ISSN : 2350-0743

www.ijramr.com

International Journal of Recent Advances in Multidisciplinary Research

Vol. 06, Issue 02, pp.4606-4613, February, 2019

RESEARCH ARTICLE

INFLUENCES OF METHODS OF DESAMERIZATION ON THE NUTRITIONAL VALUE OF *BOSCIA SENEGALENSIS* SEEDS OF NIGER

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ARTICLE INFO

Article History:

Received 14th November, 2018
Received in revised form
27th December, 2018
Accepted 24th January, 2019
Published online 28th February, 2019

Keywords:

Seeds,
Bosciasenegalensis,
Desertification,
Quality,
Nutritional,
Niger.

ABSTRACT

Immature seeds of *Boscia senegalensis* (*Anza* in Hausa language) used in human nutrition, undergo several treatments to remove bitterness. This study is to analyse the influence of removing bitterness on the nutritional value of these seeds. Seeds from 14 treatment methods are levied century in two department: Banibangou (Tillaberi) and Bambeye (Tahoua region). For the 14 methods, the contents of macronutrients (Fats and proteins contents) (fats and proteinaceous material), micronutrients (P, B, K, Ca, Mg, Mn, Cu, Zn, Fe and Na), in phytic acid as well as antioxidant activity are determined. At the macronutrient level the seeds are rich in proteins (16.11 to 22.8%). Analysis of the results shows a significant decrease in mineral content and a significant increase in protein levels s. After ash fractionation, a significant decrease in the content of P, K, Ca, Mg, Mn, Cu and B is observed for all these methods. On the other hand, the Na content shows a significant increase. The methods used in Banibangou don't show significant increase in ORAC and GAE with the exception of the G3 method and those of Bambèye, all showed a significant decrease. It can be seen that the different treatment methods significantly reduce micronutrient levels. However, Boscia seeds are a source of protein and some minerals (Fe, Zn, Ca), better than some cereals (millet, maize) and cowpea, for populations.

INTRODUCTION

In Niger, a Sahelian country, agriculture and livestock are the two main economic activities. However, the agricultural activity does not satisfy the food needs of the populations (famines of 1973, 1984, food crises of 2001, 2005, 2010 and 2012) (Alpha Gado, 1989; PNNS, 2017). The cereal deficit is chronic. Populations are forced to seasonal migrations to urban centers and coastal countries to compensate for this deficit. Those who do not migrate, especially women and children, are engaged in the exploitation of natural resources (firewood and service, straw, leaves and fruit for food) to obtain either income or food. Among these resources, we *find, Boscia senegalensis*, a spontaneous plant widely distributed in Niger. The uses that we make of Boscia, are multiple and go from the food to the protection of the environment by way of the pharmacopoeia and phytopharmacy (Julia *et al.,* 2000; Mirutse and Tilahun, 2013, Doka and Yagi, 2009**;** Ermias *et al.,* 2,008; Victoria and Khadra, 2006; Kari *et al.,* 2004; M usa *et al.,* 2011; Kim *et al.,* 1997; Adam *et al.,* 2017) .Indeed Boscia, commonly called, " *Anza* "Hausa language is particularly well known to the Nigerien people for its contribution in the management of food crises and for its pharmacological and phytosanitary virtues. During famine Boscia seeds are the main food of some households for 5 to 6 months. This use of Boscia seeds as famine food in Sahelian countries is reported by several authors (Baumer, 1981; Maydell, 1983; Booth and Wickens, 1988; Salih *et al.,* 1991; Kim *et al.,* 1997; Arbonnier, 2000; Dicko *et al.,* 2001). Working on the nutritional composition of Bosciaseeds, Kim *et al.* (1997) have demonstrated the existence of significant amounts of essential amino acids and iron. On their side; Salih *et al.* (1991) have shown that the nutritional quality of seeds is comparable to that of sorghum, but pre-treatment by boiling seeds reduces the nitrogen content. Our objective through this study is to make the plant better known, the best exploitation techniques, to value its products and by - products and to study the impacts of traditional methods on the nutritional value of the seeds.

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MATERIALS AND METHODS

Framework of the study

To take into account the ethnic diversity, in the treatment methods, the areas of their languages, Zarma and Haoussa, commonly spoken are chosen: Banibangou (region of Tillabéri) and Bamboo è ye (Tahoua region) (Figure 1).

