aménagement durable des forêts denses humides d'Afrique Centrale. Projet régional de capitalisation et transfert des recherches sur les écosystèmes forestiers de l'Afrique humide. Série FORAFRI. Document 18.Yaoundé.
32. Tene M., Tane P., Sondengam. B. L., Connolly J., 2004. "Lignans from the roots of *Echinops giganteus*," *Phytochemistry*. 65 (14): 2101–2105.
33. to age of transplants. *Journal of American Society and Horticultural Scienc*. 116 (3):416–420.
34. Vavrina C., 1991. Effect of transplant age on tomato production. Proc. Fla. State Hort. Soc. 104, 225–226.
35. Wamegni J., 1991. Etude de la phénologie, des fruits, des graines et de la germination de *Fagara macrophylla*. Mémoire d'Ingénieur des Eaux et Forêts à l'Université de Dschang. Pp. 50.
36. Weston L., 1988. Effect of flat cell size, transplant age and production site on growth and yield of pepper transplants. *Horticultural Science*. 23 (4): 709–711.
37. Weston L., Zandstra B., 1989. Transplant age and N and P nutrition effects on growth and yield of tomatoes. *Horticultural Science*. 24: 88–90.

Table 1: Influence of leaf number on the transplant of *E. giganteus* seedlings

|         | NL                        | SH                         | CD                       |
|---------|---------------------------|----------------------------|--------------------------|
| 2Leaves | 11.28 ± 6.10 <sup>a</sup> | 69.48 ± 30.93 <sup>a</sup> | 1.06 ± 0.29 <sup>a</sup> |
| 6Leaves | 10.27 ± 3.94 <sup>a</sup> | 76.35 ± 23.56 <sup>a</sup> | 1.03 ± 0.28 <sup>a</sup> |
| 4Leaves | 10.55 ± 4.50 <sup>a</sup> | 74.79 ± 24.99 <sup>a</sup> | 1.02 ± 0.28 <sup>a</sup> |
| Pr > F  | 0.35                      | 0.18                       | 0.62                     |
| SD      | No                        | No                         | No                       |

\*Values indicated by the same letters within the columns are not statistically different at  $P \leq 0.05$

Table 2: Influence of seedling height on the transplant of *E. giganteus* seedlings

|        | NL                        | SH                         | CD                       |
|--------|---------------------------|----------------------------|--------------------------|
| 12CM   | 10.65 ± 5.38 <sup>a</sup> | 73.82 ± 32.00 <sup>a</sup> | 0.99 ± 0.31 <sup>a</sup> |
| 10CM   | 11.02 ± 5.02 <sup>a</sup> | 69.42 ± 30.68 <sup>a</sup> | 0.94 ± 0.29 <sup>a</sup> |
| 14CM   | 10.52 ± 5.56 <sup>a</sup> | 69.22 ± 31.01 <sup>a</sup> | 0.99 ± 0.33 <sup>a</sup> |
| Pr > F | 0.797                     | 0.52                       | 0.34                     |
| SD     | No                        | No                         | No                       |

\*Values indicated by the same letters within the columns are not statistically different at  $P \leq 0.05$

Table 3: Influence of seedling age on the transplant of *E. giganteus* seedlings

| Weeks      | NL                         | SH                         | CD                       |
|------------|----------------------------|----------------------------|--------------------------|
| Week-ten   | 10.57 ± 5.99 <sup>a</sup>  | 69.91 ± 30.49 <sup>a</sup> | 0.94 ± 0.29 <sup>a</sup> |
| Week-eight | 11.63 ± 11.57 <sup>a</sup> | 6.13 ± 29.15 <sup>a</sup>  | 0.93 ± 0.35 <sup>a</sup> |
| Week-six   | 10.33 ± 6.37 <sup>a</sup>  | 64.46 ± 23.78 <sup>a</sup> | 0.87 ± 0.32 <sup>a</sup> |
| Pr > F     | 0.53                       | 0.393                      | 0.23                     |
| SD         | No                         | No                         | No                       |

\*Values indicated by the same letters within the columns are not statistically different at  $P \leq 0.05$

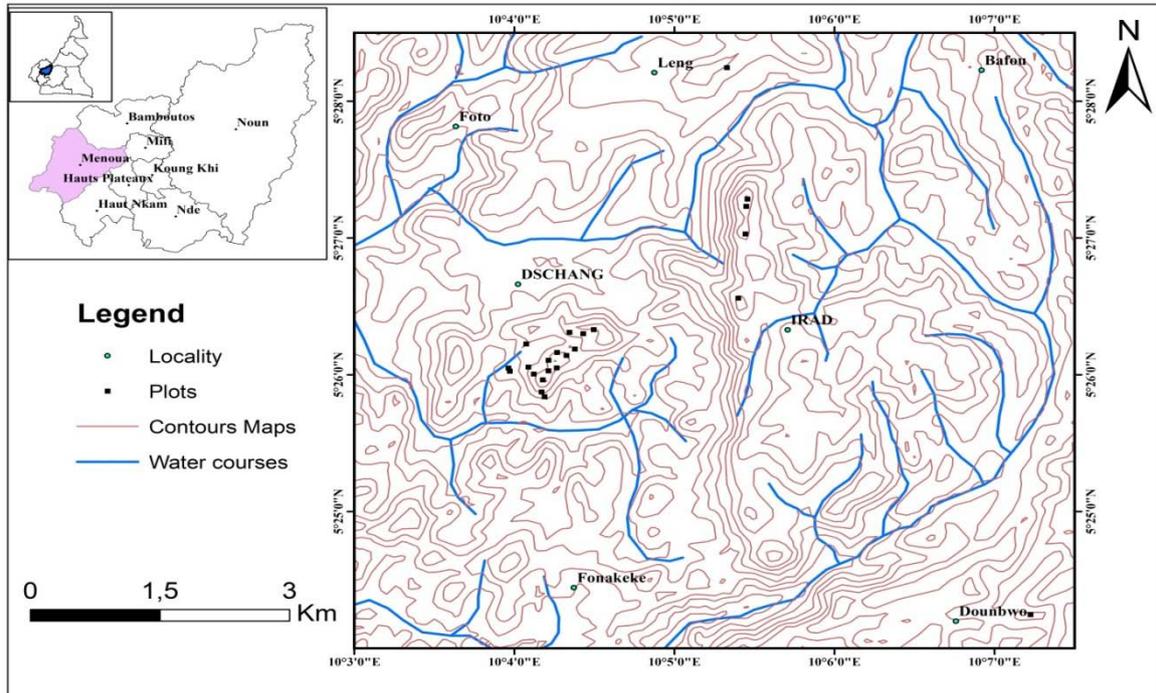


Figure 1: Map of study areas in the Menoua Division

Figure 2: Selection of *E. giganteus* seeds from the inflorescence ball



Figure 3: Researcher arranging nursery and transplanting site. Early germination stage (d)



Figure 4: Influence of leaf number on mortality rate of *E. giganteus* seedlings after transplant

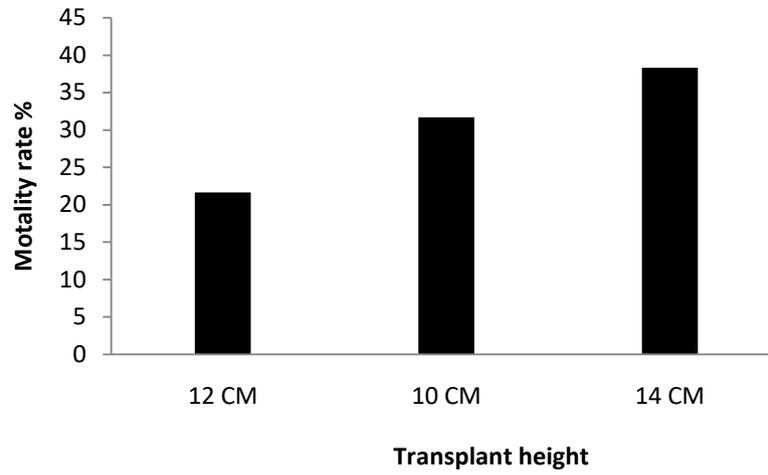


Figure 5: Influence of seedling height on mortality rate of *E. giganteus* seedlings after transplant

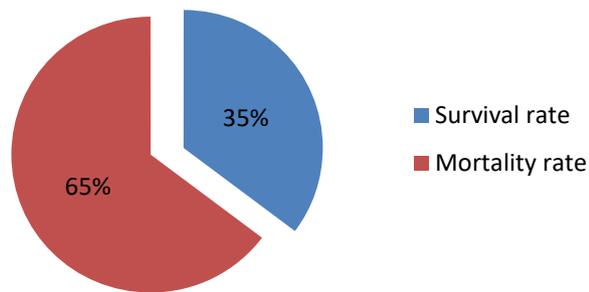


Figure 6: Influence of seedling age on mortality rate of *E. giganteus* seedlings after transplant



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## Range Extension of *Micrurus Camilae* (Serpentes: Elapidae) in the Colombian Caribbean

By Sergio Alejandro Peláez Plazas & Lilia Alejandra Perlaza Berrío

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**Abstract-** We present the first record of the snake *Micrurus camilae* for the department of Sucre, Colombia, extending its known distribution area and contributing with data about its habitat. The specimen was found in a tropical dry forest patch; in contrast with the previous records in which *M. camilae* was located in tropical rainforests.

**Keywords:** tropical dry forest, tropical rainforest, elapidae, proteroglyphous, distributional range.

**GJSFR-C Classification:** FOR Code: 279999



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# Range Extension of *Micrurus Camilae* (Serpentes: Elapidae) in the Colombian Caribbean

## Ampliación Del Área de Distribución De *Micrurus Camilae* (Serpentes: Elapidae) En el Caribe Colombiano

Sergio Alejandro Peláez Plazas <sup>α</sup> & Lilia Alejandra Perlaza Berrío <sup>σ</sup>

**Abstract-** We present the first record of the snake *Micrurus camilae* for the department of Sucre, Colombia, extending its known distribution area and contributing with data about its habitat. The specimen was found in a tropical dry forest patch; in contrast with the previous records in which *M. camilae* was located in tropical rainforests.

**Keywords:** tropical dry forest, tropical rainforest, elapidae, proteroglyphous, distributional range.

**Resumen-** Se presenta el primer registro de la especie *Micrurus camilae* para el departamento de Sucre, Colombia, ampliando su área de distribución y contribuyendo con datos sobre su hábitat. El individuo se encontró en un parche de vegetación en bosque seco tropical, a diferencia de los reportes anteriores donde se localiza en bosque húmedo tropical.

**Palabras clave:** Bosque seco tropical. Bosque húmedo tropical. Elapidae. Proteroglifa. Rango de Distribución.

### I. INTRODUCCIÓN

El género *Micrurus* (Elapidae) comprende aproximadamente 31 especies en Colombia, siendo uno de los grupos de serpientes más diversos en el país (Uetz *et al.*, 2019). Estas serpientes se distribuyen principalmente en bosques húmedos y secos y en bosques premontanos (Pitalúa *et al.*, 2018). Los individuos de este género presentan hábitos fosoriales, crepusculares, y una dentición proteroglifa que le permite suministrar un potente veneno neurotóxico (Pitalúa *et al.*, 2018).

*Micrurus camilae* es endémica de Colombia. En su descripción original se señala que la especie habita en el bosque húmedo tropical del municipio de Tierralta, Córdoba (Renjifo & Lundberg, 2003). Posteriormente, se realizaron tres registros de la especie en los municipios de Valencia (departamento de Córdoba), La Lizama y El Cedral (departamento de Santander) y Tarazá (departamento de Antioquia; Alzate, 2014; Meneses-Pelayo & Caballero, 2019; Ines Hladki *et al.*, 2016). Hasta

el momento para esta especie no se han reportado datos ecológicos o su estado de conservación, debido a que los datos actuales son deficientes (Alzate, 2014; Ines Hladki *et al.*, 2016). Sin embargo, con estos reportes se ha concluido que la especie habita en zonas con alto grado de fragmentación e intervención antrópica (Meneses-Pelayo & Caballero, 2019).

*Micrurus camilae* se caracteriza por presentar un patrón de coloración bicolor de anillos negros y amarillos, con una franja ancha mediodorsal de color rojo a lo largo de todo el cuerpo (Renjifo & Lundberg, 2003). El primer anillo se inicia sobre la región occipital, cubriendo las escamas dorsales. Presenta de 30 a 35 anillos amarillos (de 3 a 7 escamas de ancho) alternados con 31 a 36 anillos negros (de 4 a 8 escamas de ancho), cola con 4 anillos negros, 4 amarillos y escama anal dividida (Renjifo & Lundberg, 2003). Este estudio presenta el primer registro de la especie *Micrurus camilae* para el departamento de Sucre, Colombia, extendiendo hacia el norte su rango de distribución y contribuyendo con datos sobre su hábitat.

### II. MATERIALES Y MÉTODOS

En enero de 2017 (época seca), se encontró un individuo de *M. camilae* en un parche de vegetación herbácea y hojarasca cerca de la zona que limita con la hacienda Pajarito, en el municipio de Colosó, Sucre (9°31'47.3"N-75°21'54.7"O, Figura 1). La técnica empleada para el registro del espécimen fue inspección por encuentro visual (VES) y la determinación del individuo siguió la descripción de Renjifo & Lundberg (2003). El ejemplar no fue recolectado; solo se obtuvieron registros fotográficos.

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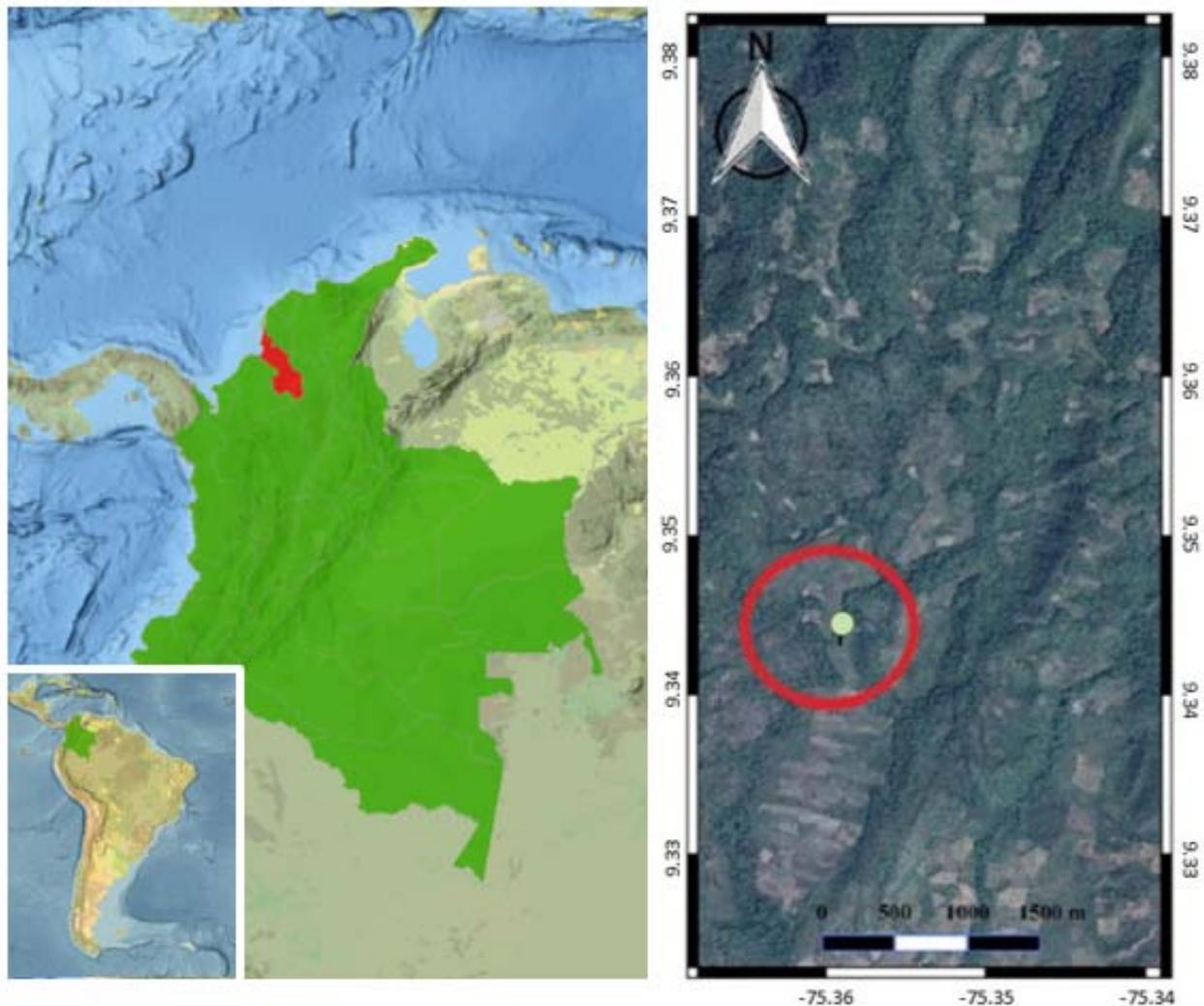


Figura 1: Localización del registro de *Micrurus camilae* en el municipio de Colosó, departamento de Sucre, Colombia

### III. RESULTADOS

El individuo de *Micrurus camilae* se observó reposando sobre vegetación herbácea y hojarasca en horas de la mañana (alrededor de las 9:00 am) cerca de la quebrada Charco Azul, a una altura de 145 m s.n.m. El patrón de coloración del cuerpo es similar al descrito por Renjifo & Lundberg (2003): 34 anillos negros que cubren de 4 a 7 escamas dorsales de ancho alternados con 34 amarillos de 4 a 5 escamas de ancho; 4 anillos negros, 4 amarillos en la cola y escama anal dividida (Figura 2). No obstante, el patrón de coloración de la cabeza se asemeja más a la descripción del individuo encontrado por Meneses-Pelayo & Caballero (2019) en el valle medio del río Magdalena, al presentar dos anillos negros discontinuos, el primero cubriendo la escama rostral, y el segundo cubriendo las escamas frontal, supraocular, preocular, postocular y parte anterior de las escamas parietales; las escamas internasales y prefrontales son de color rojo, mientras que Renjifo & Lundberg (2003) describen la coloración

de la cabeza como totalmente negra (desde la rostral hasta las supraoculares, incluyendo la frontal y la parte posterior de la parietal). Sin embargo, la disposición de las escamas se ajusta a la descripción de los autores, siendo la escama rostral más ancha que alta y visible dorsalmente, dos internasales más largas que anchas, escama frontal y dos escamas parietales más largas que anchas, escama loreal ausente, nasales divididas y una preocular más larga que ancha (Renjifo & Lundberg, 2003).



Figura 2: Individuo de *Micrurus camilae* en Colosó, Sucre, Colombia

#### IV. DISCUSIÓN

En los trabajos realizados en el bosque seco tropical de los montes de María (Sucre, Colombia) se han registrado 33 especies de serpientes (Galván *et al.*, 2009; Pineda *et al.*, 2015), de las cuales se reconocen dos de elápidos: *Micrurus dissolucus* y *Micrurus ssp.* (Galván *et al.*, 2009). Sin embargo, no existe una caracterización morfológica de *Micrurus sp.* para así poder compararla con las demás especies de elápidos de la zona, incluyendo a *M. camilae*. En otros trabajos se compara esa especie con *M. dissolucus* y *M. dumerillii*, mostrando únicamente que las tres especies son ovíparas y que difieren notablemente en el patrón de coloración (Vargaset *et al.*, 2019).

Trabajos previos (Alzate, 2014; Ines Hladki *et al.*, 2016; Meneses-Pelayo & Caballero, 2019; Renjifo & Lundberg, 2003), han señalado que *M. camilae* se encuentra en bosque húmedo tropical, entre 88 y 176 ms.n.m. En este estudio, *M. camilae* se encontró en un fragmento de bosque seco tropical a una altura de 145 ms.n.m., 190 km al noreste de la localidad más septentrional conocida hasta ahora para la especie. Es necesario ampliar los estudios sobre *M. camilae* para conocer su densidad poblacional y estado de amenaza, con el fin de promover su conservación y protección.

#### V. AGRADECIMIENTOS

Agradecemos a la Corporación Autónoma Regional de Sucre (CARSucre) por brindarnos la oportunidad ingresar a la estación Primatológica de Colosó; a la Universidad Distrital Francisco José de Caldas por su apoyo durante esta investigación; al señor Pedro Márquez por su paciencia y compañía en algunos de nuestros muestreos; y al profesor Oscar Javier Mahecha por su apoyo y dirección en este proyecto.

