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Agro-Morphological Study of four Cultivars of *Citrullus lanatus*

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Original Research Article

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Abstract: Ivorian Cucurbitaceae seeds consumed in sauce find themselves in several varieties. Among the Cucurbitaceae, *Citrullus lanatus* species comprises four cultivars listed on the basis of the size and appearance of seeds (oval seed cultivar, large seed cultivar, average seed cultivar and small seed cultivar). To promote these crops, field trials in situ were carried out to show the diversity within the species. Works have been conducted on the characterization of physico-chemical properties of seeds, and almonds. The agromorphological analysis showed different fruits weight of 1135.45 ± 266.78 g, 1075.29 ± 336.89 g, 838.43 ± 184.15 g and 764.4 ± 242.3 g for COS, CBS, CAS and CSS cultivars respectively. The morphological characteristics of peeled seeds (almonds) and not peeled (whole seeds) varied significantly (P 0,05) of a cultivar to the other. The percentage of germination of seeds showed a significant difference (p 0,05) from a cultivar to the other one. So the percentages of germination were 62,81 % and 88,88 % for the cultivars CSS and CAS respectively. As for cultivars COS and CBS, the percentages of germination were 95,72 % and 90,72 %. The qualitative and quantitative evaluation of the characteristics of the seeds of *Citrullus lanatus* cultivars showed that cultivars CBS and COS were premature, produced big fruits containing big seeds contrary to the late cultivars CAS and CSS with small and average seeds. However, the shape of fruits of the various cultivars did not determine the size of their seeds.

Keywords : *Citrullus lanatus*, Cucurbitaceae, agromorphological analysis, seeds, almonds, germination.

INTRODUCTION

States are interested in the sustainable agricultural development to strengthen the direct access to the food by the research and the valuation of new local sources of proteins, considered as better solution to the food safety [1, 2]. The food resources, in particular the plant, because of their bioavailability and their low cost with regard to animal proteins can establish an outcome in the improvement of the nutritional and sanitary quality of the populations of the Third World [3, 4].

Unfortunately, the agricultural development, centred on the marketing of the cultures of pensions (coffee, cocoa, hevea, palm oil), relegated in the background the traditional food plants said minor. Therefore, some of these subsistence crops are in dereliction and endangered [5]. Among these untidy food cultures, include Cucurbitaceae with protéo-oleaginous seeds very appreciated and called "pistache" in Côte d'Ivoire.

In Côte d'Ivoire, tries of characterization allowed to reveal that there are five species of cucurbits oleaginous plants in the zones of production of whom the species *Citrullus lanatus* [6]. Furthermore, according to the phenotypic observations made by the farmers on the basis of the size and form of the seeds, works made by Adjoumani [7], allowed to confirm this variability in the genetic plan with four cultivars (oval seeds, big seeds, average seeds and small seeds) at the level of the species *Citrullus lanatus*. Studies concerning this species, focused on the nutritional compositions of the African type "egussi" [8-10] and of the moderated type "watermelon" [11-13] as well as the varieties of chinese origin of general way [14]. New data on the biochemical and nutritional characterization of the species could allow the use of cucurbites as raw materials in the food-processing and other industries (medicine, cosmetic).

Of where, the objective of this study which is to estimate some agronomic characteristics of the cultivars of *Citullus lanatus* (cultivar oval seed,

cultivar big, myenne and small seed) by comparative tests.

MATERIAL AND METHODS

Site of study

The tries of ground were realized in the experimental farm of the Nangui Abrogoua University (Abidjan, Côte d'Ivoire) between 5°17' and 5°31' of north latitude and 3°45' and 4°22' of West longitude. It was framed in the South by the municipality of Adjamé, in the North by the municipality of Abobo, in the East by the municipality of Cocody and on the West by the forest of Banco.

Plant material

Four varieties of seeds collected within the oleaginous type of *Citrullus lanatus* were used. There was one variety (*Bebu c*ultivar) with oval flat seeds and thick edges (COS), and three varieties (*wlêwlê* cultivars) with flat seeds disentangled and sharp extremity of various size (big seed (CBS), average seed (CAS) and small seed (CSS), (Figure-1). Seeds arise from the germoplasme of Cucurbitaceae of the Nangui Abrogoua University (Abidjan, Côte d'Ivoire) where they were registered under the numbers of identification NI047, NI382, NI066 and Ni383 respectively for cultivars CSS, CAS, COS and CBS.