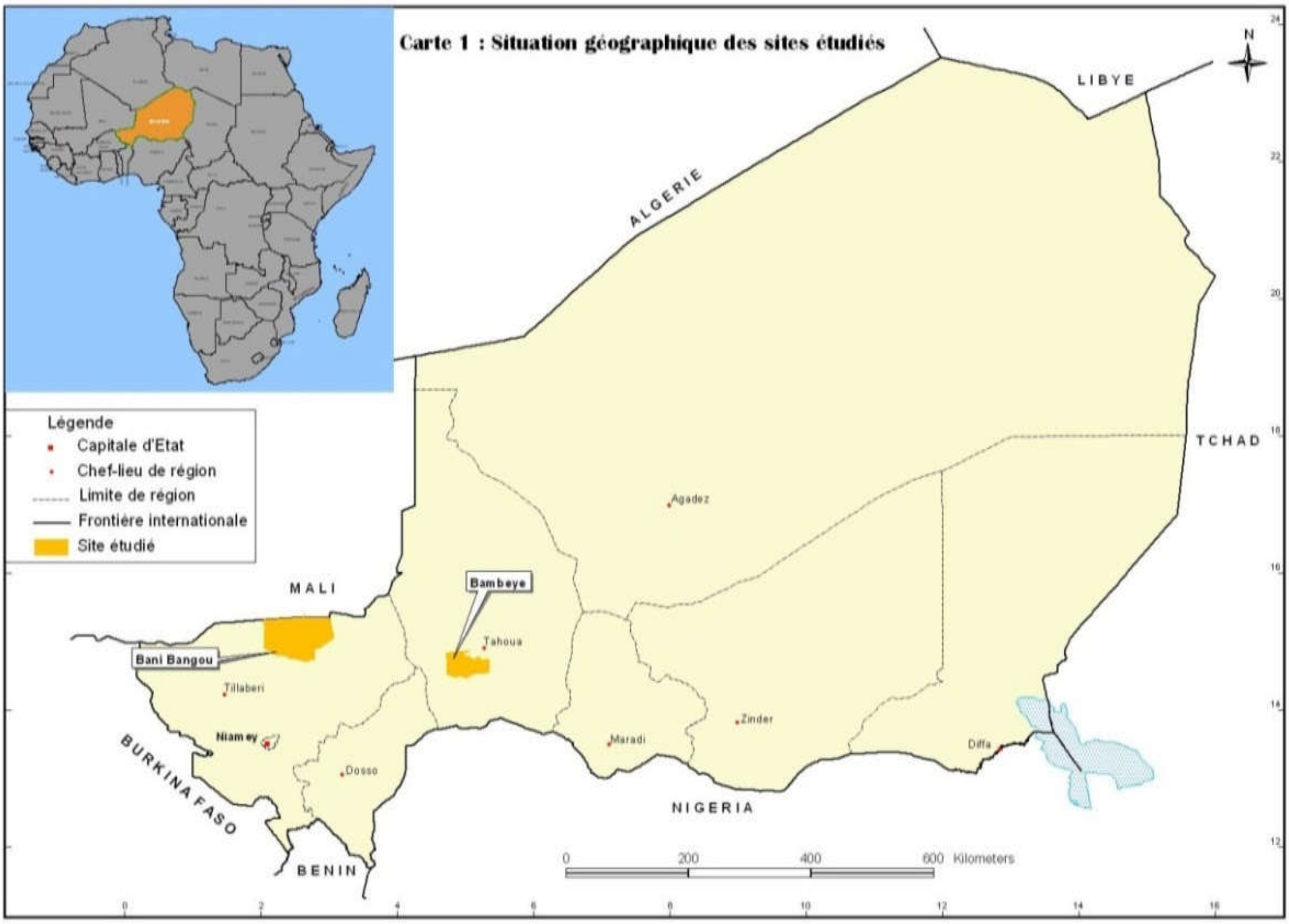


Figure 1. Geographical representation of the two communes, sites of origin of the seeds

Plant material: It consists of immature seeds of *Boscia senegalensis (Pers.) Lam.ex Poiret* bought on the local market and have undergone several treatment methods to remove bitterness.

Methods

Seed survey and preparation: After the investigation into the different methods of treating seeds of *Boscia senegalensis*, women are recruited to implement the methods chosen in the communes. 7 treatment methods n n t encountered Banibangou and 7 to Bambèye. Samples of pre-treated and cooked seeds are collected for laboratory analysis.