#### REFERENCES RÉFÉRENCES REFERENCIAS

1. Alzate, E. (2014). Geographic Distribution: *Micrurus camilae*. *Herpetological Review*, 45 (2), 285-286.
2. Galván, S., Sierra, M., Gómez, F., De La Ossa, V. & Fajardo, A. (2009) Biodiversidad en el área de influencia de la Estación Primates de Colosó, Sucre, Colombia. *Revista Colombiana Ciencia Animal*, 1(1), 98-121.
3. González, C., Cabrera, O., Munstermann, L. & Ferro, C. (2006). Distribución de los vectores de *Leishmania infantum* (Kinetoplastida: Trypanosomatidae) en Colombia. *Biomedica*, 26(1), 3-4.
4. Ines Hladki, A., Ramírez, M., Renjifo, J. & Urbina, N. (2016). *Micrurus camilae*. The IUCN Red List of Threatened Species 2016: e.T44581946A4458-1949. <http://dx.doi.org/10.2305/IUCN.UK.2016-1.RLTS.T44581946A44581949.en>
5. Lehtinen, R., Ramanamanjato, J. & Raveloarison, J. (2003). Edge effects and extinction proneness in a herpetofauna from Madagascar. *Biodiversity and Conservation*, 12(7), 1357-1370.
6. Meneses-Pelayo, E. & Caballero, D. (2019). New records and an updated map of distribution of *Micrurus camilae* Renjifo & Lundberg, 2003 (Elapidae) for Colombia. *Check List*, 5(3), 465-469.
7. Molina, C. Señaris, J., Lampo M. & Rial, A. (eds.). (2009). Introducción a los anfibios de Venezuela: Estado del conocimiento y recomendaciones para su conservación. (Informe técnico). Caracas, Venezuela: Universidad Central de Venezuela, Conservación Internacional Venezuela, Instituto de Zoología y Ecología Tropical. 23pp.
8. Mueses, V. (2011). Conservación de la biodiversidad o desarrollo social: una deliberación bioética (Tesis de maestría). Bogotá D. C.: Pontificia Universidad Javeriana, Instituto de Bioética. 37 pp.
9. Pineda, A., Jiménez, S., Fernández, C., Peña, L., Granda, H., Morelo, L., Vela, I. & González, J. (2015). *Planeación ambiental para la conservación de la biodiversidad en las áreas operativas de Eco Petrol: Ventana Montes de María, Colosó, Sucre*. (Informe Técnico). Bogotá D.C.: Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. 30 pp.

10. Pitalua, Y., Rengifo J. & Rivas, L. (2018). Aportes a la distribución del género *Micrurus* (Serpentes: Elapidae) en el Departamento del Chocó, Colombia. *Revista Colombiana Ciencia Animal*, 10(2), 131-142.
11. Renjifo, J. & Lundberg M. (2003). Una especie nueva de serpiente coral (Elapidae, *Micrurus*), de la región de Urrá, municipio de Tierra Alta, Córdoba, Noroccidente de Colombia. *Academia Colombiana de Ciencias Exactas, Físicas y Naturales*, 27(102), 142-144.
12. Uetz, P., Freed, P. & Hosek, J. (eds). (2019). *The Reptile Database*. Retrieved from <http://www.reptile-database.org>
13. Vargas, F., Muñoz, J. & Morales, M. (Coord.) (2019). *Biología de los anfibios y reptiles en el bosque seco tropical del norte de Colombia*. Tunja, Colombia: Editorial UPTC.



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## Effects of Organic and Inorganic Fertilizers on Some Vitamins and Mineral Contents of *Hibiscus Sabdariffa linn* (Sorrel)

By Joy Stephen Pudza, Mohammed Adamu Milala, Adam Lawan Ngala  
& Stanley Tella Bwala

**Abstract-** Hibiscus sabdariffalinn (sorrel) is an annual plant belonging to the family malveceae. It has great potential and high economic value especially in the food, pharmaceutical, textile, cosmetic and paper industries. This work was designed to improve the yield and productivity of sorrel. Soil samples were collected from the University of Maiduguri Agricultural Research farm. Fertilizer treatment application and seed sowing were carried out. Weekly measurements of growth parameters including plant height, stem girth, number of leaves per plant and number of branches per plant were observed. Physicochemical composition of pre-treated soil and the chemical composition of the post-treated soils were determined by standard methods. Vitamin A contents of the calyces were determined by HPLC, Vitamin C contents of the calyces were determined by 2,6-dichloroindophenol titrimetric method, mineral contents (P, K, Na, Ca, Mg, Zn and Fe) of the calyces were determined by Atomic Absorption Spectroscopy (AAS).

**Keywords:** fertilizer, organic, inorganic, vitamins, minerals, sorrel, soil.

**GJSFR-C Classification:** FOR Code: 069999



EFFECTS OF ORGANIC AND INORGANIC FERTILIZERS ON SOME VITAMINS AND MINERAL CONTENTS OF *HIBISCUS SABDARIFFA LINN* (SORREL)

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# Effects of Organic and Inorganic Fertilizers on Some Vitamins and Mineral Contents of *Hibiscus Sabdariffa linn* (Sorrel)

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**Abstract-** *Hibiscus sabdariffa* (sorrel) is an annual plant belonging to the family Malvaceae. It has great potential and high economic value especially in the food, pharmaceutical, textile, cosmetic and paper industries. This work was designed to improve the yield and productivity of sorrel. Soil samples were collected from the University of Maiduguri Agricultural Research farm. Fertilizer treatment application and seed sowing were carried out. Weekly measurements of growth parameters including plant height, stem girth, number of leaves per plant and number of branches per plant were observed. Physicochemical composition of pre-treated soil and the chemical composition of the post-treated soils were determined by standard methods. Vitamin A contents of the calyces were determined by HPLC, Vitamin C contents of the calyces were determined by 2,6-dichloroindophenol titrimetric method, mineral contents (P, K, Na, Ca, Mg, Zn and Fe) of the calyces were determined by Atomic Absorption Spectroscopy (AAS). The results for vitamins A and C showed treatments involving 1/2NPK+10CD (0.78µg/g) and 0NPK+20CD (2.07µg/g) produced the highest calyx contents of vitamins A and C respectively. Treatments involving fullNPK+10CD (0.22mg/g), 0NPK+30CD (4.87mg/g), 1/2NPK+30CD (538.00mg/g), 1/2NPK+30CD (0.92mg/g), fullNPK+30CD (0.67mg/g), 1/2NPK+10CD (1.42mg/g) and 1/2NPK+20CD (0.29mg/g) produced the highest calyx contents of phosphorus, potassium, sodium, calcium, magnesium, zinc and iron respectively. From the study, fertilizer application has greatly increased the yield and productivity of both growth and biochemical parameters thus, fertilizer treatment is necessary for improving the quantity and quality of a plant and its products.

**Keywords:** fertilizer, organic, inorganic, vitamins, minerals, sorrel, soil.

## 1. INTRODUCTION

Sorrel (*Hibiscus Sabdariffa Linn*) is a shrub belonging to the family Malvaceae (Mahadevan *et al.*, 2012). It is an annual shrub cultivated in sub-tropical and tropical zones (Kosakowska *et al.*, 2005) for its stem fibres, edible calyces, leaves and seeds. Sorrel is resistant to relatively high temperatures throughout the growing and fruiting period (Tommes, 1990). Sorrel is a short- day crop with a critical photoperiod of 12 to 12.5 hours, and progresses best in hot, dry regions with a high humidity and temperature of about 25°C to 35°C (Hacket *et al.*, 1982). The leaves are consumed as a green cooked vegetable especially in soups (Fasoyiro *et*

*al.*, 2005) while the stems are a source of pulp for the paper industry (Small *et al.*, 1991). The red acid succulent calyces are boiled with sugar to produce sorrel drink. Oil is extracted from the seeds and the residue is usually used in a fermented form as soup or cake (Aliyu, 2000). The most exploited part of a sorrel plant is its calyces which may be green, white, red and dark red (Schippers, 2000). The red calyces contain antioxidants including flavonoids, gossypetine, hibiscetine and sabdaretine (Qi *et al.*, 2005). They are also rich in vitamins and minerals such as riboflavin, ascorbic acid, niacin, carotene, calcium and iron that are nutritionally important (Mahadevan, 2009) as well as amino acids and mineral salts (Cissi'e *et al.*, 2009).

Vitamins and minerals are vital nutrients in human and animal nutrition. Vitamins are indispensable to perform various tasks within the human body in order to promote optimal health and prevent various diseases. Although, vitamins are required in minimal quantities, these quantities cannot be synthesized by the human body, hence, they rely on easily available animal and plant sources for replenishment. Vitamins have diverse biochemical functions. Some, such as vitamin D, have hormone- like functions as regulators of cell and tissue growth and differentiation (such as some forms of vitamin A). Others function as antioxidants (vitamin E and sometimes C) (Bender, 2003). The largest number of vitamins, the B complex vitamins, function as enzyme co-factors (coenzymes) or their precursor.

Minerals are indispensable part of a complete diet of animals. They serve as structural components of body tissues, they are involved in maintenance of acid-base balance and regulation of body fluids, in transport of gases and in muscle contractions. Minerals are chemical elements required as essential nutrients by organism to perform functions necessary for life. (Berdanier *et al.*, 2013). Most of the minerals in a human diet come from plant and animal sources or from drinking water. From the above, the importance of vitamins and minerals cannot be overemphasized and hence, this work was designed to investigate the effects of fertilizer application on some vitamins and mineral contents of sorrel (*Hibiscus sabdariffa*).

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## II. MATERIALS AND METHODS

### a) Chemicals

All chemicals used for the analysis were of analytical grade and were purchased from Guangdong Guanhua Science Tech. Co. Ltd, Shantou china.

### b) Soil collection and Preparation

Soil sample was collected from the University of Maiduguri Agricultural research farm, located in Maiduguri, at a depth of 0-20cm from ground surface. The soil was sieved using a 2.0mm mesh sieve to remove stones and debris. Soil sample was homogenized and weighed. Eight-kilogram (8kg) soil was put into 5litre plastic pot. A total of 36 plastic pots divided into 12 treatments were used. The physicochemical composition of the soil was determined before treatment application using standard procedures which involved Kjeldahl method (Kjeldahl, 1982) for total nitrogen, pH and electrical conductivity (EC) by pH meter and EC meter, soil organic carbon (OC) and organic matter by the Walkley and Blake (1965) method.

### c) Treatment / Experimental design

The experiment was a one-season pot experiment which comprised of 12 treatments. Treatments involved the application of two types of fertilizers to the soil sample within the pot. Three levels of inorganic fertilizer (NPK) at 0: 0: 0, 50:30:30, 25:15:15 kg/ha and four rates of organic fertilizer (cow dung) tones/ ha were used. Fertilizer application was in single and in combination. Organic fertilizer (cow dung) was applied and left to equilibrate for a period of one week before seed sowing was carried out. Inorganic fertilizer (NPK) was applied to soil sample after which seed sowing took place. Treatment was replicated three times in a Completely Randomized Design (CRD) which lasted for a period of 12 weeks.

### d) Seed Sowing and Measurements

Sorrel seeds were identified and authenticated as viable by a taxonomist from the faculty of Science, Department of Biochemistry University of Maiduguri, and three seeds were sown per pot. Various agronomic practices such as thinning and weeding was carried out to enhance high yield (Babatunde et al., 2001). Measurements of different growth parameters were carried out weekly from the time of germination to the period of termination of experiment. These growth parameters included: plant height, stem girth, number of branches per plant and numbers of leaves per plant. The plant height was measured with the aid of a meter rule, stem girth (distance around the plant) was measured with the help of a Verniercaliper. The number of branches per plant were spotted and counted as well as the number of leaves per plant.

At harvest, plants were uprooted, the stems were detached from the roots as well as the calyces from the stems, total fresh weight of stems, roots and calyces were measured with the help of a weighing balance(Gulfex Medical and Scientific England). The variables (stems, roots and calyces) were oven dried at a temperature of 65°C for 24 hours and the total dry weights were measured. Other variables measured included physicochemical composition of the post treated soil, some vitamins and mineral contents.

### e) Physicochemical Analysis of Post-Treated Soil

Physicochemical analysis of the post treated soil (after harvest) was carried out. The analysis included total nitrogen, available phosphorus, soil organic carbon (OC), organic matter (OM), electrical conductivity (EC), soil pH and exchangeable cation ( $Ca^{2+}$ ,  $Mg^{2+}$ ,  $K^+$  and  $Na^+$ ).

### f) Determination of Some Vitamins (vitamin A and C) from the calyx

Vitamin A was determined by the HPL Cmodified method (Adopted from USF 2007 volume 1). Standard preparation was carried out by dissolving an accurately weighed quantity of USP vitamin A Reference standard in n-hexane and diluted quantitatively, and a step wise to obtain a solution having a known concentration of about 15 $\mu$ g (0,015mg) of retinol acetate per ml. Assay preparation was carried out by transferring about 15mg of vitamin A ester (Retinol acetate or retinyl palmitate), accurately weighed to 100ml volumetric flask, dissolved in and diluted with n-hexane to volume and mixed. 5.0ml of this solution was pipetted into a 50ml volumetric flask, diluted with n-hexane to volume, mixed and scanned at 210nm. Sample preparation was carried out by dissolving 1g of the sample in 10ml of n-hexane, it was sonicated for 30minutes then centrifuged at 2500rpm for 10 minutes. Supernatant was collected in a cuvette and scanned in a UV spectrophotometer at 210nm. Concentration of sample was calculated using bear Lambert's law.

Vitamin C (ascorbic acid) content of the calyx was determined by the 2,6-dichloroindophenol titrimetric method (AOAC Method 967.21).

### g) Determination of Mineral Elements (Ca, P, Fe, K, Na, Zn and Mg)

Some mineral element contents of the calyx were determined by the standard Atomic Absorption Spectrophotometric method (AAS).

Analysis of variance (ANOVA) was used to analyze the data with the aid of a statistical package statistix 10.0 Microsoft (2005). The differences between the treatment means were separated using the Duncan Multiple Range Test (DMRT) at 5% probability level.

### III. RESULTS AND DISCUSSION

#### a) Physicochemical Properties of Pretreated Soil

The physicochemical properties of the pretreated soil (prior) to experiment is presented in table 1. The pH of the soil was basic (8.8), with an electrical conductivity of 0.64 dS/m. The nitrogen content of the soil was low (6.5g/kg). The soil has moderate amount of organic carbon (13.25%) and a very low phosphorus content (0.11mg/kg). The exchangeable cations recorded respective values of potassium (4.0Cmol/kg), sodium (0.12Cmol/kg), calcium (73.0Cmol/kg) and magnesium (24.0Cmol/kg). Similarly, the texture of the soil was loamy sand in nature which comprised of 77.10% sand, 15.70% silt and 7.20% clay respectively.

Application of fertilizer (organic and inorganic) to the soil have shown significant effects on the soil and biochemical parameters of *Hibiscus sabdariffa* Linn (sorrel). The soil was analyzed appropriately for pre (before experiment) and post (after experiment) physicochemical properties. The physicochemical properties of the post treated soil showed increase in the nitrogen content of the soil, as well as pH and EC. This is as a result of nitrogen fertilization via NPK and cow dung, which is in harmony with the findings of Khandar et al., (1986) and Harrera et al., (1987) who reported that fertilizer improves soil properties, water retention capacity, pH and better availability of micro nutrients.

**Table 1:** Physicochemical Properties of Pre-treated Soil

| Parameter                      | Value      |
|--------------------------------|------------|
| pH (1:2:5 Soil water)          | 8.8        |
| EC (dS/m)                      | 0.64       |
| OC (g/kg)                      | 13.25      |
| Total N (g/kg)                 | 6.5        |
| Available P (mg/kg)            | 0.11       |
| Exchangeable cations (Cmol/kg) |            |
| K                              | 4.0        |
| Na                             | 0.12       |
| Ca                             | 73.0       |
| Mg                             | 24.0       |
| CEC (Cmol/kg)                  | 14.50      |
| Particle size distribution (%) |            |
| Sand                           | 77.10      |
| Silt                           | 15.70      |
| Clay                           | 7.20       |
| Texture                        | Loamy sand |

#### b) Composition of Cow Dung

The composition of organic fertilizer (cow dung) used in the study is presented in table 2. It was composed of different compositions of mineral elements, with nitrogen (15.5%), phosphorus 10.89%),

calcium (3.05%), magnesium (0.57%), potassium (2.03%), sodium(0.54%), zinc (10.66mg/g), copper (20.29mg/g), iron (5.77mg/g) and manganese (5.11mg/g) respectively.

**Table 2:** Composition of Cow dung

| Parameter | Value     |
|-----------|-----------|
| N         | 15.5%     |
| P         | 10.89%    |
| Ca        | 3.05%     |
| Mg        | 0.57%     |
| K         | 2.03%     |
| Na        | 0.54%     |
| Zn        | 10.66mg/g |
| Cu        | 20.29mg/g |
| Fe        | 5.77mg/g  |
| Mn        | 5.11mg/g  |

#### c) Chemical Properties of Post Treated Soil (After experiment)

The chemical properties of the post treated soil (after experiment) is presented in table 3. Different rates

of organic fertilizer (cow dung) and inorganic fertilizer (NPK) applied in single and in combinations, recorded respective values for electrical conductivity (510dS/m, 510dS/m, 631dS/m, 437dS/m, 524dS/m, 538dS/m,

336dS/m, 429dS/m, 413dS/m, 430dS/m, 443dS/m and 636dS/m) across the column from treatments 1to12 respectively. Similarly, respective values for nitrogen, phosphorus, potassium, sodium, calcium, magnesium, zinc and copper were also recorded, with manganese

(0.14mg/kg, 0.31mg/kg, 0.21mg/kg, 0.19mg/kg, 0.20mg/kg, 0.30mg/kg, 0.19mg/kg, 0.27mg/kg, 0.33mg/kg, 0.22mg/kg, 0.23mg/kg, 0.14mg/kg) which was also recorded across the column from treatments 1 to 12.

**Table 3:** Effects of cow dung and NPK fertilizers on the chemical properties of the post treated soils

| Fertilizer rates | pH (1:2:5 soil water) | EC (dS/m)           | N (mg/kg)           | P (mg/kg)          | K (mg/kg)           | Na (Cmol/kg)      | Ca                  | Mg                 | Zn                 | Cu (mg/kg)        | Mn                 |
|------------------|-----------------------|---------------------|---------------------|--------------------|---------------------|-------------------|---------------------|--------------------|--------------------|-------------------|--------------------|
| ONPK+OCD         | 8.40 <sup>a</sup>     | 510.00 <sup>b</sup> | 6.50 <sup>a</sup>   | 5.00 <sup>ab</sup> | 5.00 <sup>bcd</sup> | 0.10 <sup>b</sup> | 64.00 <sup>cd</sup> | 21.00 <sup>c</sup> | 0.42 <sup>b</sup>  | 2.16 <sup>a</sup> | 0.14 <sup>e</sup>  |
| ONPK+1OCD        | 9.00 <sup>a</sup>     | 510.00 <sup>b</sup> | 6.60 <sup>a</sup>   | 3.07 <sup>c</sup>  | 3.07 <sup>ef</sup>  | 0.12 <sup>b</sup> | 55.00 <sup>ef</sup> | 17.90 <sup>d</sup> | 0.37 <sup>bc</sup> | 0.16 <sup>b</sup> | 0.31 <sup>ab</sup> |
| ONPK+2OCD        | 8.70 <sup>a</sup>     | 631.00 <sup>a</sup> | 7.20 <sup>ab</sup>  | 4.00 <sup>bc</sup> | 4.00 <sup>de</sup>  | 0.09 <sup>b</sup> | 49.00 <sup>a</sup>  | 16.00 <sup>e</sup> | 0.33 <sup>cd</sup> | 0.13 <sup>b</sup> | 0.21 <sup>d</sup>  |
| ONPK+3OCD        | 8.60 <sup>a</sup>     | 437.00 <sup>c</sup> | 8.23 <sup>d-g</sup> | 6.00 <sup>a</sup>  | 6.00 <sup>ab</sup>  | 0.12 <sup>b</sup> | 71.00 <sup>b</sup>  | 24.00 <sup>b</sup> | 0.26 <sup>e</sup>  | 0.10 <sup>b</sup> | 0.19 <sup>d</sup>  |
| 1/2NPK+OCD       | 9.00 <sup>a</sup>     | 524.00 <sup>b</sup> | 7.40 <sup>a</sup>   | 0.07 <sup>d</sup>  | 4.67 <sup>cd</sup>  | 0.11 <sup>b</sup> | 60.00 <sup>de</sup> | 19.00 <sup>d</sup> | 0.39 <sup>bc</sup> | 0.18 <sup>b</sup> | 0.20 <sup>d</sup>  |
| 1/2NPK+1OCD      | 8.40 <sup>a</sup>     | 538.00 <sup>b</sup> | 8.90 <sup>def</sup> | 2.68 <sup>c</sup>  | 4.20 <sup>cd</sup>  | 0.10 <sup>b</sup> | 66.00 <sup>bc</sup> | 22.00 <sup>c</sup> | 0.52 <sup>a</sup>  | 0.20 <sup>b</sup> | 0.30 <sup>ab</sup> |
| 1/2NPK+2OCD      | 8.60 <sup>a</sup>     | 336.00 <sup>d</sup> | 9.20 <sup>cd</sup>  | 0.14 <sup>d</sup>  | 5.00 <sup>bcd</sup> | 0.10 <sup>b</sup> | 48.00 <sup>a</sup>  | 16.00 <sup>e</sup> | 0.41 <sup>b</sup>  | 0.14 <sup>b</sup> | 0.19 <sup>d</sup>  |
| 1/2NPK+3OCD      | 9.10 <sup>a</sup>     | 429.00 <sup>c</sup> | 9.40 <sup>cd</sup>  | 0.20 <sup>d</sup>  | 2.10 <sup>f</sup>   | 0.07 <sup>b</sup> | 30.00 <sup>h</sup>  | 10.00 <sup>f</sup> | 0.33 <sup>cd</sup> | 0.16 <sup>b</sup> | 0.27 <sup>bc</sup> |
| FullNPK+OCD      | 8.70 <sup>a</sup>     | 413.00 <sup>c</sup> | 9.00 <sup>de</sup>  | 0.05 <sup>d</sup>  | 5.20 <sup>abc</sup> | 0.08 <sup>b</sup> | 77.00 <sup>a</sup>  | 26.00 <sup>a</sup> | 0.33 <sup>cd</sup> | 0.18 <sup>b</sup> | 0.33 <sup>a</sup>  |
| FullNPK+1OCD     | 8.40 <sup>a</sup>     | 430.00 <sup>c</sup> | 10.90 <sup>c</sup>  | 0.16 <sup>d</sup>  | 3.00 <sup>ef</sup>  | 0.09 <sup>b</sup> | 53.00 <sup>ab</sup> | 8.00 <sup>g</sup>  | 0.40 <sup>b</sup>  | 0.21 <sup>b</sup> | 0.22 <sup>d</sup>  |
| FullNPK+2OCD     | 8.40 <sup>a</sup>     | 443.00 <sup>c</sup> | 13.00 <sup>b</sup>  | 0.21 <sup>d</sup>  | 4.00 <sup>de</sup>  | 0.40 <sup>a</sup> | 48.00 <sup>a</sup>  | 16.00 <sup>e</sup> | 0.30 <sup>de</sup> | 0.22 <sup>b</sup> | 0.23 <sup>cd</sup> |
| FullNPK+3OCD     | 9.30 <sup>a</sup>     | 636.00 <sup>a</sup> | 17.50 <sup>a</sup>  | 0.17 <sup>d</sup>  | 6.10 <sup>a</sup>   | 0.06 <sup>b</sup> | 20.00 <sup>i</sup>  | 7.00 <sup>g</sup>  | 0.41 <sup>de</sup> | 0.13 <sup>b</sup> | 0.14 <sup>e</sup>  |
| SEM±             | 0.609                 | 16.684              | 0.612               | 0.476              | 0.376               | 0.476             | 1.937               | 0.417              | 0.022              | 0.576             | 0.014              |

Data expressed as means; n=3; CD= Cow dung; 1/2 and Full NPK = 25:15:15 and 50:30:30 respectively; Means in column within the same treatment followed by the same letter(s) do not differ significantly at  $p < 0.05$ .