To obtain a big quantity of seeds necessary for our experiment, seeds stemming from entries were sowed. Plants were maintained. Obtained fruits were collected and submitted to the decomposition. After fermentation of these fruits, seeds were extracted, washed and dried in the sun. These seeds were of use to the experiment.

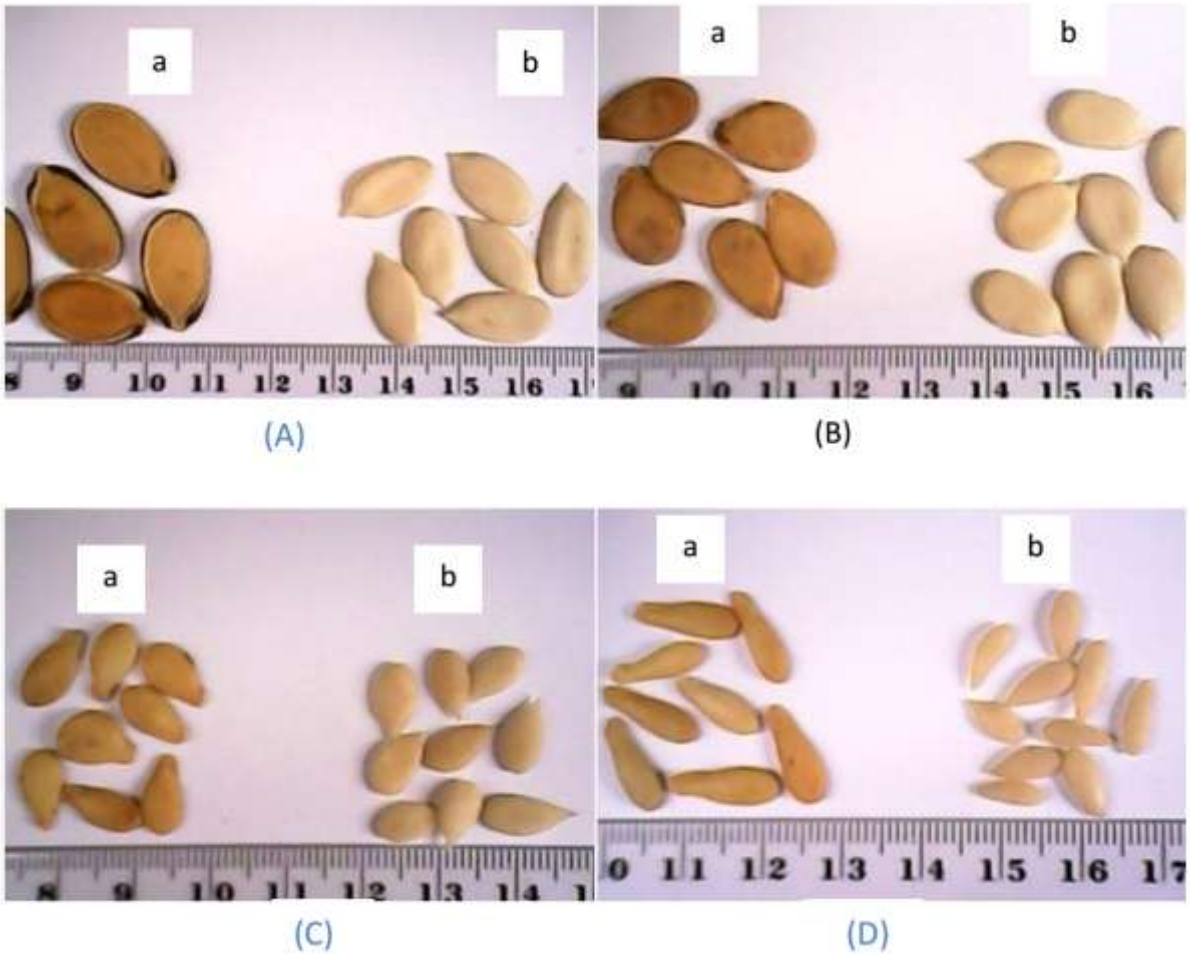

Figure 1: seeds and almonds of *Citrullus lanatus* cultivars

A: seeds (a) and almonds (b) of the cultivar COS; B: seeds (a) and almonds (b) of the cultivar CBS; C: seeds (a) and almonds (b) of the cultivar CAS; D: seeds (a) and almonds (b) of the cultivar CSS

ANALYTICS METHODS

Physico-chemical characteristics of seeds and almonds

To estimate agro-morphological variability of four cultivars of *Citrullus lanatus*, some physical characteristicss through the parameters measured on fruits, seeds and almonds were determined.