Nutritional analysis methods: The water content was determined on the mill by oven drying according to the method (AOAC, 1984). Ashes are obtained after dry mineralization of the previously dried mill (AOAC, 1984). Total proteins are determined according to the KJELDAHL reference method (Wolf, 1968). The lipids are extracted by soxhlet and percolation of hexane according to the IUPAC method (1968). The ashes are solubilized in hydrochloric acid. The mineral contents are determined century by atomic absorption spectrophotometry and phytic acid by a method Harland e t oberleas (1977).

Statistical analysis: Nutrient values obtained for each method are compared to those of raw seeds that have not been processed. The Minitab software, along with the one-factor ANOVA statistical test coupled with the Tukey average comparison method, were used.

RESULTS

The seeds from the 14 treatment methods are analyzed for macronutrient and micronutrient contents. There is the use of other inputs to remove the bitterness that will undoubtedly influence the nutritional value. Tables II and III show the influence of treatment methods on the content of MS, MM, MG, MP and water. The analysis of these tables shows a significant decrease in the levels of MS and MM and a significant increase in the levels of water and protein. For fat content (GM), methods G2 and G3 showed a non-significant increase. With regard to B ambèyemethods, only the Y1 and Y2 methods caused a significant decrease in the MG content. A significant decrease in the content of P, K, Ca, Mg, Mn, Cu and B is observed for all these methods (Table IV). On the other hand, the Na content shows a significant increase. For Zn, only the Y3, Y4 and Y5 methods caused a significant increase. It can also be concluded from these tables (IV and V) that the two methods (G and Y) significantly decrease the Mg content and significantly increase the Na content. The Banibangou methods (Table VI) cause a significant increase in ORAC and GAE with the exception of the G3 method. Indeed, the latter causes a significant decrease of ORAC and GAE. Bambueye methods (Table VI) all recorded a significant decrease in ORAC and GAE. In order to observe the influence of the treatment methods on the pythic acid content, the content of the latter in several methods is compared with that of the raw sample (Table VIII). The analysis of these results shows that the treatment methods have an influence on the pythic acid content. All of these methods have a significant influence compared to the raw sample.

Table I. Methods processing seeds *Bosciasenegalensis* and codes used for analyzes in the laboratory

Treatmentmethod	Code	Treatmentmethod	Code
Gross BBG	Gbrut	BBYE raw	Ybrut
I. Soaking during a night	G1	I. Soaking for 2 nights	Y1
II. baking direct + change water	G2	II. Soaking with curd + water change	Y2
III. Method of soaking with hot water	G3	III. Soakingwith water overnight	Y3
IV. Washing with water of ashes	G4	IV. Water washing of wood ash	Y4
V. Soaking for 2 days	G5	V. Soaking for 1 night at the pond	Y5
VI. Method that combines washing plus boiling	G6	VI. kalgowash(*Piliostigmentreticulatum*)	Y6
VII. Soaking in the pond	G7	VII. Soaking with washing water of millet grains	Y7

Table II. Composition Dry matter (DM), Mineral matter (MM), Protein material (MP) and Fat (MG) of *Boscia* seeds *senegalensis* from Banibangou

N° échant	Moy % MS	Moy % eau	Moy % MM	Moy% MG	% MP
Gbrut	94,7±0,01a	5,3±0,01h	0,04±0,01a	1,257±0,01a	17,342±0,001
G1	91,91±0,01f	8,09±0,01c	0,02±0,01a	0,399±0,001b	18,071±0,001e
G2	92,04±0,01d	7,96±0,01e	0,01±0,01a	1,278±0,001a	20,581±0,001c
G3	91,39±0,01h	8,61±0,01a	0,01±0,01a	1,318±0,001a	16,113±0,001b
G4	91,94±0,01e	8,06±0,01d	0,02±0,01a	0,28±0,001b	16,510±0,001g
G5	92,14±0,01c	7,86±0,01f	0,01±0,01a	0,2±0,001b	17,677±0,001d
G6	92,37±0,01b	7,63±0,01g	0,02±0,01a	0,4±0,001b	17,256±0,001f
G7	91,52±0,01g	8,48±0,01b	0,01±0,01a	0,01±0,001b	22,821±0,001a
G8	91,94±0,01e	8,06±0,01d	0,01±0,01a	0,2±0,001b	

Table III. Composition in Dry matter (DM), Mineral matter (MM), Protein material (MP) and Fat (MG) of *Boscia* seeds *senegalensis* of Bambèye