#### Effects of Organic (cow dung) and Inorganic (NPK) Fertilizers on Some Mineral Elements and Vitamin Contents of Sorrel Calyces.

The effects of cow dung and NPK on some minerals and vitamin contents of sorrel calyces are presented in table 4.4. The different rates of fertilizers applied, resulted in appreciable values of P, K, Na, Ca, Mg, Zn, Fe, vitamin A and C respectively. Variations were observed among the minerals and vitamin contents as a result of the different fertilizer rates that were used. Treatment involving full NPK + 0 CD (0.22 mg/g) produced the highest contents of P and treatments involving 0 NPK + 10 CD (0.11mg/g) and 1/2 NPK + 10 CD (0.11 mg/g) recorded the lowest P contents of the calyces. Treatment involving 0 NPK + 30 CD (4.87 mg/g) produced the highest K contents of the calyces. Similarly, treatment involving full NPK + 0 CD (0.83 mg/g) produced the lowest K contents of the calyces. Again, treatment involving 1/2 NPK+30 CD (538.00 mg/g) recorded the highest Na content and treatment involving 0 NPK + 20 CD (313.33 mg/g) recorded the lowest Na content. The highest content of Ca was produced with treatment involving 1/2 NPK + 30 CD (0.92 mg/g) while treatment involving 1/2 NPK + 10 CD (0.21 mg/g) recorded the lowest content of Ca in the calyces. Treatments involving full NPK + 0 CD (0.67 mg/g) and 0 NPK, 0 CD (0.12 mg/g) produced the highest and lowest Mg content of the calyces respectively. The table also shows treatment involving

1/2 NPK + 10 CD (1.42 mg/g) and control treatment 0 NPK, 0 CD (0.15 mg/g) which recorded the highest as well as the lowest content of Zn in the calyces. In the case of Fe, treatment involving 1/2 NPK + 30 CD (1.14 mg/g) recorded the highest content of Fe in the calyces whereas, treatment involving full NPK+ 0 CD (0.13 mg/g) recorded the lowest content of Fe in the calyces.

The vitamin A and C (ascorbic acid) contents of the calyces are also presented in table 4.4. Variations were observed among the vitamin contents produced by the various fertilizer rates. Treatment involving 1/2 NPK + 10 CD (0.78  $\mu$ g/g) and the control treatment 0 NPK, 0 CD (0.01  $\mu$ g/g) recorded the highest and lowest contents of vitamin A in the calyces. Similarly, treatments involving 0 NPK + 20 CD (2.07  $\mu$ g/g) and full NPK + 0 CD (0.50  $\mu$ g/g) produced the highest as well as the lowest contents of vitamin C in the calyces.

Similarly, application of fertilizer to the soil also showed significant effect on some minerals and vitamin contents of sorrel. Variations were observed in the nutrient contents of the calyces of sorrel, which has previously been reported by some researchers among whom are Ciss'e et al., (2009), who reported that the fresh calyces of *Hibiscus sabdariffa* Linn are very rich in mineral salts. Wong et al., (2002) also reported that the calyces of *Hibiscus sabdariffa* Linn have been found to be rich in vitamins. Comparably, Babalola et al. (2000) also pointed out that the calyces of *Hibiscus sabdariffa* Linn is rich in minerals. Likewise, Amin et al., (2008)

reported that the calyces of sorrel contains nine times more vitamin C than citrus (*Citrus sinensis*). Again, Jung et al., (2013), also reported that the calyces of sorrel is rich in ascorbic acid and minerals especially calcium and iron. The findings are also in agreement with the findings of Mahadevan et al., (2009) who found out that the fresh calyces of sorrel are also rich in ascorbic acid, carotenoid, calcium, iron, that are nutritionally important. Other researchers like Seung et al., (2000), have investigated and reported on the effects of fertilizer application on vitamins. He pointed out that fertilizers have influence on vitamin contents of sorrel, which is also in harmony with the findings of Christin et al., (2005), who reported that increasing fertilizer rates increases the concentration of carotene (provitamin A) of parsley. It is also in line with the findings of Biesiada et al., 2008, who reported that increasing nitrogen fertilizer increases the concentration of carotenoids in Lavender, which is also in uniformity with the findings of Zameer Khan et al., (2010) who reported that quality biochemical parameters like carotene and vitamin C contents are also affected with phosphorus and potassium fertilization. This finding also agrees with the finding of Lola, (2009), who reported that vegetables are rich sources of minerals with leafy vegetables being the most sources of minerals.

The concentrations of Mg, Na and Zn from the study carried out are high, which may be recommended

for the consumption of this vegetable. This is so because Magnesium is one of the abundant ions present in living cells, it is involved in many essential metabolic reactions. Mg is an essential cofactor in almost all enzymatic systems involved in DNA processing. It is required by the adenosine triphosphate (ATP) synthesizing protein in mitochondria and required at a number of steps during the synthesis of nucleic acid (DNA and RNA) and proteins. Mg plays a structural role in bone, membranes and chromosomes (Hartwig, 2001). Sodium is necessary for maintenance of electrolyte balance and fluid balance, for heart activity and certain metabolic functions (Pohl et al., 2013). Zinc is important for immune function (McCarthy et al., 1992; Solomons, 1998) wound healing, protein synthesis, DNA synthesis and cell division (Prasad et al., 1995). It is also required for proper sense of taste and smell (Heyneman, 1996; Prasad et al., 1997). It also supports normal growth and development during pregnancy, childhood and adolescence (Simmer et al., 1985; Fabriset et al., 1995; Maretet et al., 2006). Vitamin A is required for somatic function or systemic function, reproduction (spermatogenesis, oogenesis, placental development, fetal and embryonic growth) and for visual processes and Vitamin C enhances the human immune defense system.

Table 4: Effects of cow dung and NPK fertilizers on minerals and vitamin contents

| Fertilizer rates | P                    | K                   | Na                    | Ca (%)             | Mg                 | Zn (mg/g)          | Fe                  | Vit A(μg/g)       | Vit C               |
|------------------|----------------------|---------------------|-----------------------|--------------------|--------------------|--------------------|---------------------|-------------------|---------------------|
| ONPK, 0CD        | 0.21 <sup>ab</sup> b | 3.50 <sup>b</sup>   | 398.33 <sup>cde</sup> | 0.42 <sup>c</sup>  | 0.12 <sup>c</sup>  | 0.15 <sup>f</sup>  | 0.21 <sup>cd</sup>  | 0.01 <sup>l</sup> | 1.43 <sup>abc</sup> |
| ONPK + 10CD      | 0.11 <sup>f</sup>    | 3.07 <sup>bc</sup>  | 363.67 <sup>de</sup>  | 0.31 <sup>d</sup>  | 0.57 <sup>ab</sup> | 0.18 <sup>ef</sup> | 0.17 <sup>d-g</sup> | 0.23 <sup>g</sup> | 1.53 <sup>abc</sup> |
| ONPK + 20CD      | 0.21 <sup>ab</sup>   | 3.43 <sup>b</sup>   | 313.33 <sup>e</sup>   | 0.42 <sup>c</sup>  | 0.14 <sup>c</sup>  | 0.38 <sup>d</sup>  | 0.22 <sup>cd</sup>  | 0.46 <sup>e</sup> | 2.07 <sup>a</sup>   |
| ONPK + 30CD      | 0.18 <sup>bc</sup>   | 4.87 <sup>a</sup>   | 502.00 <sup>abc</sup> | 0.40 <sup>c</sup>  | 0.51 <sup>ab</sup> | 0.61 <sup>b</sup>  | 0.14 <sup>fg</sup>  | 0.02 <sup>k</sup> | 1.60 <sup>abc</sup> |
| 1/2NPK + 0CD     | 0.15 <sup>cde</sup>  | 2.67 <sup>bcd</sup> | 449.00 <sup>a-d</sup> | 0.33 <sup>d</sup>  | 0.10 <sup>c</sup>  | 0.43 <sup>cd</sup> | 0.16 <sup>efg</sup> | 0.60 <sup>d</sup> | 1.13 <sup>bcd</sup> |
| 1/2NPK + 10CD    | 0.11 <sup>f</sup>    | 3.60 <sup>b</sup>   | 449.33 <sup>a-d</sup> | 0.21 <sup>e</sup>  | 0.66 <sup>a</sup>  | 1.42 <sup>a</sup>  | 0.18 <sup>cf</sup>  | 0.78 <sup>a</sup> | 1.40 <sup>bc</sup>  |
| 1/2NPK + 20CD    | 0.18 <sup>bc</sup>   | 1.50 <sup>ef</sup>  | 513.00 <sup>ab</sup>  | 0.37 <sup>cd</sup> | 0.17 <sup>c</sup>  | 0.45 <sup>cd</sup> | 0.29 <sup>b</sup>   | 0.71 <sup>b</sup> | 1.47 <sup>abc</sup> |
| 1/2NPK + 30CD    | 0.21 <sup>ab</sup>   | 1.80 <sup>def</sup> | 538.00 <sup>a</sup>   | 0.92 <sup>a</sup>  | 0.32 <sup>bc</sup> | 0.51 <sup>c</sup>  | 1.14 <sup>a</sup>   | 0.03 <sup>j</sup> | 1.53 <sup>abc</sup> |
| FULLNPK+0CD      | 0.13 <sup>def</sup>  | 2.23 <sup>cde</sup> | 493.33 <sup>abc</sup> | 0.31 <sup>d</sup>  | 0.07 <sup>c</sup>  | 0.17 <sup>ef</sup> | 0.13 <sup>g</sup>   | 0.42 <sup>f</sup> | 1.40 <sup>bc</sup>  |
| FULLNPK+10CD     | 0.22 <sup>a</sup>    | 1.80 <sup>def</sup> | 426.33 <sup>bcd</sup> | 0.69 <sup>b</sup>  | 0.20 <sup>c</sup>  | 1.35 <sup>a</sup>  | 0.22 <sup>c</sup>   | 0.67 <sup>c</sup> | 1.70 <sup>ab</sup>  |
| FULLNPK+20CD     | 0.17 <sup>cd</sup>   | 1.67 <sup>def</sup> | 473.67 <sup>abc</sup> | 0.43 <sup>c</sup>  | 0.17 <sup>c</sup>  | 0.47 <sup>c</sup>  | 0.14 <sup>fg</sup>  | 0.66 <sup>i</sup> | 0.97 <sup>cd</sup>  |
| FULLNPK+30CD     | 0.13 <sup>ef</sup>   | 0.83 <sup>f</sup>   | 466.33 <sup>a-d</sup> | 0.33 <sup>d</sup>  | 0.67 <sup>a</sup>  | 0.24 <sup>e</sup>  | 0.19 <sup>cde</sup> | 0.20 <sup>h</sup> | 0.50 <sup>d</sup>   |
| SEM±             | 0.013                | 0.375               | 36.388                | 0.224              | 0.097              | 0.029              | 0.013               | 0.001             | 0.223               |

Data expressed as means; n=3; CD= Cow dung; 1/2 and Full NPK = 25:15:15 and 50:30:30 respectively; Means in column within the same treatment followed by the same letter(s) do not differ significantly at p<0.05.

#### IV. CONCLUSION

In conclusion, fertilizer treatment has tremendously influenced the soil, as well as some vitamins and mineral contents of sorrel. In particular, combination treatment of organic and inorganic

fertilizers produced the highest nitrogen contents and other essential amount of nutrients that was made available to sorrel plant as nitrogen is the key plant nutrient in the production of crops and an important component responsible for photosynthetic activity and crop yield capacity. Thus, the vitamin and mineral

contents of sorrel were significantly affected by the fertilizer application via the increase of essential nutrients in the soil. Therefore, based on the result of the experiment, combination treatment involving varying rates of organic (cow dung) and inorganic (NPK) fertilizers should be encouraged for maximum levels of vitamins and minerals of sorrel.

## REFERENCES RÉFÉRENCES REFERENCIAS

1. Aliyu M. S., Salih W. M, Mohammed A. H., Homeida A.M. (2000). Investigation on the Antispasmodic Potentials of *Hibiscus sabdariffa* Calyces. *Ethnopharmacol.* 31:249-257.
2. Amin I, Hainida EKI, Halimatul SMN (2008). Roselle (*Hibiscus sabdariffa* L.) seeds- National composition, protein quality and health benefits. *Foods*. 2(1):1-16.
3. Babalola, S. O., A. O. Babalola, and O. C. Aworh. 2001. Compositional attributes of the calyces of Roselle (*Hibiscus sabdariffa* L.). *The Journal of Food Technology in Africa*, 6(4): 133-134.
4. Babatunde, FE (2001). Response of Red Variant Roselle (*Hibiscus sabdariffa* L.) to Some Agronomic Practices Unpublished Ph. D.Thesis presented to the Postgraduate School, Abubakar Tafawa Balewa University, Bauchi, Nigeria. pp. 116
5. Bender, David A. (2003). Nutritional Biochemistry of the Vitamins. Cambridge, U.K. *Cambridge University Press*. ISBN 978-0-521-86388-5.
6. Berdanier, Carolyn D; Dwyer, Johanna T, Heber, David (2013). Handbook of Nutrition and Food (Third edition). CRC Press. P. 199. ISBN 978-1-4665-0572-8. Retrieved 3<sup>rd</sup> July 2016.
7. Biesiada, A.; Sokol-Letowska, A.; A. (2008). The Effect of Nitrogen Fertilization on Yielding and Antioxidant Activity of Lavender (*Lavandula angustifolia*). *Acta Science*.7:33 – 40.
8. Christin, H.C.; Dean, A.K.; David, E.K. (2005). Nitrogen Concentration Affects Nutrient and Carotenoid Accumulation in Parsley. *Journal of Plant Nutrition*.28, 285 – 297.
9. Ciss'e M. Dornier M, sakho M, N' Dtaye A Reynes, M, Sack O (2009). Le Bissap(*Hibiscus sabdariffa* L): composition et Principals Utilizatio. *Fruits* 64(3): 179-134.
10. Fabris N, Moc'chegiani 6 (1995). Zinc, Human Diseases and As Redox Sensors and Signal Transducers, *Antioxid. Redox signal*. 8, 1419-1441.
11. Fasoyiro SB, Ashaye OA, Adeola, A, Samuel FO(2005). Chemical and Storability of Fruits Flavored (*Hibiscus sabdariffa*) drinks. *Word J. Agricultural Science*.
12. Hacket C, Carolene J, (1982). Edible Horticultural Crops: A Compendium of Information on Fruits, Vegetables, Spice and Nut Spicies. *Academic Press*. Australia, p. 17.
13. Hartwig A. (2001) Role of Magnesium Genomic Stability. *Mutation Resources*; 475(1-2):112-21.
14. Herrera R, Aranguren J, Escalante G, Acardi A, Navidad E, Toro M and Cuenca G (1987) Coffee and cacao plantations under shade trees in Venezuela. In: Beer J, Fassbender HW and Heuvelodop J, eds, *Advances in Agroforestry Research*, pp 173–181. Serie Tecnica No 117. CATIE, Turrialba, Costa Rica.
15. Heyneman C.A (1996). Zinc Deficiency and Taste Disorders. *Annual pharmacother*, 30:186-7.
16. Jung, E.K.; Kim, Y.J. and Joo, N. (2013). Physicochemical properties and Antimicrobial activity of Roselle (*Hibiscus sabdariffa* L.). *J. Sci. Food Agric.*, 93: 3769–3776.
17. Khandar U. R, Nigam K.B (1986). Effect of Farmacyard Manure and Fertility on Growth and Yield of Ginger (*zingiberofficinale*). *Ind. Journal of Agricultural Science*, 66:549-550.
18. Kosakowska O. (2005). Sterole and Fatty Acid in the Seeds of Roselle (*Hibiscus sabdariffa* L) cultivation inEgypt. *Herbapolonica*58: 108-112.
19. Lola, A. (2009). The Effect of Boiling on Nutrients and Anti-Nutrients in Two Non Conventional Vegetables. *Pakistan Journal of Nutrition*, 18:1430-1433.
20. Mahadevan, N-shivali and P,kamboj (2009). *Hibiscus sabdariffa* Linn, - an overview *Natural product radiance*, 8(1): 77-83.
21. Mahadevan, N-shivali and P, kamboj (2009). *Hibiscus sabdariffa* Linn, - an overview *Natural product radiance*, 8(1): 77-83.
22. Maret W, Sandstead HH (2006) Zinc requirements and the risks and benefits of zinc supplementation. *J Trace Elem Med Biol* 20:3–18.
23. McCarthy T.J, Zeelic J.J. Krause D. J. (1992). The Antimicrobial Action of Zinc Ion/Antioxidant Combinations. *Clinical Pharmacology and Therapeutics* 17:15.
24. N. W. Solomons, Mild human zinc deficiency produces an imbalance between cell-mediated and humoral immunity, *Nutr. Rev.* 56, 27–28 (1998).
25. Pohl, Hanna R.; Wheeler, Johns; Murray, H. Edward (2013). "Chapter 2. Sodium and Potassium in Health and Disease". In Astrid sigel, Helmut sigel and Roland K-o-siegel. *Interrelations between Essential metal Ions and Human Diseases. Metal Ions in Life Science. Springer*. 13 Pp 29-47.
26. Prasad A. S. (1995). Zinc: an overview. *Nutrition*, 11:3-9
27. Prasad A.S, Beck F.W, Grabowski S.M, Kaplan J, Mathog R.H (1997). Zinc Deficiency: Changes in Cytokine Production and T-cell Subpopulations in patients with head and neck cancer and in non-cancer subject. *Pix. Association. AM. Physicians*, 109:68-77.