Determination of the masses of fruits, seeds and almonds

Twenty (20) whole fruits of each cultivar of *Citrullus lanatus* (COS, CBS, CAS and CSS) taken at random were individually weighed by means of a precision balance (Scaltec SBA51 (1/100 g), Belgium) .Cent (100) seeds stemming from each cultivar were shelled or not, then weighed individually by means of a balance (Adventurer TM, OHAUS (1/1000g), Belgium).

Determination of the size of fruits, seeds and almonds

The size of whole fruits were determined by means of a graduated ruler after their section. Those of the seeds and almonds of each cultivar were measured by means of a caliper with electronic display (INOX HARDENED) whose range of measure varies 0 to 150 mm with a 0,03 mm precision. The size measured were the length and the diameter for fruits, then the length and the width for seeds and almonds.

Parameters relative to the germination

To estimate the agronomic parameters to know the germinative potential of seeds and the production of fruits of the various cultivars of *Citrullus lanatus*, certain parameters were selected. They concern the percentage, the rate and the time of germination (Table-1).

Table-1: Parameters relative to the germination of seeds of 4 cultivars of *Citrullus lanatus*.

Parameters	Abbreviation	Method of measure/calculation
Percentage of germination (%)	PcGe	Report (n/N) x 100, with n = average number of seeds germinated in 7 days and N = average number of sowed seeds
germination time (days)	TeGe	Average time of the date of sowing in the opening of the first two cotylédonaires leaves
Rate of germination (%)	TaGe	Average number of seeds germinated a day (seeds / j). The Somme of the report between the number n of seeds germinated in the day i and the number of Days j since the sowing of seeds.TaGe $\equiv \sum_{i-1}^{N} \frac{ni}{ji}$

RESULTS

Germinative power of seeds

The values of the parameters relative to the germination of seeds were presented in the Table 2. The percentage of germination of seeds showed a significant difference (p 0,05) from a cultivar to the other one. So the percentages of germination were 62,81 % and 88,88 % for the cultivars CSS and CAS respectively. As for cultivars COS and CBS, the percentages of germination were 95,72 % and 90,72 %. Consequently, the percentage of germination was higher for the big seeds compared with the small seeds. Seeds stemming from various cultivars (CSS, CAS, CBS and COS) puted respectively 4.46; 4.38; 3.24 and 3.19 days to germinate. The statistical analysis revealed that the time of seeding decreases significantly (p=0,05) with the size of seeds. More seeds were big, less they puted time to germinate. So the time of germination was shorter with the big seeds compared with the small seeds. Indeed, There was a similarity between cultivars with big seeds (COS and CBS) and between those of small seeds (CAS and CSS) for the times of seeding. As for the speed of seeding, more the seeds were big and more it was raised. Indeed, concerning the rate of germination, the seeds of the cultivar COS germinated together in number raised contrary to those of the cultivars CBS, CAS and CSS which re-hanged themselves daily.

Table-2: Germinative power of *Citrullus lanatus* seeds.

Parameters	Cultivars			
	CSS	CAS	CBS	COS
Percentage of germination (%)	62,81±11,57^{d}	88,88±11,04^{c}	90,72±7,84^{b}	95,72±3,06^{a}
Germination time (j)	4,46±0,78^{a}	4,38±0,77^{a}	3,24±0,75^{b}	3,19±0,81^{b}
Rate of germination (seeds/day)	2,43±1,64^{c}	2,59±0,61^{c}	2,93±0,56^{b}	3,73±0,44^{a}

Each value is the average and the standard deviation of three repetitions. For each parameter, data on the same line affected by different letters are significantly different (P = 0,05). COS: cultivar oval seed, CAS: cultivar average seed, CBS: cultivar big seed and small CSS cultivar small seeds.