28. Qi, Z., Hao, C.M Langenbach, R.I, Breyer, R.M, Pedha, R., Morrow J. D Breyer, M.D., (2005). Opposite Effects of Cyclooxygenase-land-2 Activity on the Pressor Response to Angiotensin ii. *Journal of clinicalinvestigation*110:61-69.
29. Schippers, R.R. (2000). African Indigenous Vegetables: An Overview of the Cultivated Species. University of Greenwich, *Natural Resources Institute London, UK*, 2000.
30. Seung, K.L.; Adel, A.K. (2000): Preharvest and Postharvest Factors Influencing Vitamin C Content of Horticultural Crops. *Postharvest Biology Technology*. 20:207-220.
31. Simmer K, Thompson R.P (1985). Zinc in The Foetus and New Born. Actapaediator. *Scand suppl*. 319:158-63
32. Small, T. and E.G. Rhoden. 1991. Production and nitrogen uptake of rozelle. *Hort Science* 26:738 (Abstr).
33. Tomme, P, Heriban, V & Claeysens, M (1990) Adsorption of two cellobiohydrolases from *Trichoderma reesei* to Avicel: evidence for 'exo-exo' synergism and possible 'loose complex' formation. *Biotech. Lett*. 121: 525–530
34. Wong, P.K., S. Yusof, H.M. Ghazali and Y.B. Che Man, 2002. Physico-chemical characteristics of roselle (*Hibiscus sabdariffa* L.). *Nutr. Food Sci.*, 32: 68-73.
35. Zameer Khan, M.; Ehsan Akhtar, M.; Naeem Safdar, M.; Masd Mahmood, M.; Ahmad, S.; Ahmed, N. (2010). Effect of Source and Level of Potash on Yield and Quality of Potato Tubers. *Pak. Journal of Botany*.42: 3137 – 3145.

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# Effect of Sub Lethal Cadmium Concentrations on Serum Biochemical Parameters in Seabream (*Sparusaurata*) Fingerlings

By Hussien M. EL - Shafei

**Abstract-** Cadmium (Cd) is a heavy metal with limited biological function, is widely distributed in the aquatic environment as a result of natural and anthropogenic activities. The effect of exposure on gilthead sea bream (*Sparusaurata*) fingerlings to sub-lethal concentrations of Cd was evaluated as levels of Cd content. The main objective of this study was to determine the effects of cadmium at sub-lethal concentrations (1 and 3  $\mu\text{g/L}$ ) on serum biochemical parameters including enzymes, i.e. alkaline phosphatase (ALP), aspartate amino transferase (AST) and alanine amino transferase (ALT), glucose, triglyceride, cholesterol and total protein in seabream (*S. aurata*) fingerlings, sea bream were exposed to cadmium at intervals of 1, 15, and 30 days, selected parameters were evaluated. Triglyceride and cholesterol decreased transiently at day 15 and then increased at day 30. Total protein, AST, ALT and ALP increased linearly by time and Cd concentration. This investigation suggests that growth and serum biochemical parameters could be used as important and sensitive biomarkers in ecotoxicological studies concerning the effects of metal contamination and fish health.

**Keywords:** cadmium, sea bream, aspartate amino transferees, total protein.

**GJSFR-C Classification:** FOR Code: 300799p



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## I. INTRODUCTION

Various environmental conditions of marine ecosystems may cause several changes in the serum biochemical parameters of the sea bream (*Acanthopagruslatus*) fish [1]. Heavy metals have received considerable attention due to their toxicity and accumulation. The increase in industrial activities, as well as in the use of chemical fertilizers and pesticides in the agricultural practice during the past few decades led to the marked rise of heavy metals in the environment. Fish serum may reflect the status of many biochemical processes in metabolism. Heavy metals, as environmental stressors, may alter serum biochemical parameters in fishes [2]. Cadmium is a common environmental pollutants has a direct correlation with fish serum biochemical abnormalities [3]. Some of the physiological effects of chronic exposure to waterborne cadmium at sub-lethal levels are manifested in the form of disturbances in respiration [4], [5], reduction in growth [6] disruption in whole-body or plasma ion regulation [7], [8], and changes in hematology, enzyme activity [9], [10], [11], and other blood parameters, such

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as glucose, total protein, triglyceride and cortisol that reveal the stress response in fish, the activity of total protein showed depletion. Glucose was significantly increased [1], [12], [13]. Cadmium concentration at sub-lethal levels have been found to decrease in growth in juvenile and adult rainbow trout (*Oncorhynchus-mykiss*) [6], as well as to mortality and reduced growth in juvenile bull trout (*Salvelinus confluentus*) [14]. and guppy (*Poecilia reticulata*) [15]. Serum enzymes such as alkaline phosphatase (ALP), alanine transaminase (ALT) and aspartate transaminase (AST) are important serum markers to study the health of animal species in question. The main objective of this study was to determine the effects of cadmium at sub-lethal concentrations (1 and 3 µg/L) on growth and serum biochemical parameters including enzymes (ALP, AST and ALT), glucose, triglyceride, cholesterol and total protein in sea bream (*S. aurata*). Generally, an exposure concentration that is lower than LC<sub>50</sub> is considered as sub-lethal. The preliminary experiment showed that 72 h-LC<sub>50</sub> of cadmium was 9 µg/L. Therefore in this study, the sub-lethal doses of cadmium (1 and 3 µg/L) were determined according to 1/9th and 1/3th of the 72 h-LC<sub>50</sub>.

## II. MATERIALS AND METHODS

### a) Fish holding conditions and acclimation

Seabream (*S. aurata*) fingerling, were collected during August 2014 from one farm at Mediterranean sea coast in Damietta city, matched for size (16.5±0.4 g; 10.5±0.3 cm), were transferred to the laboratory. They were kept in continuously aerated tanks (50 l). The physicochemical characteristics of experimental water were as shown in (Table 1). Temperature, DO (Dissolved Oxygen), TDS (total dissolved solids), and pH were monitored daily in all tanks. During an acclimation period of 2 weeks, the fish were handfed twice daily at random times. Any fish that showed abnormal behavior was removed immediately from the tanks.

### b) Exposure system

Active groups of 20 fish were randomly transferred to 160l polyethylene exposure tanks with continuous aeration. The fish were exposed to: (i) control: nominally zero cadmium [actual measured 'in-tank' value: 0.051 µg/L], (ii) low cadmium [1 µg/L] and

(iii) high cadmium [ $3 \mu\text{g/L}$ ] for 1, 15 and 30 days. Cadmium was added as  $\text{CdCl}_2 \cdot \text{H}_2\text{O}$  (Merck, Germany), each with three replicates. The water was changed every two days to minimize metal loss and maintain the concentration of metal. The water quality parameters mentioned were assessed at collection days during the experimental period.

#### c) Sampling and biochemical processing

The fish were fasting for a 24-h period before sampling. Four fish were removed from each tank on days 1, 15 and 30. Fish blood samples were collected with a hypodermic syringe from the caudal vein. Blood samples were immediately kept in a refrigerator for four h. Serum was separated from cells by centrifugation of whole blood (10 min, 4000 g,  $4^\circ\text{C}$ ) and stored at  $-48^\circ\text{C}$  until the experimental assays. The levels of ALT, AST, ALP with concentrations of glucose, triglyceride, cholesterol and total protein in the serum were measured using a Gen Way biochemical analyzer.

#### d) Statistical analysis

Initially, the raw data were checked for normality of distribution by Kolmogorov-Smirnov tests. All values were expressed as means  $\pm$  standard error. The analysis of differences between control and different sampling times in each exposure group and growth parameters was tested by one-way analysis of variance (ANOVA). The post hoc Duncan's multiple range tests was used among treatment means with SPSS 14. Significance was determined at  $P < 0.05$ .

### III. RESULTS

#### a) Serum biochemical parameters

After 15 days in both Cd-exposed groups, the concentration of glucose increased it reached  $94.3 \pm 2.4 \text{ mg/dl}$  compared to  $25.6 \pm 1.5 \text{ mg/dl}$  (control). This elevation in the glucose was transient and returned to the same level in the control group within 30 days (figure 1). After first and 15<sup>th</sup> days of exposure to different concentrations of Cd, the level of triglyceride decreased to its minimum value and reached to  $285.3 \pm 6.5 \text{ mg/dl}$  (high Cd-exposed group) compared to  $511 \pm 8.7 \text{ mg/dl}$  (control group). These reductions were then followed by a rapid elevation in 30 days so that the level of triglyceride in serum in both Cd concentrations returned to the same level in the control group (figure 2). Serum cholesterol showed a significant reduction after first and 15<sup>th</sup> days in both Cd exposed groups and returned to the same level in the control group. In the first 15 days, the cholesterol level decreased rapidly and reached to  $256 \pm 10.3 \text{ mg/dl}$  (low-dose)  $192.6 \pm 1.6 \text{ mg/dl}$  (high-dose) compared to  $328 \pm 8.2 \text{ mg/dl}$  in control group but this reduction was transient (Figure 3). Total protein in serum exhibited a linear pattern and increased after 30 days. This elevation was not significant in 15 days but increased rapidly to  $2.6 \pm 0.1 \text{ g/dl}$  (low-dose) and

$3.8 \pm 0.1 \text{ g/dl}$  (high-dose) compared to  $2.4 \pm 0.1 \text{ g/dl}$  in control group after 30 days (Figure 4 & Table 2).

#### b) Serum enzymes

Both aspartate transaminase (AST) and alanine transaminase (ALT) activities exhibited a linear pattern and increased after 30 days (figures 5 & 6). This increase was more remarkable in ALT activity for fish exposed to  $3 \mu\text{g/L}$  Cd so that after 30 days a 127% increase was observed. Following by a transient reduction, AST activity also increased after 30 days. Similarly, this elevation was greater in high concentration of Cd ( $3 \mu\text{g/L}$ ). The level of alkaline phosphatase (ALP) also exhibited remarkable increases in level from a mean control level, when the fish were exposed to the both sub-lethal concentrations of cadmium. This trend continued over time and with increasing Cd levels (figure 7).

#### c) Serum biochemical parameters

After 15 days in both Cd-exposed groups, the concentration of glucose increased and reached  $94.3 \pm 2.4 \text{ mg/dl}$  compared to  $25.6 \pm 1.5 \text{ mg/dl}$  (control). This elevation in the glucose was transient and returned to the same level in the control group within 30 days (figure 1). After the first and 15<sup>th</sup> days of exposure to different concentrations of Cd, the level of triglyceride decreased to its minimum value and reached to  $285.3 \pm 6.5 \text{ mg/dl}$  (high Cd-exposed group) compared to  $511 \pm 8.7 \text{ mg/dl}$  (the control group). These reductions were then followed by a rapid elevation in 30 days so that the level of triglyceride in serum in both Cd concentrations returned to the same level in the control group (figure 2). Serum cholesterol showed a significant reduction after first and 15<sup>th</sup> days in both Cd exposed groups and returned to the same level in the control group. In the first 15 days, the cholesterol level decreased rapidly and reached to  $256 \pm 10.3 \text{ mg/dl}$  (low-dose)  $192.6 \pm 1.6 \text{ mg/dl}$  (high-dose) compared to  $328 \pm 8.2 \text{ mg/dl}$  in the control group but this reduction was transient (Figure 3). Total protein in serum exhibited a linear pattern and increased after 30 days. This elevation was not significant in 15 days but increased rapidly to  $2.6 \pm 0.1 \text{ g/dl}$  (low-dose) and  $3.8 \pm 0.1 \text{ g/dl}$  (high-dose) compared to  $2.4 \pm 0.1 \text{ g/dl}$  in the control group after 30 days (Figure 4 & Table 2).

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mean control level, when the fish were exposed to both continued over time and with increasing Cd levels sub-lethal concentrations of cadmium. This trend (figure 7).

**Table 1:** Water quality parameters, cations, anions, and background metals in acclimation

| Parameter                                    | Acclimation water |
|--|-------------------|
| Temperature (°C)                             | 25±1°C            |
| pH   | 8.1±0.2           |
| Dissolved oxygen (mg/l)                      | 8.2-8.9           |
| Total Hardness (mg/l as CaCO <sub>3</sub> )  | 106.2             |
| Total alkalinity(mg/l as CaCO <sub>3</sub> ) | 42.8              |
| Total dissolved solids(mg/l)                 | 173               |
| Sodium (mg/l)                                | 5.0               |
| Calcium (mg/l)                               | 31.0              |
| Potassium (mg/l)                             | 0.6               |
| Magnesium (mg/l)                             | 6.1               |
| Cl <sup>-</sup> (mg/l)                       | 10.5              |
| NH <sub>3</sub> (mg/l)                       | 0.034             |
| SO <sub>4</sub> (mg/l)                       | 13.0              |
| PO <sub>4</sub> (mg/l)                       | 0.03              |
| Copper(µg/l)                                 | 0.63              |
| Cadmium (µg/l)                               | 0.051             |
| Zinc (µg/l)                                  | 0..35             |

**Table 2:** Biochemical effects of cadmium in low exposed (1µg/L) and high exposed (3 µg/L) sea bream (*Sparusaurata*) fingerlings in comparison with control group over the experimental period of 1, 15 and 30 days

| Parameters          | Day | Control groups | LowCd       | HighCd      |
|---------------------|-----|----------------|-------------|-------------|
| Glucose(mg/dl)      | 1   | 31.6±0.7       | 31±1.3      | 38.6±1.5    |
|                     | 15  | 25.6±1.5       | 70±7.5      | 94.3±2.4    |
|                     | 30  | 32±1.1         | 61±2.5      | 35.3±1.8    |
| Triglyceride(mg/dl) | 1   | 511±8.7        | 290.6±13.3  | 284.6±4.4   |
|                     | 15  | 480.6±29.5     | 301.3±3.7   | 285.3±6.5   |
|                     | 30  | 556.6±31.1     | 490.3±4.1   | 614±24.3    |
| Cholesterol(mg/dl)  | 1   | 328±8.2        | 231.3±5.1   | 255.6±5.5   |
|                     | 15  | 282.6±23       | 256±10.3    | 192.6±1.6   |
|                     | 30  | 340.3±21.1     | 327.3±5.7   | 383±6.2     |
| Total Protein(g/dl) | 1   | 2.1±0.3        | 2.2±0.1     | 2.7±0.1     |
|                     | 15  | 2.2±0.1        | 2.6±0.1     | 3.8±0.1     |
|                     | 30  | 2.4±0.1        | 3.1±0.1     | 4.1±0.1     |
| AST(IU/L)           | 1   | 1640.3±31.2    | 1785.6±21   | 1925.3±42.4 |
|                     | 15  | 1830.3±63      | 1617.3±39.1 | 1850.3±32.1 |
|                     | 30  | 18.30±51.2     | 2140.6±36.5 | 2464.3±40   |
| ALT(IU/L)           | 1   | 124.3±4        | 120.6±4.1   | 131±10.5    |
|                     | 15  | 140.3±15.2     | 174±4.1     | 203.6±3.1   |
|                     | 30  | 160±4.5        | 251.3±15.2  | 304.6±8.7   |
| ALP(IU/L)           | 1   | 440±30.3       | 386.6±20.8  | 453±21.8    |
|                     | 15  | 503±51.6       | 566±21.5    | 615.3±25.1  |
|                     | 30  | 503.6±14.4     | 620.3±13.2  | 880.6±24.6  |

Figures (1-7): Effects of different sub-lethal cadmium concentrations on biochemical parameters and serum enzymes activities in sea bream (*Sparusaurata*) fingerlings.

Data are expressed as mean ± standard error (SE). Means with different letters are significantly different from each other (P < 0.05). Values with the same letters are not significantly different.

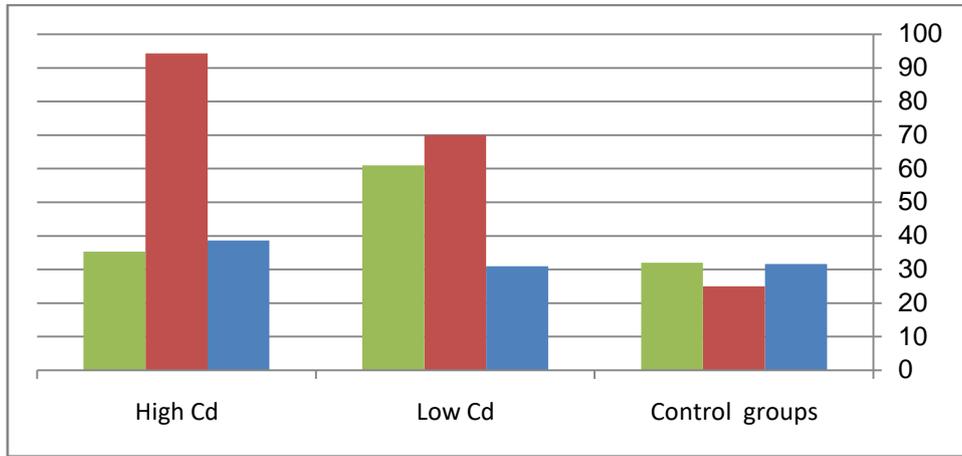


Fig. 1: Serum glucose level; after 15 days, the concentration of glucose increased but this elevation was transient so that after 30 days, the level of glucose returned to the same level in the control group

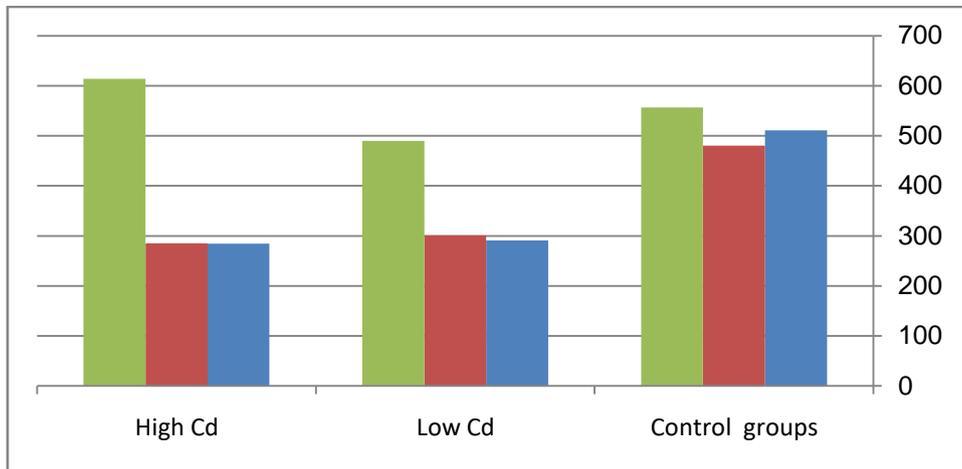


Fig. 2: Serum triglyceride level; there was a decrease in the level of triglyceride in the first and 15th days but it followed by a rapid elevation in 30 days

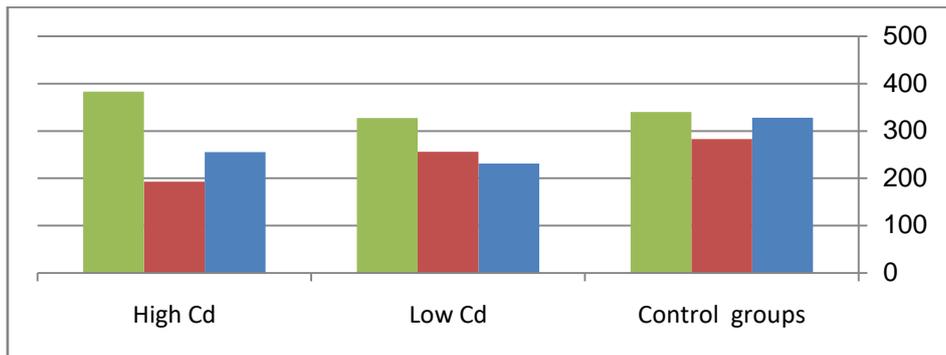


Fig. 3: Serum cholesterol level; a significant reduction was observed after the first and 15th days

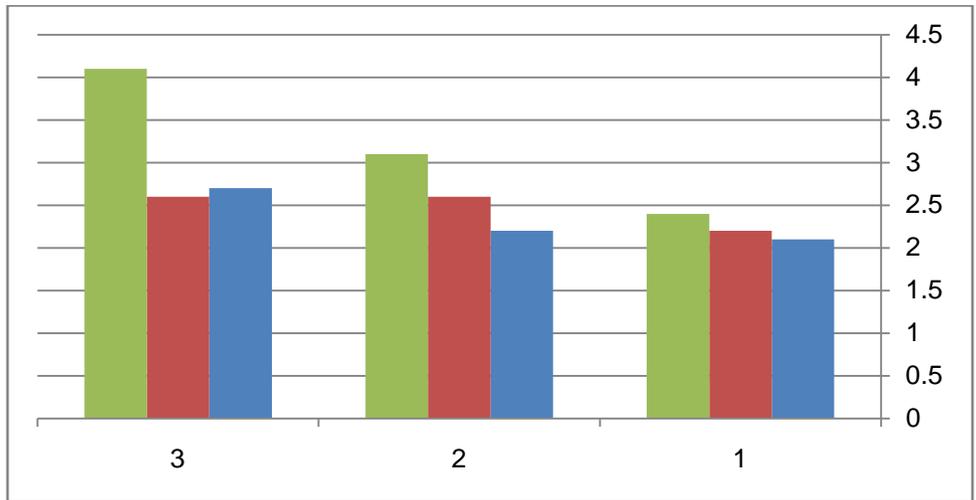


Fig. 4: Serum total protein level; there was a significant increase after 30 days

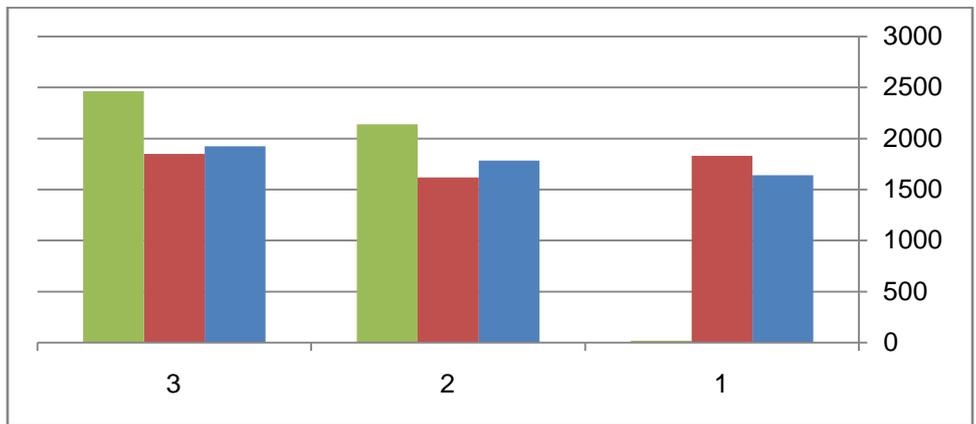


Fig. 5: Serum aspartate transaminase (AST). The AST increased and exhibited a liner pattern.