Quantitative and qualitative characteristics of fruits, seeds and almonds

Mass and size of fruits

The physical characteristics of fruits, seeds and almonds were presented in the Table 3. The parameters of fruits varied very significantly (P=0,05)

from a cultivar to the other one. So cultivars COS and CBS produced the biggest fruits with 13,15 cm and 12,54 cm of diameter, and mass of 1075,29 g and 1135,45 g respectively. The cultivar CAS produced fruits with 10,86 mm of diameter and average mass of 838,43 g. As for the smallest fruits of mass of 764,4 g and 9,08 cm of diameter, they were produced by the cultivar CSS.

Mass and size of seeds and almonds

The morphological characteristics of peeled seeds (almonds) and not peeled (whole seeds) varied significantly (P 0,05) of a cultivar to the other (Table-3).

The seeds of the cultivar COS had a length of 18,03 mm and a width of 9,83 mm. These seeds had an mass of 0,209 g. When they were peeled, their size decreased (14,42 mm long and 6,33 mm wide) and their mass falled (0,112 g). So, to this cultivar, the almond occupied a part of the seed and more than half the its mass. The shelling led to a decrease of the weight (0,203 g of 0,108 g), of the size (from 15,17 mm to 13,15 mm for long and from 8,86 mm to 4,89 mm for wide). This decrease of mass is relatively low for the cultivar CBS. The cultivars CAS and CSS, produced small seeds (11,06 mm and 9,88 mm of long and 5,31 mm and 4,34 mm of wide) of weaknesses mass (0,060 g and 0,045 g). The shelling of these seeds not pulled no significant decrease of their mass, their length and their width. So to these cultivars (CAS, CSS), the almond occupied a very wide part of the seed.

Table-3: Morphologics characteristics of fruits, seeds and almonds of *Citrullus lanatus*.

Cultivars	Fruits		Seeds			Almonds		
	Mass (g)	Diameter (cm)	Mass (g)	Length (mm)	width (mm)	Mass(g)	Length (mm)	width (mm)
CSS	764,4±242,3^{c}	9,08±1,47^{d}	0,045±0,001^{c}	9,88±0,002^{d}	4,34±0,02^{d}	0,038±0,001^{d}	8,72±0,08^{d}	3,31±0,05^{c}
CAS	838,43±184,15^{b}	10,86±0,89^{c}	0,060±0,004^{b}	11,06±0,08^{c}	5,31±0,03^{c}	0,054±0,001^{c}	10,04±0,10^{c}	4,11±0,04^{b}
CBS	1075,29±336,89^{a}	12,54±1,12^{a}	0,203±0,001^{a}	15,17±0,02^{b}	8,86±0,01^{b}	0,108±0,003^{b}	13,15±0,08^{b}	4,89±0,07^{b}
COS	1135,45±266,78^{a}	13,15±1,43^{a}	0,209±0,002^{a}	18,03±0,01^{a}	9,83±0,02^{a}	0,112±0,002^{a}	14,42±0,08^{a}	6,33±0,04^{a}

Number of fruits: 20; number of seeds and almonds: 100. For each parameter, data in the same column affected by different letters are significantly different (P = 0,05). COS: cultivar oval seed, CAS: cultivar average seed, CBS: cultivar big seed and CSS: cultivar small seeds

DISCUSSION

To estimate the various cultivars of *Citrullus lanatus*, we were interested in the parameters bound to fruits, seeds and almonds. The study of the morphological characteristics (mass, size and the germinative power allowed the comparison of these various cultivars (COS, CBS, CAS and CSS).

The analysis of the characteristics studied showed that cultivars of *Citrullus lanatus* had significant difference ($p \leq 0,05$) by their fruits. Indeed, the cultivar CSS presented fruits of mass lower than the cultivar CAS fruits, which weigh were less than those of cultivars CBS and COS characterized by big fruits. The diameters obtained were comparable to those of certain species of Cucurbitaceae (*Cucumis hirsutus*, *Cucumis myriocarpus*, *Cucumis africanus*, *Momordica balsamina*) studied by Mladenovic *et al*., [15]. Indeed, these authors obtained some fruits with diameter which varied from 4,4 cm to 16,4 cm. The varietal diversity of the various cultivars would be of genetic origin [16]. According to Koffi [17], plants mobilize the main part of their available resources for the increase of the size of fruits. Indeed, the size of seeds increased the cavity occupied in the fruit, so pulling an augmantation of the fruit.