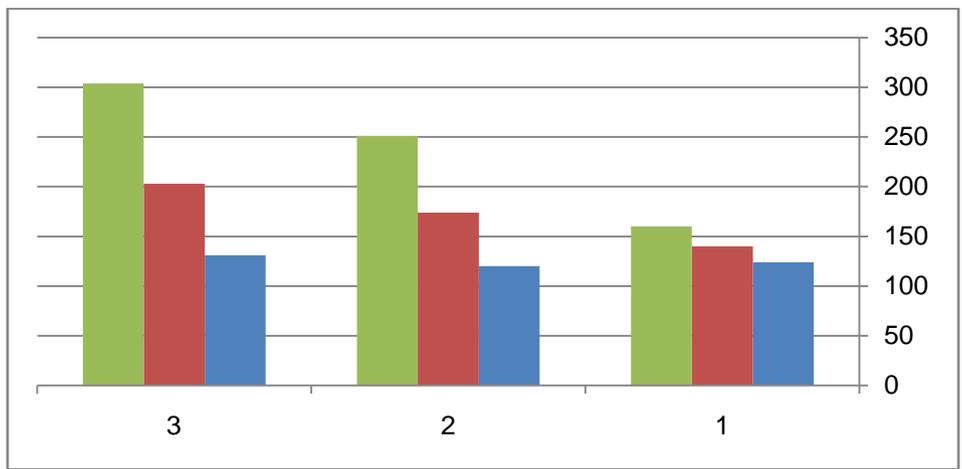


Fig. 6: Serum alanine transaminase (ALT). The ALT increased and exhibited a liner pattern

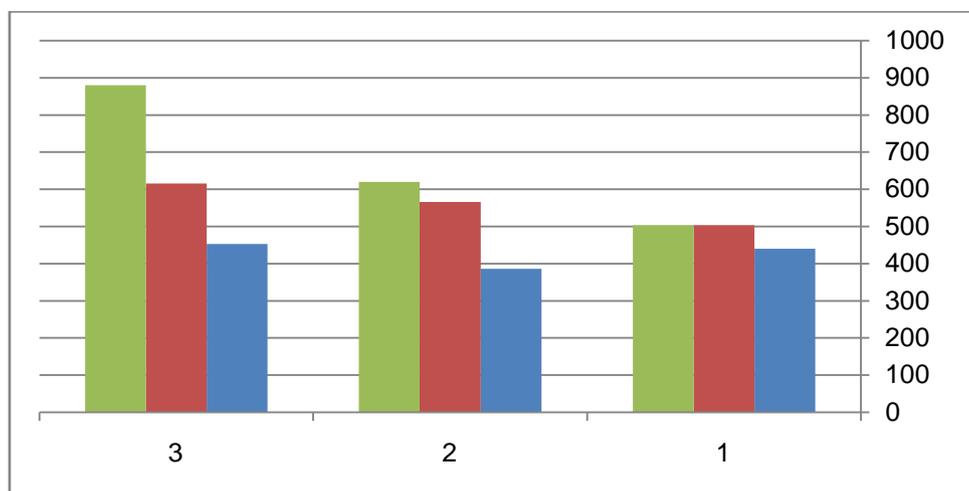


Fig. 7: Serum alkaline phosphatase (ALP) in sea bream (*Sparusaurata*) fingerlings exposed to cadmium. After 30 days. The level of the ALP also showed a significant increase compared to the control group, when the fish were exposed to the both concentrations of cadmium

#### IV. DISCUSSION

##### a) Glucose

Changes of blood glucose are a good indicator of metal stress in fish[16], and alterations in the glucose level might be related to renal injury, liver damage, and lack of nutrition[17]. This study showed a dose-dependent increase of glucose level after first 15-days. Similarly, serum glucose levels of *C. carpio* exposed to sublethal concentrations of Cd for ten days increased with increasing concentrations of Cd in the water[18]. Nevertheless, the level of glucose reduced for the next 30 days of the current study. The higher level of glucose established on the first days of exposure might be a result of glycogenolysis (a release of glucose into the blood from energy resources stored as glycogen in muscles and liver), initiated by hormones (cortisol and catecholamines) when the organism was in unfavorable condition. The reduced level of glucose established at the end of exposure probably reflected the exhaustion of the energy reserves of the organism and impaired capacity of fish to restore them and acclimatized conditions[19]. Another study showed that glucose was significantly increased compared to the control treatment. This study showed that cadmium has a direct correlation with sea bream (*Acanthopagruslatus*) serum biochemical abnormalities.

##### b) Triglyceride

Triglyceride functions primarily in providing cellular energy and can be used as an indicator of nutritional status. Triglyceride concentration in the serum of cadmium exposed fish also showed a different pattern. The present study showed a reduction in serum triglyceride concentration in 15 days and returned to the control level after 30 days due to acclimation to the toxicant over time. Serum triglyceride concentration in

*Oreochromisniloticus* exposed to 0.05 mg/L Cd during 30 day did not change when compared to control value [20]. Variations in serum triglyceride concentrations might be due to differences in exposure concentration, lipid metabolism, and glycogen storage impairment in different fish species. Another study determined the LC<sub>50</sub> value in *Oreochromisniloticus* fry; they found 50 % mortality of fish fry at 1.6 mg/L[21]. LC<sub>50</sub> value of cadmium chloride for the fish *Oreochromisniloticus* was determined by Probit-regression analysis using SPSS 15, and LC<sub>50</sub> was found to be 35.848 mg/L. This value obtained was lower than the LC 50 values determined in other tilapia species, i.e. 200 mg/l in *Tilapia mossambica* [22] and 80mg/L as determined by [23]. This shows that *Oreochromisniloticus* is less resistant to cadmium toxicity as compared to other tilapia species. The difference may be due to the size of fish as large size fish are more resistant to the toxicity as compared to fish fry[24].

##### c) AST and ALT

In the present study, the level of both AST and ALT increased linearly over a 30 day period, and the higher concentration caused a more significant effect on fish. Similarly, continuous exposure to sub-lethal cadmium concentrations resulted in significantly elevated levels of both AST and ALT activity in *Oreochromisniloticus* exposed to 0.05 mg/L Cd of 20-days[20]. Transaminases like ALT and AST play a significant role in amino acid, and protein metabolism and they may release into the plasma following tissue damage and dysfunction. The activity of AST and ALT enzymes in blood may also be used as a stress indicator. The significant changes in the activities of these enzymes in blood plasma indicate tissue impairment caused by stress[25],[26]. In the present study, there were significant changes in AST and ALT

activities in plasma of fish exposed to cadmium compared to the control group. The increase in the concentration of AST and ALT in blood plasma indicates impairment of parenchymatous organs, mainly the liver. In addition, the increase of plasma AST and ALT may be attributed to the hepatocellular damage or cellular degradation in liver, spleen or muscles [27]. These results are in agreement with those reported by [28] who found that sub-lethal concentration of Cd caused significant increases in AST and ALT of Common Carp after 7 and 25 days. Some studies showed that plasma enzymes (AST and ALT) were greatly affected by exposure to Cd in marine fish *Mugilsepheli* and after a transient reduction during the first two days, activity of enzymes increased to reach levels similar to the control value [29]. Similarly, [30] showed that the levels of AST and ALT activity increased in the tissues of *Oreochromismossambicus* exposed to cadmium chloride due to necrosis and increases in the permeability of cell membrane resulting in the damage of tissues after 7 and 14 days. Different factors such as life history, water quality, and exposure duration and cadmium concentration influence ALP activity.

#### d) ALP

The present study showed a linear pattern of increasing ALP over time with Cd exposure resulting in recognizable physiological and functional alterations after 30-days. In contrast, *Oreochromisniloticus* exposed to 0.05 mg/L Cd during 30-days showed a reduction in ALP activity [20]. The decrease in ALP activity might be a result of disturbance of the membrane transport system, although the increase in the activity may be related to tissue damage [31].

#### e) Cholesterol

The present study showed a reduction in cholesterol within 15-days, possibly due to tissue damage in the kidney. On the contrary, in *Oreochromisniloticus*, an increase in cholesterol was seen during a 21 days to cadmium [20]. This alteration in cholesterol concentration could be due to the hazardous effects of metals on the cell membrane. Thus, an increase in cholesterol levels is good indicators of environmental stress in fishes.

#### f) Total protein

Total protein (TP) measurements from previous studies also exhibited no consistent pattern of response; protein levels decreased or were unaffected by cadmium exposures. The present study showed an increase in a 30 days. In contrast, when *Oreochromisniloticus* was exposed to 0.05 mg/L Cd during 30 days, no significant alteration occurred in protein concentration [20]. Changes in the serum TP may be due to liver damage, reduction absorption, and protein loss and thus may be a good indicator of the health status of fish. Another results showed that the

amount of protein for polluted creeks was lower than clean creek that means the occurrence of hypoproteinemia. Hypoproteinemia results from either decreased production or increased loss of protein. In dietary toxicity studies, decreased protein production can result from effects on food consumption, digestion, or absorption. Because of the reserve capacity of the liver, the hepatic injury must be fairly severe before protein synthesis is notably diminished [32]. However, in large studies, small differences between the control and treated groups might be apparent with mild to moderate hepatotoxicity [33]. Hypoproteinemia, like anemia, can be masked by dehydration. A small, statistically significant decrease in serum albumin concentration is one of the most frequent findings in toxicology studies. The exact mechanism is usually not apparent but a combination of factors, similar to those causing mildly lower glucose, are probably responsible [35]. Some studies showed that in the controls, Cd content was significantly higher in gills compared to in the liver, still the treatment of fish with 0.1mg/L Cd induced a stronger accumulation of metal in the liver depending on the length of the exposure period [1]. Cd traces were found in plasma, muscle, and kidney. Cd forms complexes in the cytosol with MT only in the liver still Cd-MT content significantly increased after 11 days of exposure to the metal, while after four days of treatment, the protein level was similar to the control. The "comet assay" performed on *S. aurata* erythrocytes isolated from fish treated for four and 11 days with 0.1mg/L Cd showed that there was no DNA damage at both exposure periods. Recorded data for the activity of total protein showed depletion in all treatments. Some studies indicated a decrease in total protein content during heavy metal exposure. Such decreases were, for example, found in the edible crab (*Scylla Serrata*) exposed to cadmium or in the common carp exposed to mercury [34]. Depletion in the protein content of the *Catlacatla* exposed to mercury chloride sub-lethal concentrations was estimated [36]. The rapid decrease in total protein content was associated with the active degradation of proteins under stress. This fact is correlated to the development of resistance toward toxic stress. Proteins being involved in the architecture and physiology of the cell, they seem to occupy a key role in cell metabolism. Catabolism of proteins makes a major contribution to the total energy production in fishes. Under stress, situations may constitute a physiological mechanism with an important role in providing energy to cope with the stress full situation. Therefore, a depletion of total protein content might also be attributed to the destruction or necrosis of cellular function, and consequent impairment in protein synthetic machinery [37]. When an animal is under toxic stress, diversification of energy occurs to accomplish the impending energy demands and hence the protein level is depleted [38]. The depletion of the total protein content

may be due to the breakdown of protein into free amino acid under the effect of mercury chloride at the lower exposure period [39]. Reduction in protein content in liver of exposed fish might be due to either arrested metabolism in the liver or to use it to build up new cells or enzymes to reduce the stress [40].

## V. CONCLUSIONS

Results of the present investigation showed that pollutants have a direct correlation with fish serumbiochemical abnormalities and also indicated that the difference in the environmental conditions of marine ecosystems might cause several changes in the serum biochemical parameters of the studied fish.

## REFERENCES RÉFÉRENCES REFERENCIAS

- Vaboonian, Ali., Movahedinia, Abdolali; Safahieh, Alireza; and Hedayati, Aliakbar. Serum biochemical changes of yellowfin sea bream (*Acanthopagrus latus*) in response to sublethal cadmium toxicity Comparative Clinical Pathology. (2015); 24 (1): 35.
- Amutha C, Subramanian P. Cadmium alters the reproductive endocrine disruption and enhancement of growth in the early and adult stages of *Oreochromis mossambicus*. *Fish Physiol Biochem*. 2013; (39): 351-361.
- M Saeed Heydarnejad, Mozhdeh Khosravian-Hemamai and Amin Nematollahi. Effects of cadmium at sub-lethal concentration on growth and biochemical parameters in rainbow trout (*Oncorhynchus mykiss*). *Irish Veterinary Journal*. 2013; (66):11.
- Shaffi SA, Manohar YR, Nandan MJ. Influence of protective agents on metal induced respiratory distress in Labeorohita (Ham). *Bull Environ Contam Toxicol*. 2001; 66:611-616.
- Witeska M, Jezierska B, Wolniaki J. Respiratory and hematological response of tench *Tinca tinca* (L.) to a short-term cadmium exposure. *Aquacul Inter*. 2006; 14:141-152.
- Ricard AC, Daniel C, Anderson P, Hontela A. Effects of subchronic exposure to cadmium chloride on endocrine and metabolic functions in rainbow trout *Oncorhynchus mykiss*. *Arch Environ Contam Toxicol*. 1998; 34:377-381.
- Mc Geer JC, Szebedinszky C, McDonald DG, Wood CM. Effects of chronic sub-lethal exposure to waterborne Cu, Cd, or Zn in rainbow trout: 1. Ionoregulatory disturbance and metabolic costs. *Aquat Toxicol*. 2000; 50:233-245.
- Baldisserotto B, Kamunde C, Matsuo A, Wood CM. A protective effect of dietary calcium against acute waterborne cadmium uptake in rainbow trout. *Aquat Toxicol*. 2004; 67:57-73.
- Lal Shah S. Hematological changes in *Tinca tinca* after exposure to lethal and sublethal doses of Mercury, Cadmium and Lead. *Iran J Fish Sci*. 2013; 9:434-443.
- Abedi Z, Hasantabar F, Mohammad A, Khalesi K, Babaei S. Effect of Sublethal Concentrations of Cadmium, Lead and Chromium on Some Enzymatic Activities of Common Carp; *Cyprinus carpio*. *W J Zool*. 2013; 8:98-105.
- Hontela A, Daniel C, Ricard AC. Effects of acute and subacute exposures to cadmium on interrenal and thyroid function in rainbow trout, *Oncorhynchus mykiss*. *Aquat Toxicol*. 1996; 35:171-182.
- Brodeur JC, Daniel C, Ricard AC, Hontela A. In vitro response to ACTH of the interrenal tissue of rainbow trout (*Oncorhynchus mykiss*) exposed to cadmium. *Aqua Toxicol*. 1998; 42:103-113.
- Lacroix A, Hontela A. A comparative assessment of the adrenotoxic effects of cadmium in two teleost species, rainbow trout, *Oncorhynchus mykiss*, and yellow perch, *Perca flavescens*. *Aquat Toxicol*. 2004; 67:13-21.
- Hansen JA, Welsh PG, Lipton J, Cacela D, Dailey AD. Relative sensitivity of bull trout (*Salvelinus confluentus*) and rainbow trout (*Oncorhynchus mykiss*) to acute exposures of cadmium and zinc. *Environ Toxicol Chem*. 2006; 21:67-75.
- Miliou H, Zaboukas N, Oraitou-Apostolopoulou M. Biochemical composition, growth, and survival of the guppy, *Poecilia reticulata*, during chronic sub-lethal exposure to cadmium. *Arch Environ Contam Toxicol*. 1998; 35:58-63.
- Gagnon A, Jumarie C, Hontela A. Effects of Cu on plasma cortisol and cortisol secretion by adrenocortical cells of rainbow trout (*Oncorhynchus mykiss*). *Toxicol*. 2006; 78:59-65.
- Pratap HB, Wendelaar Bonga SE. Effect of waterborne cadmium on plasma cortisol and glucose in the cichlid fish *Oreochromis mossambicus*. *Comp Biochem Physiol*. 1990; 95:313-317.
- Bedii CK, Kenan N., The Effects of Cadmium on Levels of Glucose in Serum and Glycogen Reserves in the Liver and Muscle Tissues of *Cyprinus carpio* (L., 1758). *Tur J Vet An Sci*. 2005; 29: 113-117.
- Kazlauskienė N, Vosylienė MZ. Peculiarities of the physiological responses of rainbow trout to copper. *Acta Zoo Litua Hydro*, 1999; 9:1392-1657.
- Oner M, Atli G, Canli M. Changes in serum parameters of freshwater fish *Oreochromis niloticus* following prolonged metal (Ag, Cd, Cr, Cu, Zn) exposures. *Environ Toxicol Chem*, 2008; 2: 360-366.
- Andaya, A. A. & Gotopeng, E. U. Cadmium toxicity and uptake in *Tilapia nilotica*. *Kalikasan*. 1982; 11(2 3):309-318.

22. Banerjee, .K., Dastdar, S. G., Mukhopadhyaya, P. K. & Dehadrai, P. V. Toxicity of cadmium: A Comparative study in the air-breathing fish, *Clarias-batrachus*(Linn) and in the non air-breathing, *Tilapia mossambica*(peters). *Indian J. Exp. Biol.* 1978; 16(2): 1274-1277.
23. Chung, S. Lethal effects of cadmium in tropica. *Bull. Jpn. Soc. Sci.* 1983; 49(10): 1565-1568.
24. Mehweisj Faheem, Abdual Qayyumkhan Sulehria, Mehrab Tariq, I ram Khadija, Ayesha Fiaz., Maleeha Saeed. Effect of sub-lethal dose of Cadmium Chloride on biochemical profile and catalase activity in fresh water fish *Oreochromis niloticus* *Biologia (Pakistan)*,, 2012; 58 (1&2), 73-78 .0006.
25. James, P., Thorpe, I.J., Kokkinos, N., Morkot, R. & Frankish, J. Centuries of Darkness: context, methodology and implications. *Cambridge Journal Archive*, 1991; 1: 228-35.
26. Svoboda, M. Stress in fishes (a review). *Bulletin VÚRH Vodňany*. 2001; 4. 169- 191[26].
27. Yamawaki, K., Hashimoto, W., Fujii, K., Koyama, J., Ikeda, Y. & Ozaki, H. Hemochemical changes in carp (*Cyprinus carpio*) exposed to low cadmium concentrations. *Nippon Suisan Gakkaishi Bulletin*. 1986; 52: 459- 466.
28. Shalaby, A.M, Biochemical and physiological studies on metal contamination in the common carp (*Cyprinus carpio L*). Ph. D. Thesis, Zagazig University, Faculty of Science, Benha branch. 1997; 268.
29. El-Naga EHA, El-Moselhy KM, Hamed MA., Toxicity of cadmium and copper and their effects on some biochemical parameters of marine fish Mugilseheli. *Egypt Aquat.* 2005; 2: 60–71.
30. Thirumavalavan R., Effect of cadmium on biochemical parameters in fresh water fish, *Oreochromis mossambicus*. *Asia J Sci Tech.* 2010; 4: 100–104.
31. Bernet D, Schmidt H, Wahli T, Burkhardt-Holm P. Effluent from a sewage treatment works causes changes in serum chemistry of brown trout (*Salmo trutta L.*). *Ecotoxicol Environ Saf*, 2001; 48: 140–147.
32. Ahmad Savari, Aliakbar Hedayati, Alireza Safahieh and Abdolali Movahedinia., Changes in Some Serum Biochemical Values of Yellowfin Sea Bream (*Acanthopagrus latus*) in Mahshahr Creeks (Persian Gulf) *Global Veterinaria*, 2010; 5 (4): 233-238. 1992-6197.
33. Kaneko, J.J. Clinical biochemistry of domestic animals (5th ed.). San Diego, CA: Academic Press. 1997.
34. Reddy, P.S. and A. Bhagyalakshmi Changes in oxidative metabolism in selected tissues of the crab (*Scylla serrata*) in response to cadmium toxicity *Ecotoxicol. Environ. Saf.* 1994; 29: 255-264.
35. Gad, S.C. *Animal Models in Toxicology*. CRC Press. 2007: 950.
36. Prasath, M. and S. Arivoli. Biochemical Study of Freshwater Fish *Catla catla* with Reference to Mercury Chloride. *Iran. J. Environ. Health. Sci. Eng.* 2008; 5(2): 109-116.
37. David, M., S.B. Mushigeri, R. Shivakumar and G.H. Philip. Response of *Cyprinus carpio*(Linn) to sublethal concentration of cypermethrin: alterations in protein metabolism profiles. *Chemosphere*. 2004; 56: 347-352.
38. Neff, J.M., Use of biochemical measurement to detect pollutant mediated damage to fish. *ASTM spec. Tech. Publ.* 1985; 854: 154-183.
39. Shakoori, A.R., A.L. Mughal and M.J. Iqbal. Effects of sublethal doses of fenvalerate (a synthetic pyrethroid) administered continuously for four weeks on the blood, liver and muscles of a freshwater fish, *Ctenopharyngodon idella*. *Bull. Environ. Contam. Toxicol.* 1996; 57: 487-494.
40. Sakr, S.A. and J.S.M. Al lail, Fenvalerate. Induced Histopathological and Histochemical Changes in the Liver of the Catfish *Clarias Gariepinus*. *J. App. Sci. Res.* 2005; 1(3): 263-267

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# Floristic Inventory of Invasive Alien Aquatic Plants Found in Malebo Pool in Congo Rivers, Kinshasa, DR. Congo (Case of MOLONDO, MIPONGO, and JAPON Islands)

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**Abstract- Objective:** To make a floristic inventory and determine of the invasive aquatic alien plant species found in the Malebo Pool and their behavior and impacts.

**Study design:** The present study used a combination of reasoned sampling and simple random sampling to select different sites from which samples were have been taken. site and duration of the study: This study was carried out in three different islands as follow: Molondo island, Mipongo island and Japon island at the Malebo pool in Kinkole (Pool Malebo system) in the city of Kinshasa in the Democratic Republic of the Congo. The Malebo Pool stretches along the Congo River. This study was conducted in August 2020.

**Keywords:** *invasive alien plants, environmental impacts, pool malebo, kinshasa, DR. congo.*

**GJSFR-C Classification:** FOR Code: 070402



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# Floristic Inventory of Invasive Alien Aquatic Plants Found in Malebo Pool in Congo Rivers, Kinshasa, DR. Congo (Case of MOLONDO, MIPONGO, and JAPON Islands)

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**Methodology:** The sample collection was carried out after direct observation. Using a motorized canoe, we docked on islands for sample collection as well as in the swampy areas of the Kinkole Islands. We also collected invasive species in the middle of the Congo River. The recorded species were classified either as alien species or as invasive alien species depending on the status in the study region. The botanical classification of the species was made according to APG III (2009). Environmental impacts have also been taken into account.

**Results:** Among the collected specimens 12 species were recognized as exotic and 2 species were found to be invasive alien species. These are *Echinochloa pyramidalis* and *Eichhornia crassipes*. These species pose a serious threat from the erosion of aquatic biodiversity. These species form a monospecific mat and eliminate native or autochthonous species from the aquatic or riparian flora.

**Conclusion:** the invasion of alien species is a consequence of human activities and a concern, as they affect all sectors of society. The invasion of these species presents a real challenge for environmentalists, economists, social scientists, agricultural engineers, and others. Hence the need to develop and implement robust risk analysis frameworks and environmental impact assessments.

**Keywords:** *invasive alien plants, environmental impacts, pool malebo, kinshasa, DR. congo.*

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## I. INTRODUCTION

Invasive alien species are considered as the second cause of biodiversities's erosion, here seen as a decline in biodiversity just after habitat destruction and fragmentation (Genovesi and Shine, 2004). The socio-environmental impacts associated with plant invasions are increasingly recognized around the world and are expected to increase dramatically due to climate change or land use (Dukes & Mooney, 1999; Hellmann et al., 2008; Vicente et al., 2019) cited by Akodewou, (2019). Apart from their negative or positive impacts on biodiversity (Downey & Richardson, 2016; Mostert et al., 2017), invasive plants also have positive economic, social and ecological contributions (Wagh & Jain, 2018) and whose populations local people have a good knowledge. Local people assess the impact of invasive plants based on how their socio-economic needs are influenced by these species (Shackleton et al., 2007; Rai et al., 2012). In Africa, several invasive plant species are used by local populations who also have the knowledge to manage these plants. Depending on the uses made of it, better knowledge and management of invasive plants could help improve the living conditions of populations (Akodewou, op cit).

Species and ecosystems constitute the biological diversity of the earth, and are so important that their loss and degradation handicap nature. Species other than ours have a right to exist and to a place in the world. We are unable to determine which species are essential or redundant for the functioning of a given ecosystem and which will flourish in a changing world.

When a new species is introduced into an ecosystem, often the impact is not immediately apparent, it will take a fairly long period of time (5 years, 10 years) to realize its environmental impacts.

An alien species is a plant, animal, including fish, or micro-organism that has been introduced as a result of human activity, other than its natural range. They are sometimes referred to as alien species or non-native species (CBD, 2004).

In the Democratic Republic of the Congo with regard to the socio-environmental considerations mentioned below, a floristic inventory of invasive exotic aquatic plants was carried out in August 2020 in 3 Islands of The malebo pool : Molondo, Mipongo, and Japon.

## II. SITE, MATERIAL AND METHODS

### a) Study environment

The Malebo pool, formerly called Stanley Pool, (Figure 1), is the terminal part of the middle course of

the Congo River (Teugels and Guégan, 1994). It stands at an average elevation of 272 m and ranges from 4° 05' to 4° 20' South latitude and 15° 19' to 15° 32' East longitude. It is the widening of the Congo River located on the border between the Democratic Republic of Congo (Kinshasa city) and the Republic of Congo (Brazzaville City). The word pool is an English term meaning "swimming pool" or "lake". This term is used in Congo to designate the vast body of water located between Kinshasa and Brazzaville (Pwema K.V, 2014).

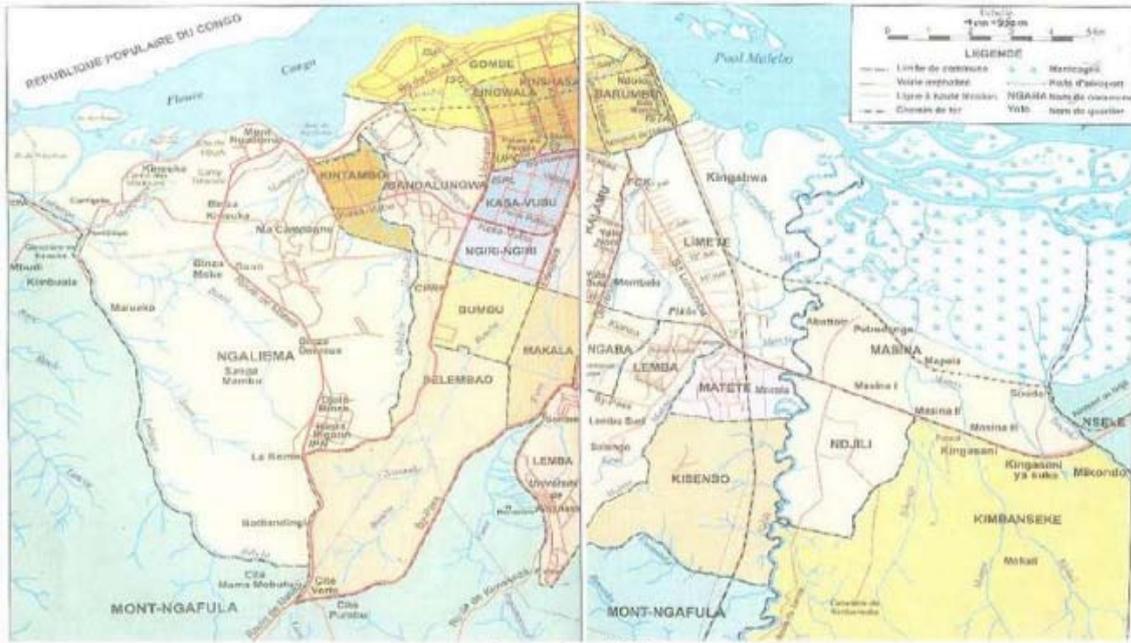


Figure 1: Kinshasa City and Pool Malebo

The Malebo Pool refers to the palm trees (*Borassus aethiopicum* Mart, Syn. *Borassus flabelifera*), locally called Malebo, which abundantly displays the banks and islands of Pool Malebo as well as the alluvial plain of Kinshasa. Pool Malebo is dotted with numerous islets and temporary sandbanks (Lelo Nzuzi, 2008); Mbamou Island, which covers an area of approximately 180 km<sup>2</sup>, occupies the center. It is entirely part of the Republic of Congo and forms, in its eastern limit, the border with the Democratic Republic.

### b) Climat

#### i. Temperature and precipitation

The Pool Malebo region have an equatorial to tropical climate (Léveque and Paugy, 1999). Two great seasons characterize the climate of this region. Three dry months (June, July, and August) and nine rainy months (September to May) with a short dry season that occurs between January and February. The most abundant precipitation is observed in November, December and March. The driest month is July.

The city of Kinshasa being in the climate of low altitude is characterized by a hot and humid tropical climate of type AW4 according to the classification of Köppen (Bultot, 1950). There is an alternation of two seasons: a dry season going from June to September and a rainy season going from September to the end of May.

### c) Study material

#### i. Field equipment

The field work was summarized in the floristic inventory on Pool Malebo at the sites of Molondo, Mipongo and Japon. The collection and determination of aquatic botanical specimens required the following material;

- The Camera (Motorola (moto g (6) play 7791;
- Identification keys; as well as the flora of Central Africa;
- Knife; GPS (Etrex / Venture / Garmin; Made in Field notebook;
- Pen and pencil

d) *Biological material*

The plants collected constitute the biological material of this study.

e) *Methods*

i. *Flora study*

The identification of the plants in the field was done by ourselves; those whose identification was hardly possible on site - because the samples present were either botanically sterile (absence of flower and fruit) or lacking identification keys in our possession - were brought back to the Laboratory of Systematic Botany and Plant Ecology in order to undergo a taxonomic verification for the specimens already identified in situ, as well as a suitable identification by comparison with the dead floristic collection kept at the Herbarium of the University of Kinshasa IUK and the national institute for agricultural study and research (INERA) for unidentified specimens in the field.

f) *Ecological studies*

i. *Biological types (BT.)*

The biological types are morphological arrangements by which plants show their adaptation to the environment in which they live (Dajoz, 1975). For (Mandango, 1981), phytogeographers are unanimous in affirming that biological forms explain the physiognomic and ecological organization of the vegetation of a territory or region.

The classification of biological types is inspired by Raunkiaer as adapted to tropical regions by Lebrun, (1947, 1960 and 1966) and taken up by Schnel (1971), taking into account the behavior of species to protect their buds or their young shoots during bad weather season. The following types Biologys have been recognized in the florula of these islands s:

1. *Phanerophytes (Ph)*

These are trees, shrubs and lianas whose persistent shoots or buds are located at a notable distance on the air axes. They are endowed with a more or less long persistence.

The diversification of these biological types has made it possible to distinguish the following subdivisions:

- *Mesophanerophytes (MsPh)*: trees whose renewal organs are located between 10 and 30m above the ground.
- *Microphanerophytes (McPh)*: shrubs whose buds are located in the space between 2 and 10m above the ground.]
- *Nanophanerophytes (NPh)*: sub-shrubs and bushes whose young shoots can be seen at a height of less than 2m.]
- *Climbing phanerophytes (Phgr)*: they are twining lianas which climb to the top of trees by various means of attachment.

2. *Chaméphytes (Ch)*

They are herbaceous or subline plants whose perennial buds are located less than 50 cm above the ground.

It is:

- *Erect chaméphytes (Chd)*: subline plants with an erect or erect aerial axis.
- *Climbing chaméphytes (Chgr)*: these are under - woody plants whose herbaceous part wraps around a support.]
- *Prostrated chaméphytes (Chpr)*: these are subline plants whose aerial axis, generally branched, remains lying on the ground at its base.
- *Creeping chaméphytes (Chrp)*: these are subline plants with a stem lying on the ground, emitting adventitious roots at the nodes.
- *Chaméphytes cespitoux (Chces)*: sub-woody plants with many stems from the base

3. *Hemicryptophytes (Hc)*

They are herbaceous plants whose renewal organs are sheltered at shallow depths in the soil. There are the following types:

- *Cespitose hemicryptophytes (Hces)*: plants whose buds or young shoots are protected by shells from the evergreen leaves forming a sheath around the buds and young replacement axes.
- *Geophytes (G)*: These are perennial herbaceous plants whose renovation buds remain buried in the soil during the unfavorable period. There are the following types:
- *Bulbous geophytes (Gb)*: plants whose renovation organs are bulbs.
- *Tuberous geophytes (Gt)*: plants whose perennial organs are made up of tubers.
- *Rhizomatous geophytes (Grh)*: plants whose renovation organs are represented by rhizomes (underground stems).

4. *The Therophytes (Th)*

These are herbaceous plants that present the extreme case of adaptation to climatic rigors. The whole plant disappears or at least only remains in the seed state at the end of the favorable period for its development.

It is:

- *Cespitose Therophytes (Thces)*: grasses forming radical or axial tufts.
- *Erect Therophytes (Thd)*: plants with an aerial vegetative apparatus formed by an erect or erect stem.
- *Prostrate Therophytes (Thpr)*: herbaceous plants whose stem is half-lying at its base.
- *Climbing therophytes (Thgr)*: these are lianiform annuals.

5. *Hydrophytes (HD) these are plants with perennial organs located in water. We find*

Hydrophytes and pelophytes, the latter are rooted in the mud (mud).

i. *Types of diaspores (T.D).*

Diaspores are organs capable of regenerating, through various modes of dissemination, corresponding plant individuals. Based on the categorization of the morphological types of diaspores defined by Dansereau and Lems in Lejoly and Mandango, (1982), Schnel (1968) and, Lacoste and Salomon, (1998), the following types were recognized on the inventoried sites:

1° *Anemochoric plants*

The dissemination of plants is ensured by the wind. The types of diaspores recognized in this category are:

- *Pterochora (Ptero):* diaspores with aliform appendages scattered over short distances;
- *Pogonochores (Pogo):* diaspores with feathery or silky appendages like crested fruits and seeds, stipites or sessile with a slight tuft of hairs at the end;
- *Sclérochores (Scléro):* relatively light non-fleshy diaspores which can be carried by the wind over great distances.

2° *Zoochorous plants*

The dissemination of plants is ensured by animals, including humans. Their diaspores are represented.

- *Desmochores (Desmo):* hanging or adhesive diaspores. *Sarcochores (Sarco):* totally or partially fleshy diaspores.

3 *Autochthonous plants*

The transport of diaspores is under the effect of gravity; they are plants with an autonomous mechanism of dispersion. These are:

*Ballochores (Ballo):* diaspores expelled by the plant itself as a result of movements due to alternating pressure of drought and humidity.

*Barochores (Baro):* non-fleshy but heavy diaspores falling at the foot of the mother plant and regeneration takes place on site.

4. hydrochloric plants The transport of diaspores is provided by water. This transport can be either in fresh water, it is hydrochory, or in marine or brackish water, it is thalassochory. We recognized: the *Pleochores (Pleo):* diaspores equipped with a flotation device

g) *Biological spectra*

Biological spectra reflect the respective importance of biological types in the flora of a territory or within a plant community. A distinction is made between the raw spectrum and the weighted or real spectrum.

i. *Raw spectrum (S.B)*

The raw spectrum is determined by the number of species identified in each group in accordance with the eco-morphological criterion considered. The results obtained being expressed as a percentage according to the following formula:

$$S.B. =$$

h) *Chorological study*

The study of phytogeographic distribution (D.P) is inspired by the chorological divisions recognized for tropical Africa by the following authors: Lebrun, (1947, 1960 and 1966), MULLENDERS, (1954); EVRARD, (1968); AUBREVILLE, (1962); WHYTE, (1979) and DENYS, (1980).

1° *Species with very wide distribution*

- Cosmopolitan species (Cosm): plants found both in tropical and temperate zones of the world; ]
- Pantropical species (Pan): plants observed in all tropical regions of the globe; ]
- Afro-American species (Aa): plants found in Africa and tropical America; ]
- Paleotropical species (Pal): plants distributed in the tropics and subtropics of the old world (Africa, Asia); ]
- ✓ Afro-Malagasy species (Am): species from regions of tropical Africa and the island of Madagascar. ]

2° *Species of the Guinean base element*

These are plants distributed in the Guinean - Congolese region (region of African forests). This element consists of:

- *Guinean - Congolese species (GC):* plants found in all regions of the African equatorial forest (region from Guinea to Congo); ]
- *Guinean species (G):* plants whose distribution covers all of West Africa; ]
- ✓ *Congolese species (C):* endemic species in the Congo Basin. ]

### III. RESULTS

a) *Floristic inventory of aquatic plants*

The general floristic list of the different work sites indicates the presence of 19 species including 2 Pteridophytes and 17 Angiosperms, divided into 19 families, 12 orders. Classified according to the alphabetical enumeration of species, the floristic list of the presence and absence of species according to the study sites is given in Table 2.

The geographical coordinates taken by the brand GPS: (etrex/Venture/Garmin; which give the location of the sites where we collected our data, are included in the appendix.

Table 1 presents the general list of species listed on the different sites; they are classified into clades, orders and families in accordance with the new phylogenetic classification system APG III, and the Pteridophytes determined according to CRONQUIST (1968). The floristic list of exotic species found among

these species is given in Table 2, which presents 11 species also classified in alphabetical order.

The list of the most invasive alien species on the sites is given in Table 3 while Figure 2 represents the survey sites.