The study relative to the size and mass of fruits, seeds and almonds showed that the cultivars COS and CBS produced the biggest fruits, compared with the cultivars CAS and CSS. The size obtained with the seeds of the various cultivars of *Citrullus lanatus* were close to values obtained by Adjoumani [7] with the various cultivars of *Citrullus lanatus* studied. He obtained masses of fruits which were 1125,35; 1065,19; 847,12 and 768,5 g, then diameters of fruits with values which were 13,05; 12,49; 10,94 and 9,17 cm respectively for cultivars COS, CBS, CAS and CSS. However, the values obtained were lower than those of Koffi [17] with masses of 1796.3, 1450, 1282.7 g and diameters of 13.57, 12.98, 12.37 cm respectively for the cultivars COS, CAS and CSS and to those obtained by Olaefo and Adeyeye [18] with the varieties (Calabash whole and Calabash Kernel) of *L. Siceraria* that the lengthes were 22,3 and 19 mm and the widths, 10,3 and 8,3 mm. Study of the mass and size measured showed that fruits of cultivars COS and CBS presented heavy and big seeds that

those of the cultivars CAS and CSS who presented light seeds.

Furthermore, the average values of the characteristics (length and width) of the examined seeds were in accordance with those of Koffi [17] and Adioumani [7] during their works. This result could be attributed to the human selection made on the basis of certain characteristics as size of the seeds. Indeed, according to Cordazzo [16], the resources were limited for the small seeds because of their embryo less developed compared with the big seeds. However, during the germination, the embryo benefits of resources pulled from the ground, what would have an influence on the vigour of the plants resulting from the development of fruits. The shelling had brought a reduction of mass and size of the seeds of the cultivars CBS and COS contrary to the cultivars CAS, CSS where no significant decrease ($p \leq 0,05$) was observed. The mass and the size of almonds obtained with the cultivar CAS were in agreement with those obtained by Gbogouri *et al*., [10] with the same cultivar (mass: 0,045 g; length: 1,00 cm and width: 0,45 cm). This reduction was due to the importance (presence in large quantities) of the tegument to the cultivars COS and CBS because of their sizes.

Analysis of the performances of germination showed a significant difference from a cultivar to the other one. According to the results obtained, the seeds of cultivars with big seeds had a germinative power higher than those of the cultivars with average seeds and small seeds. The germination capacity is function of the size and the weight of seeds. Such observations had been shown by Hashim *et al.*, [19] with the seeds of *Acacia ehrenbergiana* and those of Matheus *et al*., [20] with *Copaifera langsdorffii* seeds. Besides, cultivars COS and CBS had germinated faster than cultivars CAS and CSS. This difference of germination time would be due to the difference of size of the seeds. Indeed, the seeds of cultivars COS and CBS being big, would arrange more nourishing reserves than those of the cultivars CAS and CSS. The quantity of nourishing reserves of a seed is function of its size and can facilitate its germination [16]. Moreover, the results obtained showed that the parameters of germination (percentage and rate) were higher with cultivars with big seeds (COS and CBS) followed by CAS and CSS.

CONCLUSION

The qualitative and quantitative evaluation of the characteristics of the seeds of *Citrullus lanatus* cultivars showed that cultivars CBS and COS were premature, produced big fruits containing big seeds contrary to the late cultivars CAS and CSS with small and average seeds. However, the shape of fruits of the various cultivars did not determine the size of their seeds.

REFERENCES

1. F.A.O. (2006). Sécurité alimentaire.n°2. Programme de sécurité alimentaaireCEFAO. 4.
2. Kenfack, M., & Blandine, L. (2010). *Propriétés nutritionnelles et fonctionnelles des protéines de tourteaux, de concentrats et d'isolats de Ricinodendron heudelotii (Bail.) Pierre ex Pax et de Tetracarpidium conophorum (Müll. Arg.)* (Doctoral dissertation, Vandoeuvre-les-Nancy, INPL).
3. Rasul, M. G., Hiramatsu, M., & Okubo, H. (2007). Genetic relatedness (diversity) and cultivar identification by randomly amplified polymorphic DNA (RAPD) markers in teasle gourd (Momordica dioica Roxb.). *Scientia horticulturae*, *111*(3), 271-279.
4. Meita, A., Kouame, K. G., & Offomou, A. M. (2008). Evaluation de l\'activité hémagglutinante des lectines des graines de trois espèces de Cucurbitaceae couramment consommées en Côte d\'Ivoire. *Sciences & Nature*, *5*(2), 199-204.
5. Djè, Y., Heuertz, M., Ater, M., Lefebvre, C., & Vekemans, X. (2007). Évaluation de la diversité morphologique des variétés traditionnelles de sorgho du Nord-ouest du Maroc. *Biotechnologie, agronomie, société et environnement*, *11*(1), 39-46.
6. Zoro BI, I. A., Koffi, K. K., & Djè, Y. (2003). Caractérisation botanique et agronomique de trois espèces de cucurbites consommées en sauce en Afrique de l'Ouest: Citrullus sp., Cucumeropsis mannii Naudin et Lagenaria siceraria (Molina) Standl. *Biotechnologie, agronomie, société et environnement*, *7*(3-4), 189-199.
7. Adjoumani, K. (2013) Etude des systèmes de reproduction, de la caractérisation agromorphologique et des populations en ségrégation chez les cultivars de *Citrullus lanatus* (Thumb.) Matsumara et Nakai (Cucurbitaceae). provenant de la Côte d'Ivoire. Thèse de Doctorat de L'université Nangui Abrogoua (Abidjan, Côte d'Ivoire). 199.
8. Oyolu, C. (1975, August). Extraction rates and chemical composition of seed types in egusi (Colocynthis citrullus L.). In *IV Africa Symposium on Horticultural Crops 53*: 287-290.
9. Norman, J. C. (1992). *Tropical vegetable crops*. Arthur H. Stockwell Ltd.
10. Gbogouri, G. A., Brou, K., Linder, M., Tehrany, E. A., Gnakri, D., & Bi, I. A. Z. (2011). Comparative study of physicochemical and thermal properties of the seed oils of three cucurbit species. *International Journal of Biological and Chemical Sciences*, *5*(3).
11. Martin, F. W. (1984). Cucurbit seed as possible oil and protein sources. *Echo Technical Note, ECHO, North Ft. Myers, Florida, USA*.
12. Fondio, L., Kouamé, C., & Djidia, A. H. (2000). Rapport d'avancement du projet de

développement de la culture de la tomate et des plantes oléagineuses en région centre. *Bouaké, Côte d'Ivoire, Centre National de Recherche Agronomique,(CNRA)*, 21-23.

13. Enujiugha, V. N., & Ayodele-Oni, O. (2003). Evaluation of nutrients and some anti-nutrients in lesser-known, underutilized oilseeds. *International journal of food science & technology*, *38*(5), 525-528.
14. Ma, K., Zhang, X. P., & Wang, M. (1990). Nutrients in seeds of edible watermelon (Citrullus lanatus (Thunb.) Matsum. and Nakai). *Report-Cucurbit Genetics Cooperative*, (13), 43-44.
15. Mladenović, E., Berenji, J., Kraljević-Balalić, M., Čukanović, J., & Blagojević, I. (2012). Multivariate analisys of species from Cucurbitaceae family. *Genetika*, *44*(2), 227-234.
16. Cordazzo, C. V. (2002). Effect of seed mass on germination and growth in three dominant species in southern Brazilian coastal dunes. *Brazilian Journal of Biology*, *62*(3), 427-435.
17. Koffi, K. K. (2009). Variabilité génétique des cultivars ivoiriens de trois cucurbites oléagineuses (*Citrullus lanatus* (Thumb.) Matsum. et Nakai, *Cucumerpsis mannii* Naudin, *Lagenaria siceraria* (Molina) Standl.) et leurs implications dans la constitution d'une banque de gènes. Thèse unique. Abidjan (Côte d'Ivoire) : Université Abobo Adjamé; 161.
18. Olaofe, O., & Adeyeye, E. I. (2009). Characteristics of Chinese bottle gourd (Lagenaria siceraria) seed flour. *Oriental Journal of Chemistry*, *25*(4), 905.
19. El Atta, H., Aref, I., & Ahmed, A. (2013). Effects of seed mass and seed coat on germination and seedling emergence of Acacia ehrenbergiana Hayne. *Life Science Journal*, *10*(3).
20. Souza, M. L., & Fagundes, M. (2014). Seed size as key factor in germination and seedling development of Copaifera langsdorffii (Fabaceae). *American Journal of Plant Sciences*, *5*(17), 2566.