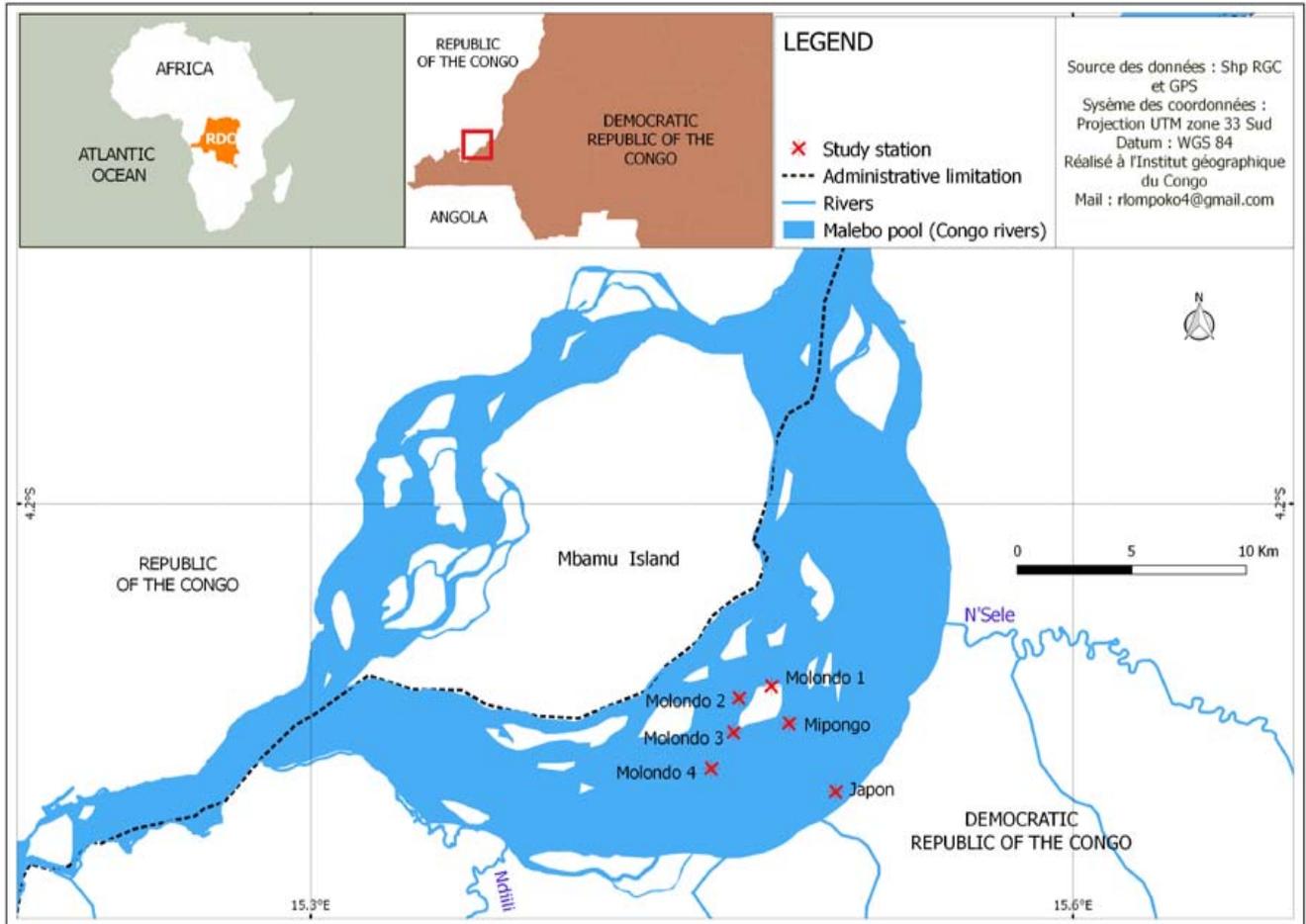


Figure 2: Mapping of prospecting sites

Table 1: General list of species recorded at the three Kinkole sites (Molondo, Mipongo, Japan)

| Classification phylogénétique               | TB   | TD     | DP  |
|---|------|--------|-----|
| Clade Angiosperms                           |      |        |     |
| Clade Rosidae/Malvidae                      |      |        |     |
| O.1.Myrtales                                |      |        |     |
| F1. Onagraceae                              | Chd  | Sclero | GC  |
| Es1. <i>Ludwigia abyssica</i> A. Rich.      | Chd  | Sclero | Aa  |
| Es2. <i>Ludwigia leptocarpa</i> (Nutt) Hara |      |        |     |
| Clade : True dicotyledonous core            |      |        |     |
| O.2. Caryophyllales                         | Ch   | Sar    | Pan |
| F2. Amaranthaceae                           |      |        |     |
| ES3. <i>Alternanthera sessilis</i> (L.) DC. |      |        |     |
| Clade : Lamidea                             | Hdfl | Ptero  | Pan |
| O.4. Solanales                              |      |        |     |
| F3. Convolvulaceae                          |      |        |     |
| Es4. <i>Ipomoea aquatica</i> Forsk          | Hd   | Pleo   | Pal |
| Clade : Angiosperms                         |      |        |     |
| O.5Nymphaeales                              |      |        |     |
| F4 Nymphaeaceae                             | Chrp | Scléo  | Pan |
| Es5. <i>Nymphaea lotus</i> L                |      |        |     |
| Clade : Angiosperm                          | Hd   | Scléo  | Pan |
| O. 6.Commelinales                           |      |        |     |
| F5 Commelinaceae                            | Hdfl | Pléo   | Pan |
| Es6. <i>Commelina diffusa</i> Burm.F        | Gt   | Sarco  | Pan |
| F6. Pontederiaceae                          |      |        |     |
| Es7. <i>Eichhornia crassipes</i> ( Mart)    | Grh  | Scléro | C   |
| O.7.Alismatales                             |      |        |     |
| F7. Araceae                                 | Grh  | Scléro | Pan |
| Es8. <i>Pistia stratiotes</i> L             | Grh  | Pléo   | Pan |
| Es9. <i>Colocasia esculenta</i> (L) Schott  |      |        |     |
| O.8. Poales                                 |      |        |     |
| F8. Cyperaceae                              |      |        |     |
| Es10. <i>Cyperus papyrus</i> L              | ch   | scléro | Pan |
| F9 Poaceae                                  |      |        |     |
| Es11. <i>Echinochloa pyramidalis</i> ( Lam) |      |        |     |
| Es12. <i>Leersia hexandra</i> ( Sw)         | Th   | Scl    | Pal |
| Clade : Tracheophytes                       |      |        |     |
| Clade : Angiosperms                         |      |        |     |
| Clade : Eudicots                            |      |        |     |
| O.9. Caryophyllales                         |      |        |     |
| F10 Polygonaceae                            |      |        |     |
| Es13. <i>Polygonum lanigerum</i>            | NnPh | Bal    | At  |
| O.10.Caryophyllales                         | NnPh | Bal    | Am  |
| F11Gisekiaceae                              |      |        |     |
| Es14. <i>Gysekia pharnaceiodes</i> L.       |      |        |     |
| Clade : Angiospermes                        |      |        |     |
| Clade : Dicotylédones vraies                |      |        |     |
| Clade : Noyau des dicotylédones vraies      | Th   | Scléo  | Pan |
| Clade : Rosidées                            |      |        |     |
| Clade : Fabidées                            |      |        |     |
| O.11. Fabales                               |      |        |     |
| F12 Fabaceae                                |      |        |     |
| Es15. <i>Aeschynomene fluitans</i> L.       | Grh  | Pléo   | Gc  |
| Es16. <i>Aechinomum sensitiva</i> Swartz    |      |        |     |
| Clade : Asteridées                          | Hd   | Pléo   | Gc  |
| Clade : Lamidées                            |      |        |     |



|  |  |  |  |
|--|--|--|--|
| O.12.Gentianales                                   |  |  |  |
| F13 . Rubiaceae                                    |  |  |  |
| Es17. <i>Oldenlandia affinis</i> ( Roem.&Schult.). |  |  |  |
| Phyllum: Pteridophyta/ Filicopsida                 |  |  |  |
| O.13. Selaginellales                               |  |  |  |
| F14 Selaginellaceae                                |  |  |  |
| Es18. <i>Selaginella myosorus</i> L                |  |  |  |
| O.14. Hydropteridales                              |  |  |  |
| F15 Salviniaceae                                   |  |  |  |
| Es19. <i>Salvinia molesta</i> D.S.Mitchell         |  |  |  |

Legend: biologiques Types (TB): MspH = Phanerophytes, Ch= Chamephytes, Th=Therophytes, Hc=Hemicryptophytes, Hd= Hydrophytes, Geophytes, Nanophanerophytes (NPh) .

Type of Diaspora (TD): Ptero= ptérochore, Pogo= Pogochoire, Scléro= Sclérochoire, Desmo= Desmochoire, Sarco= Sarcochoire, Ballo= Ballochoire, Baro= Barochoire, Plèo=Plèochore.

Phytogeographical Distribution (DP): Cosm= cosmopolit, pan= pantropical, Aa = Afro-américain, Pal= Paleotropical, At=Afro-malgache, Gc= Guineo-congolaise, Congolaise C= congolaise Am =Afro-malgache.

The table 1 presents the general list of aquatic plants collected in the various prospecting sites comprising 19 species divided into 15 families, 14 orders in two Phylum including the Pteridophytes and Angiosperms.

Table 2: Comparison of the vegetation of the studied sites

| Family / species                                 | Molondo | Mipongo | Japon |
|--|---------|---------|-------|
| Onagraceae                                       |         |         |       |
| 1. <i>Ludwigia abyssica</i> A. Rich.             | +       | +       | +     |
| 2. <i>Ludwigia leptocarpa</i> (Nutt) Hara        | +       | +       | -     |
| . Amaranthaceae                                  |         |         |       |
| 3. <i>Alternanthera sessilis</i> (L)DC           | +       | +       | +     |
| . Convolvulaceae                                 |         |         |       |
| 4. <i>Ipomoea aquatica</i> Forsk                 | +       | +       | +     |
| . Nymphaeaceae                                   |         |         |       |
| 5. <i>Nymphaea lotus</i> L                       | +       | -       | -     |
| Commelinaceae                                    |         |         |       |
| 6. <i>Commelina diffusa</i> Burm.F               | +       | +       | +     |
| Pontederiaceae                                   |         |         |       |
| 7. <i>Eichhornia crassipes</i> ( Mart)           | +       | +       | +     |
| Araceae  |         |         |       |
| 8. <i>Pistia stratiotes</i> L                    | +       | +       | +     |
| 9. <i>Colocasia esculenta</i> (L) Schott         | +       | -       | -     |
| Cyperaceae                                       |         |         |       |
| 10. <i>Cyperus papyrus</i> L                     | -       | -       | +     |
| Poaceae  |         |         |       |
| 11. <i>Echinochloa pyramidalis</i> ( Lam)        | +       | +       | +     |
| 12. <i>Leersia hexandra</i> ( Sw)                | +       | -       | -     |
| Polygonaceae                                     |         |         |       |
| 13. <i>Polygonum lanigerum</i>                   | +       | +       | +     |
| Giseciaceae                                      |         |         |       |
| 14. <i>Gysekia pharnaceiodes</i> L.              | -       | +       | +     |
| Fabaceae   |         |         |       |
| 15. <i>Aeschynomene fluitans</i> L.              | +       | -       | -     |
| 16. <i>Aechinomum sensitiva</i> Swartz           | -       | +       | +     |
| Rubiaceae  |         |         |       |
| 17. <i>Oldenlandia affinis</i> ( Roem.&Schult.). | -       | +       | -     |
| Selaginellaceae                                  |         |         |       |
| 18. <i>Selaginella myosorus</i> (Sw.) Alston.    | +       | -       | -     |
| Salviniaceae                                     |         |         |       |
| 19. <i>Salvinia molesta</i> D.S.Mitchell         | +       | +       | +     |
| Total espèces par site                           | 15      | 13      | 12    |

Legend: + presence / - absence

b) Study of ecological spectra

i. Raw spectra of biological types

The various tables, showing the figures and calculations for each spectrum are given in appendix 1.

The spectrum of biological types is given in Figure 3 below.

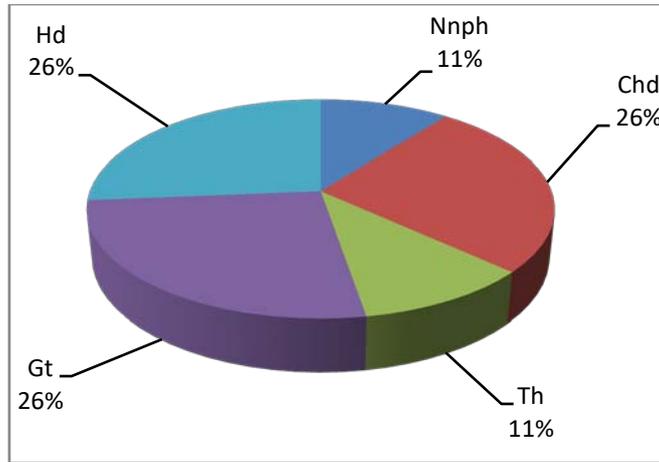


Figure 3: Raw spectrum of biological types

This diagram provides information on the strong dominance of Chaméphytes, Geophytes and Hydrophytes with respectively 26.3% each followed by Nanophanerophytes and Therophytes with a low representation (11%).

Figure 4 gives the chorological distribution of different inventoried taxa.

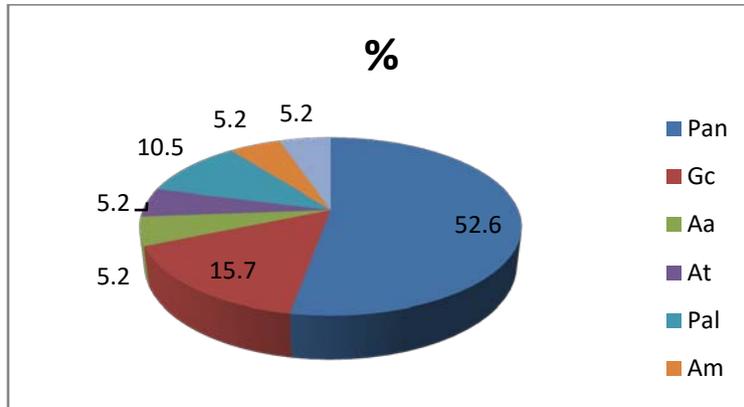


Figure 4: Raw spectrum of distribution types of phytochories

We note in this figure 4 the strong dominance of Pantropical species (52.6%), Guinean-Congolese species (15.7%) and Paleotropics (10.5%). The other phytochories are weakly represented with 5.2% respectively.

The raw spectrum of the type distribution of the diaspores of the species listed is given in figure 5

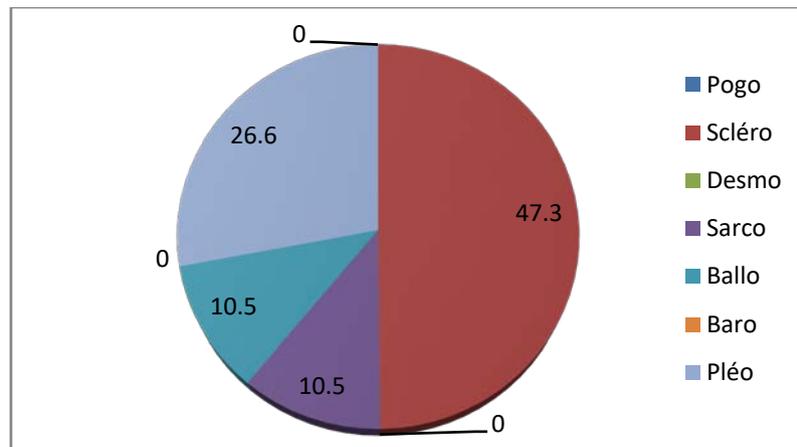


Figure 5: Raw spectrum of diaspore types

The data in Figure 5 show a clear predominance of sclerochoric species (47.3%), followed by Pleochores (26.6%), while sarcochores and ballochores respectively represent only 10.5 of the florula studied. Note the absence of desmochoric species.

Table 3 below shows the exotic species.

Table 3: Exotic species listed after the inventory

| Family / species                                   | D.P |
|--|-----|
| . Amaranthaceae                                    |     |
| 1. <i>Alternanthera sessilis</i> (L)DC             | Pan |
| . Convolvulaceae                                   |     |
| 2. <i>Ipomoea aquatica</i> Forsk                   | Pan |
| . Nymphaeaceae                                     |     |
| 3. <i>Nymphaea lotus</i> L                         | Pan |
| Commelinaceae                                      |     |
| 4. <i>Commelina diffusa</i> Burm.F                 | Pan |
| Pontederiaceae                                     |     |
| 5. <i>Eichhornia crassipes</i> ( Mart)             | Pan |
| Araceae  |     |
| 6. <i>Pistia stratiotes</i> L                      | Pan |
| 7. <i>Colocasia esculenta</i> (L) Schott           | Pan |
| Poaceae  |     |
| 8. <i>Echinochloa pyramidalis</i> ( Lam)           | Pan |
| 9. <i>Leersia hexandra</i> ( Sw)                   | Pan |
| Polygonaceae                                       |     |
| 10. <i>Polygonum lanigerum</i>                     | Pan |
| Gisekiaceae  |     |
| 11. <i>Gysekia pharnaceiodes</i> L.                | Pan |
| Rubiaceae  |     |
| 12. <i>Oldenlandia affinis</i> ( Roem. & Schult.). | Pan |

Legend: D.P=phytogéographic distribution / Pan : Pantropical

The two aliens exotic species are listed in the table 40

Table 4: Invasive alien species found at the three study sites

| Invasive alien species            | Observation  |
|-----------------------------------|--|
| 1. <i>Eichhornia crassipes</i>    | Very invasive; Mono specific mat formation always in association with <i>Echinochloa pyramidalis</i> |
| 2. <i>Echinochloa pyramidalis</i> |  |

Photos of different sites illustrating species invasions in Pool Malebo are shown below.



Photo A: *Eichhornia crassipes* (2) and *Echinochloa pyramidalis* (1)  
(Photo Mukendi, 2020 Mipongo site)



B

Photo B: *Eichhornia crassipes* (2) and *Echinochloa pyramidalis* (1) (Photo Mukendi, 2020, Mipongo Site).



Photo C: *Echinochloa pyramidalis*(1) 2 and *Ipomoea aquatica* (2) (Photo Mukendi 2020). (Molondo collected site)



Photo: *Echinochloa pyramidalis* in the site de Molondo (Photo Mukendi, 2020)



Photo: *Eichhornia crassipes* and *Echinochloa pyramidalis* in Japon site (Photo Mukendi 2020)

#### IV. DISCUSSION

The study of invasive aquatic exotic plants in the hydrographic network of the city of Kinshasa, at Pool Malebo, in the three islands (Molondo, Mipongo and Japon), at Kinkole, identifies 19 plant species including 12 exotic species and 2 species. Invasive alien. These results show that the aquatic flora of Kinshasa is polluted with the presence of many exotic species (63.16%). This is explained by the fact that aquatic environments are often open, and hydrochory is also one of the most effective modes of dispersal of diaspores.

The study conducted by of N'guessa and Pedia (CDB 2013) showed that the flora of Côte d'Ivoire contains 3853 plant species, including 240 species (6.2%) exotic or introduced. Of these, 20 species (8.3%) are invasive alien species. Ten species are found in the hydrographic network of Côte d'Ivoire. These are: *Eichhornia crassipes*, *Echinochloa pyramidalis*, *Pistia stratiotes*, *Salvinia molesta*, *Nelumbo nucifera*, *Typha australis*, *Polygonum lanigenum* var *africanum*, *Bacopa crenata*, *Hydrolea glabra* and *Paspalum vaginatum* (CDB, 2013).

In the Democratic Republic of Congo, this study on the vegetation of the islands of the river supports the work of Mbale et al, (2019), on the inventories of invasive exotic flora in Pool Malebo and other rivers including the Lukaya and La Funa which reveal *Eichhornia crassipes* and *Echinochloa pyramidalis* as invasive species.

The results of this study also show that out of the 19 plant species collected in general, 12 species are exotic and only 2 show invasive behavior. As in Ivory Coast, *Eichhornia crassipes*, and *Echinochloa*

*pyramidalis* are part of the procession of exotic species but also invasive alien species.

In Benin, the water hyacinth, has been discovered in 1977 in the Sô river, became ten years later the worst aquatic plant. The population calls it "Togble" which means "the country is in ruins". It is one of two invasive aquatic alien plants that have been reported in Benin: *Eichhornia crassipes* and *Pistia stratiotes* (ANONYMOUS, 2004).

#### V. CONCLUSION

The floristic study of invasive alien aquatic plants in Kinshasa is part of the work relating to the achievement of the Aichi targets, Objectives 9 and 19 of the Nagoya 2010 protocol.

The present study is research involving a territory whose vegetation cover is increasingly being impacted by hydrological and anthropogenic parameters by the introduction of exotic species. Indeed, anthropogenic fishing, market gardening and rice cultivation activities on the banks of the Congo River sometimes lead to allochthon species being introduced into the aquatic environment of the islands of the river. The inventory of the flora prospected indicated the presence of 19 species in general, including 2 Pteridophytes and 17 Angiosperms, divided into 19 families, 14 orders.

The present study revealed the presence of 12 exotic plants, 2 of which are invasive in environments: *Eichhornia crassipes* and *Echinochloa pyramidalis*. These two species deserve increased surveillance, as they pose major challenges for the navigability of rivers, and the invasion of fishing sites, sometimes completely

modifying the spawning areas of fish. Ecological analysis revealed that this flower is predominantly dominated by Sclerochores and Pleochores.

Species recorded in Kinshasa highlighted the existence of a disturbed flora dominated by species with a very wide distribution which, over time, have supplanted those of the Guinean base element whose disappearance in the prospected perimeter confirms makes explicit the anthropogenic regressive evolution. The Congo Basin is very large, and the Congo River has several tributaries likely to be colonized by aquatic species. It is therefore recommended to widen the prospecting field in order to identify and list the exotic and/or invasive aquatic species of the Congo's aquatic flora. This study will be long-term, but it deserves to be undertaken before the aquatic ecosystems are sufficiently degraded, with the risk of losing many aquatic species in our country.

Botanists, biodiversity defenders and political decision-makers are therefore invited to become aware of this aspect of the problem, and to take appropriate measures to manage to protect the local aquatic flora, and avoid the invasion by exotic species of the aforementioned. flora.

## REFERENCES RÉFÉRENCES REFERENCIAS

1. APG III. (2009): An update of the Angiosperm phylogeny Group Classification for the orders and families of flowering plants in Botanical journal of the Linnean. society, 161, 105 - 121.
2. AUBREVILLE, and KOEHLIN, J. (1962): Flore du Gabon. 5- Gramineae family. Ed. Nat. Museum Hist., Paris 291 p.
3. BULTOT, F. (1950): Map of climatic regions of the Belgian Congo established according to the Köppen criteria (communication n°2 from Bureau climatologique) Publ. INEAC, coll. In. 4°
4. CBD (2004): National Strategy on Invasive Alien Species. Canada, 38p.
5. CBD, (2013): GTI Capacity Development Workshop for Aichi Targets 9 and 19 in West and Central Africa. DAKAR, SENEGAL problematic of invasive alien species.
6. CRONQUIST, A. (1968): Evolution and classification of floring plants Houghton Misslin Company, Boston.396p.
7. DAJOZ, R. (1975): Précis d'écologie Ed. Gauthier - villars. Paris 549p
8. DENYS, E. (1980): A attempt phytogéographical division of tropical Africa based on a mathematical analysis of distribution maps. Bull, Jard. . Bot. Nat Belg. 50, pp. 465 - 504.
9. EVRARD.C. (1968): Ecological research on the forest stand of hydromorphic soils of the central Congolese basin. Publ. INEAC. Ser.Sc. n° 110 Brussels 295p.
10. LEBRUN, J. (1947): The vegetation of the alluvial plain south of Lake Edouard. Expl. Albert Natural Park Tomes I and II. Brussels, 800p.
11. LEBRUN, J. (1960): Study on the flora and vegetation of lava fields north of Lake Kivu.Parc Nat. Albert Bruxelles, 352p.
12. LEBRUN.J. (1966): Biological forms in the tropics. Same. Sc. Bot. Fr. 45: pp 164-175.
13. LEJOLY, J, & MANDANGO, M. A. (1982): Arbustive association with Alchornea cordifolia in Haut-Zaire. Bull. Roy. Bot. In studies on aquatic vascular plants pp 257-265.
14. MULLENDERS, W. (1954): Vegetation of Kaniama (between Lubishi - Lubilash, Belgian Congo) Publ. INEAC, Sér.Sc. No. 61, 499p.
15. SCHNEL, R. (1971): Introduction to the phytogeography of tropical countries, general problems, media, plant groups. Ed. Gauthier - villars, Vol.II. 951p.
16. CALLON M., LASCOUMES P., BARTHE Y. (2001) "Acting in an uncertain world. Essay on technical democracy "in" Biodiversity and sustainable development: what indicators? », LEVREL H., thesis, Ecole des Hautes Etudes en Sciences Sociales, 406 p.
17. MANDANGO, M.A. (1981): Flora and vegetation of Tundulu Island in Kinsangani (Haut - Zaire). Diss. UNIKIS. Fac .Sc. 128p.
18. MULUMBU, N. D.D. (2007): Comparative study of the reproduction of two species of the genus Hemichromis Spp, Pisces (Cichlidae) in the Malebo Pool on the Congo River, Mémoire Unikin Dépt Biologie, 45p.
19. PWEMA, K. (2004): Comparative ecological study of three species of Labeo (Cyprinidae) from Pool Malebo, Congo river. Mem.DEC, fac. Univ.Notre Dame de la Paix.43p unpublished.
20. Teugels G.G., and Guégan J-F., 1994. Biological diversity in African fresh-and brackish water fishes. Geographical overviews-Symposium Paradi-Biological diversity of freshwater and saltwater fish in Africa. Geographical summaries. Teugels et al. (eds), 1994.
21. Lelo N.F., 2008. Kinshasa, city and environment Ed. L'Harmattan.282p.
22. PWAMA K.V., 2014. Food ecology, reproduction and modes of adaptation of five species of Labeo Cuvier, 1817 in lentic environments and rapids at Pool Malebo in the Congo River
23. Mbadu Z.V., 2011. Biology of species of the genus Distichodus Muller and Troschl, 1845 (Distichodontidae, Pisces) from Pool Malebo (Congo river) in relation to the mechanisms of exploitation of their trophic niches. Doctoral thesis presented and defended with a view to obtaining the degree of Doctor of Science, 442p.

24. ANONYMOUS (2004): Prevention and Management of Invasive Foreign Species Proceedings of a Regional Workshop: Implementation of Cooperation in West Africa March 9-11, 151p Accra, Ghana.
25. Van Andel and Van der Bergh (1987): Vitousek et al. (2)

## ANNEXES

### Appendices



Photo Mukendi 2020 *Echinochloa pyramidalis* sur le Pool Malebo



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## Organoleptic Characteristics of Fresh Meat Purchased from Public Market at Five Different Time

By Haroon-Abdukadir, H. T, Lawal, W. S, Adebayo, S. M & Salami, M. O

*Institute of Applied Sciences*

**Abstract-** Meat sample was purchased from Ipata market five (5) different time namely 8am, 11am, 2pm, 4pm and 6pm and organoleptic characteristics of the meat samples was then carried out and at the end it was found that the colour of the meat bought 8 and 2pm are well accepted ( $P < 0.05$ ) both flavor and overall acceptability has the 8am meat has been the best while Aroma and Texture has the 4pm meat as the best ( $P < 0.05$ ). Juiciness has 8am meat has been well accepted.

*GJSFR-C Classification: FOR Code: 069999*



*Strictly as per the compliance and regulations of:*



# Organoleptic Characteristics of Fresh Meat Purchased from Public Market at Five Different Time

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**Abstract-** Meat sample was purchased from Ipata market five (5) different time namely 8am, 11am, 2pm, 4pm and 6pm and organoleptic characteristics of the meat samples was then carried out and at the end it was found that the colour of the meat bought 8 and 2pm are well accepted ( $P < 0.05$ ) both flavor and overall acceptability has the 8am meat has been the best while Aroma and Texture has the 4pm meat as the best ( $P < 0.05$ ). Juiciness has 8am meat has been well accepted.

## I. INTRODUCTION

For consumers to attain the best of taste and all the nutrients from meat they purchased from the meat retailers, then meat shops and abattoirs should adopt a very good preservative technology for their unsold meat (Lawal, 2013). One of the main purposes of food industry is to optimize preservation technologies of perishable foods, so as to reach a final product with optimal quality.

Flavour and tenderness are the most appreciated characteristics in lamb meat by consumers. While tenderness is probably the most important factor that determines acceptability in other species, such as beef (Boleman et al., 1997), flavour is very important for lamb meat (Crouse, 1983), followed by tenderness. Indeed, one of the main reasons some consumers reject lamb meat is its characteristic flavour (Cramer, 1983), which is very appreciated, instead, by other consumers as a feature making lamb meat more tasty than meat from other species. Altamura and Trimeticchio sheep are two genotypes reared in Apulia region, Southern Italy, which are threatened with extinction at the present time. Altamura breed is a triple purpose breed, which in the last years was reared, mostly, to produce wool for mattress; actually, the size meaning of breed is reducing year by year until to less than one thousand, mainly due to a dramatic drop in wool demand. Trimeticchio sheep was obtained at the Segezia Experimental Station of the Italian Istituto Sperimentale per la Zootecnia from a crossbreeding programme for the genetic improvement of meat yield and quality of the Gentile di Puglia breed. The present study carried out to investigate meat

organoleptic properties of Altamura and Trimeticchio lambs slaughtered at 42 and 70 days of age.

Safety and guaranteed quality of food are of great importance to current consumers.

Meat is a vital part of human diet and therefore there is an increasing demand for improving health factors related to its consumption (Šubrt et al., 2002). Consumers require consistently tender, flavourful meat with low fat contents (Homer et al., 1997). Beef quality in terms of chemical composition and sensory aspects is affected by many factors including breed (Chambaz et al., 2001; 2003) and nutrition (Geay et al., 2001). Meat from heifers of beef breeds is highly valued for its quality and culinary use and has the potential to meet the high requirements of today's consumers.

## II. MATERIAL AND METHODS

*Collection of Samples:* The meat samples were purchased from the Ipata main market from a particular butcher at five (5) different time (8am, 11am, 2pm, 4pm and 6pm), each time it is purchased, four small piece of meat is collected from the purchased for the four different methods of meat preservation, another part of the meat is also cut for sensory evaluation and the remaining part is taken to the laboratory for microbial load, this is the procedure all the pieces of the purchased meat for the five different method under go. Each meat sample is labelled with its time of purchase i.e sample 8 sample 11 etc.

## III. SENSORY EVALUATION

Each of the five meat sample is boiled and presented for sensory analysis, five (5) panelist was invited and the meat sample is served while the panelist record their observations using the nine (9) point edonic scale, panelist response is used for our data.

## IV. LABORATORY ANALYSIS

There are two types of analysis in the laboratory, this are fungi and bacteria as explained below.

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## Fungal

### a) Total viable count (TVC)

The media was autoclaved and 20 ml of sterilized Nutrient Agar medium measured into the plate. 100 $\mu$ L of the product was pipette into the Petri dish and swilled to mix aseptically. They were incubated at 35 $^{\circ}$ C for 24 hrs. The colony forming units were counted and recorded as CFU.

### b) Total Fungal count

The media were autoclaved and 20 ml of sterilized Potato Dextrose agar was measured into the sterile culture plates. 100 $\mu$ L of serially diluted sample (x10-6) were pipetted into the Petri dishes and swilled to mix aseptically. They were incubated at 35 $^{\circ}$ C for 3 – 5 days.

The colony forming units were counted and recorded as CFU.

### c) Total Coliform count (TCC)

The media was autoclaved and 20 ml of sterilized MacConkey Agar medium the plate. 100 $\mu$ L of the product was pipette into the Fetri dish and swilled to mix aseptically. They were incubated at 35 $^{\circ}$ C for 24 hrs. The colony forming units were counted and recorded as CFU.

## Microbial

### a) Total Bacteria count (TBC)

The media was autoclaved and 20 ml of sterilized Nutrient Agar medium measured into the plate. 100 $\mu$ L of the product was pipette into the Petri dish and swilled to mix aseptically. They were incubated 35 $^{\circ}$ C for 24 hrs. The colony forming units were counted and recorded as CFO.

## V. PROCEDURE FOR MEAT QUALITY EVALUATION

### a) Cooking loss

This was determined by cooking 20g of the breast and the thigh meat in water bath for 20 minutes at 80 $^{\circ}$ C. The difference in weight before and after cooking gives the cooking loss according to the procedure A.M.S.A, (1995)

### b) Chilling loss

This was carried out by cutting and refrigerating 20g of both the breast and thigh meat for 24 hours and the difference gives the chilling loss according to procedure of A.M.S.A,(1995)

### c) Drip loss

It was carried out by freezing 20g of breast and thigh meat for 24 hours and the difference in weight after freezing gives the drip loss A.M.S.A, (1995).

### d) Grill loss

This was carried out by oven drying 20g of breast and thigh meat till is consumable and the difference in weight gives the grill loss A.M.S.A, (1995).

### e) Thermal loss

Four centimeter (4cm) muscle length was cut from the breast and the thigh meat and subjected to heat at 80 $^{\circ}$ C temperature in water bath for 15minutes.The change in length gave the thermal loss. A.M.S.A,(1995).

## VI. RESULT AND DISCUSSIONS

The table 4.1 above shows the response of the panelist on beef purchased from Ipata market at five (5) different periods, as earlier stated and this periods was assigned letters A, B,C,D and E. It was observed that, there was significant different between the treatments analyzed (P<0.05).

There was no significant different in colour of the beef except the sample E that was purchased around 6pm (P>0.05)

No significant different was observed in flavor of the beef (P<0.05) except in sample A, sample E is the only different one in terms of aroma while all other sample. The texture of all the meat sample were all the same with no significant different in them. All the sample are same in terms of juiciness except the sample A that is highly significant when compare to others, but the overall acceptance is same no significant different occurred in any of the samples.

The colour of sample E that is different and significant may be as a result of the fact that the meat has stayed in the abattoir and enough microorganism has infected the meat and this caused a drastic change in the colour of the meat. This is similar to result obtained by Bowkers, 2014 in his experiment.

The flavor of sample A that is highly significant when compared with other sample may be as a result of the fact that the sample was purchased fresh immediately the animal was slaughtered. This is similar to what Bramblett 1959 obtained in his experiment.

Aroma of the sample E that was the least may be as a result of the sample that has been touched severally by series of interested buyer that did not later buy the meat again in addition to house fly that has touched the sample severally that made the aroma changed. This result is same with what Alvarado and Sams, 2004 got in their experiment.

The texture of the meat did not change irrespective of the time of purchase, this may be because the time of stay and amount of micro-organism that attacked the meat did not really make any change in the texture of the meat samples The result obtained is similar to what Van Laack and Lane, 2000 got in their experiment.

The juice of the sample A that was very high when compared with others may be as a result of the fact the sample was purchased immediately when the animal was slaughtered and all the juice and the nutrients of the beef is almost intact as compared to

those that has been drain by sunrays, attack by microorganism and touching from prospective buyers. This is similar to what Yu et al 2005 got in their experiment

Table 3.1: Organoleptic Characteristics of Fresh Meat

| Parameter   | A                   | B                  | C                   | D                  | E                  | SEM  |
|-------------|---------------------|--------------------|---------------------|--------------------|--------------------|------|
| Colour      | 60.00 <sup>ab</sup> | 64.00 <sup>a</sup> | 62.00 <sup>a</sup>  | 65.00 <sup>a</sup> | 46.00 <sup>b</sup> | 1.89 |
| Flavour     | 68.00 <sup>a</sup>  | 51.00 <sup>b</sup> | 49.00 <sup>c</sup>  | 57.00 <sup>b</sup> | 50.00 <sup>b</sup> | 1.94 |
| Aroma       | 36.00 <sup>ab</sup> | 34.00 <sup>b</sup> | 39.00 <sup>ab</sup> | 45.00 <sup>a</sup> | 20.00 <sup>c</sup> | 2.25 |
| Texture     | 44.00 <sup>ab</sup> | 38.00 <sup>b</sup> | 37.00 <sup>b</sup>  | 46.00 <sup>a</sup> | 45.00 <sup>a</sup> | 1.09 |
| Juiciness   | 69.00 <sup>a</sup>  | 53.00 <sup>b</sup> | 48.00 <sup>c</sup>  | 46.00 <sup>c</sup> | 42.00 <sup>c</sup> | 2.54 |
| Overall ac. | 67.00 <sup>a</sup>  | 68.00 <sup>a</sup> | 50.00 <sup>b</sup>  | 50.00 <sup>b</sup> | 51.00 <sup>b</sup> | 2.29 |

## VII. CONCLUSION AND RECOMMENDATIONS

### Conclusion

1. The meat sample purchased at 4pm followed by that of 11am has the best colour as expressed by the panelist.
2. The flavor of 8am meat has the best flavor
3. The Aroma and Texture of the 4pm meat sample was the best
4. Juiciness was well accepted by panelist for 8am and 11am meat so also the overall acceptability

### Recommendations

1. When meat is purchased and cooked immediately after slaughter all the organoleptic characteristics will still be intact.
2. Meat not sold or consumed by consumer or butcher should be properly preserved

## REFERENCES RÉFÉRENCES REFERENCIAS

1. Boleman, S. J., Miller, R. K., Taylor, J. F., Cross, H. R., Wheeler, T. L., (1997) Consumer evaluation of beef of known categories of tenderness. *J. Anim. Sci.* 75:1521-1524.
2. Cramer, D. A. (1983) Chemical compounds implicated in lamb flavor. *Food Technol.* 37(5):249-257.
3. Crouse, J. D., 1983. The effects of breed, sex, slaughter weight, and age on lamb flavor. *Food Technol.* 37(5):264-268.
4. Duckett S. K., Snowden, G. D., Cockett, N. E., (2000) Effect of the callipyge gene on muscle growth, calpastatin activity, and tenderness of three muscles across the growth curve. *J. Anim. Sci.* 78:2836-2841.EXPE
5. Hawkins, R.R., Kemp, J.D., Ely, D.G., Fox, J.D., Moody, W.G., Vimini, R.J., (1985) Carcass and meat characteristics of crossbred lambs born to ewes of different genetic types and slaughtered at different weights. *Livest. Prod. Sci.* 12:241-250.
6. Lynch, J.J., Hinch, G.N., Adams, D.B., (1992): The Behaviour of Sheep, p. 237 C.A.B. International and CSIRO, Australia, East Melbourne.
7. Naes, T., (1991). Handling individual differences between assessors in sensory profiling. *Food Qual. Prefer.* 2:187 -199.
8. Santos-Silva, J., Mendes, I.A., Bessa, R.J.B.(1997): The effect of genotype, feeding system and slaughter the quality of light lambs 1. Growth, carcass composition and meat quality *Livest. Prod. Sci.* 76:17-25.
9. Sanudo, C., Campo, M.M., Sierra, I., Maria, G., Olleta, J.L., Santolaria P., 1997. Breed effect on carcass and meat quality of suckling lambs. *Meat Sci.* 46:357-365. SAS. 1999. SAS/STAT User.
10. Owens, F., Secrist, D., Hill, W. & Gill, D. (2012). Acidosis in Cattle: A Review1. *Journal of Animal Science*, 76: 275–286.
11. Patolia H, Saikaew, W and Chaudhary, R (2007) Response of Jatrophacaurcas grown on chemicals *International Journal of environmental studies vol. 64, 2007 issue 6, 659-674.*
12. Penfield, M.P and Mayer, B. H (1975): Changes in tenderness and collagen of beef semi-Tendinosus muscle heated at rates. *Journal Food Sci.* 32:150-154. *Process. Preserv.*10:311-329.
13. Penny (1980) Role of endogenous proteases in meat tenderization. *Amer. Journal of meat Sc* 18(3)304-444.
14. Pharmacopoeia (2003). World Health Organization, Geneva. 3rd ed., v.5.

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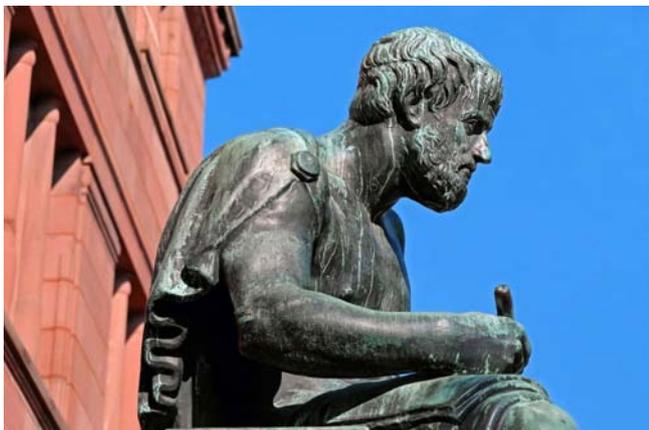
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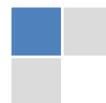
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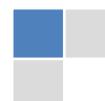
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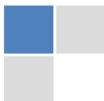
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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

### Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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## PREPARING YOUR MANUSCRIPT

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.



### ***Manuscript Style Instruction (Optional)***

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

### ***Structure and Format of Manuscript***

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

- a) A title which should be relevant to the theme of the paper.
- b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
- c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
- d) An introduction, giving fundamental background objectives.
- e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
- f) Results which should be presented concisely by well-designed tables and figures.
- g) Suitable statistical data should also be given.
- h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

- i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
- j) There should be brief acknowledgments.
- k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



## FORMAT STRUCTURE

***It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.***

All manuscripts submitted to Global Journals should include:

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The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

### **Author details**

The full postal address of any related author(s) must be specified.

### **Abstract**

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

### **Keywords**

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

### **Numerical Methods**

Numerical methods used should be transparent and, where appropriate, supported by references.

### **Abbreviations**

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

### **Formulas and equations**

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

### **Tables, Figures, and Figure Legends**

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.



## Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

## PREPARATION OF ELETRONIC FIGURES FOR PUBLICATION

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

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## TIPS FOR WRITING A GOOD QUALITY SCIENCE FRONTIER RESEARCH PAPER

Techniques for writing a good quality Science Frontier Research paper:

**1. Choosing the topic:** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

**2. Think like evaluators:** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

**3. Ask your guides:** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

**4. Use of computer is recommended:** As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

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**6. Bookmarks are useful:** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

**7. Revise what you wrote:** When you write anything, always read it, summarize it, and then finalize it.

**8. Make every effort:** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

**9. Produce good diagrams of your own:** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

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**11. Pick a good study spot:** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

**12. Know what you know:** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

**13. Use good grammar:** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

**14. Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

**15. Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**16. Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

**17. Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

**18. Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**19. Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.



**20. Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

**21. Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

**22. Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

**23. Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

### **Key points to remember:**

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

### **Final points:**

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

### **The discussion section:**

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

### **General style:**

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



### *Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

### **Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

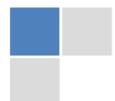
- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

### **Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

### **Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

#### **Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

#### **Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

#### **Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

#### **Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

#### **Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

#### **What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

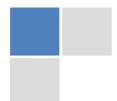
If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

**Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

## THE ADMINISTRATION RULES

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

*Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.*

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CRITERION FOR GRADING A RESEARCH PAPER (COMPILATION)  
BY GLOBAL JOURNALS

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

| Topics                        | Grades   |   |  |
|-------------------------------|--|---|--|
|                               | A-B  | C-D   | E-F  |
| <i>Abstract</i>               | Clear and concise with appropriate content, Correct format. 200 words or below   | Unclear summary and no specific data, Incorrect form<br><br>Above 200 words                         | No specific data with ambiguous information<br><br>Above 250 words |
| <i>Introduction</i>           | Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited | Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter | Out of place depth and content, hazy format                        |
| <i>Methods and Procedures</i> | Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads  | Difficult to comprehend with embarrassed text, too much explanation but completed                   | Incorrect and unorganized structure with hazy meaning              |
| <i>Result</i>                 | Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake   | Complete and embarrassed text, difficult to comprehend  | Irregular format with wrong facts and figures                      |
| <i>Discussion</i>             | Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited   | Wordy, unclear conclusion, spurious   | Conclusion is not cited, unorganized, difficult to comprehend      |
| <i>References</i>             | Complete and correct format, well organized  | Beside the point, Incomplete  | Wrong format and structuring                                       |



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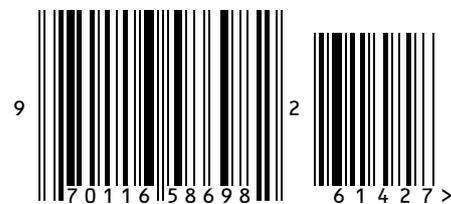


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