Sample No.	Moy% MS	Moy% water	Avg% MM	Avg% fat	% MP
Ybrut	94.71 ± 0.01A	5,29 ± 0,01b	0.03 ± 0.01A	0.139 ± 0,001f	16,900 ± 1,74b
Y1	93.66 ± 0,01f	6.34 ± 0,01ab	0.01 ± 0,006b	0.06 ± 0.001 g	20.341 ±0,001a
Y2	94.29 ± 0,01b	5,71 ± 0,01b	0.01 ± 0,001b	0.039 ± 0,001h	20.518 ±0,001a
Y3	93.88 ± 0,01e	6.12 ± 0,01ab	0.01 ± 0,001b	0.32 ± 0,001e	20.679 ±0,001a
Y4	94,15 ± 0,01c	5,85 ± 1,72b	0.01 ± 0,001b	0.778 ± 0.01A	20.628 ±0,001a
Y5	94.29 ± 0,01b	5.71 ± 0.01A	0.01 ± 0,001b	0.62 ± 0,005b	19.871 ±0,001a
Y6	92.57 ± 0.01g	7.43 ± 0,01ab	0.01 ± 0,001b	0.439 ± 0,001c	20.277 ± 0.001
Y7	94,05 ± 0,01d	5.95 ± 0,01ab	0.01 ± 0,001b	0.419 ± 0,001d	19.794 ±0,001c

Table IV. Composition in P, B, K, Ca, Mg, Mn, Cu, Zn, Fe and Na *Boscia* seeds *senegalensis* from Banibangou

Sample	P	K	It	mg	mn	Cu	B	Zn	Fe	N / A
Number	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm
Gbrut	0.21 ± 0,01d	1.27 ± 0.01A	0.15 ± 0.01A	0.12 ± 0.01A	24 ± 1c	11 ± 1b	16 ± 1a	57 ± 1g	137 ± 1a	117 ± 0,01h
G1	0.3 ± 0.01A	0.02 ± 0,01c	0.16 ± 0.01A	0.07 ± 0.01A	30 ± 1b	15 ± 1a	8 ± 1b	137 ± 1b	54 ± 1g	6091 ± 0.01A
G2	0.19 ± 0,01d	0.02 ± 0,01c	0.05 ± 0,01c	0.01 ± 0,51a	9 ± 1st	11 ± 1b	7 ± 1b	86 ± 1st	92 ± 1d	3592 ± 0,01b
G3	0.28 ± 0,01ab	0.34 ± 0,01b	0.16 ± 0.01A	0.07 ± 0.01A	34 ± 1a	14 ± 1a	7 ± 1b	159 ± 1a	89 ± 1º	794 ± 0.01g
G4	0.26 ± 0,01bc	0.02 ± 0,01c	0.15 ± 0.01A	0.08 ± 0.01A	28 ± 1b	14 ± 1a	7 ± 1b	113 ± 1c	78 ± 1f	3403 ± 0,01c
G5	0.25 ± 0,01c	0.32 ± 0,01b	0.11 ± 0,01b	0.05 ± 0.01A	20 ± 1d	11 ± 1b	6 ± 1b	78 ± 1f	90 ± 1of	1189 ± 0,01f
G6	0.3 ± 0.01A	0.02 ± 0,01c	0.16 ± 0.01A	0.12 ± 0.01A	33 ± 1a	15 ± 1a	6 ± 1b	113 ± 1c	134 ± 1b	2173 ± 0,01d
G7	0.25 ± 0,01c	0.02 ± 0,01c	0.1 ± 0,01b	0.03 ± 0.01A	18 ± 1d	11 ± 1b	6 ± 1b	90 ± 1d	101 ± 1c	2122 ± 0,01e

Table V. Composition in P, B, K, Ca, Mg, Mn, Cu, Zn, Fe and Na *Boscia* seeds *senegalensis* of Bambèye

Sample	P	K	It	mg	mn	Cu	B	Zn	Fe	N / A
Number	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm
Ybrut	0.23 ± 0.01A	1.1 ± 0,58a	0.13 ± 0.01A	0.12 ± 0.01A	34 ± 1 ^{a}	10 ± 1a	14 ± 1a	56 ± 1d	130 ± 1a	87 ± 1f
Y1	0.2 ± 0,01bc	0.02 ± 0,01b	0.05 ± 0,01de	0.01 ± 0.01A	6 ± 1d	7 ± 1b	6 ± 1b	44 ± 1st	67 ± 1of	2298 ± 1a
Y2	0.19 ± 0,01c	0.48 ± 0,01ab	0.04 ± 0,01e	0.01 ± 0,001a	3 ± 1 ^{e}	6 ± 1b	7 ± 1b	36 ± 1st	79 ± 1c	139 ± 1of
Y3	0.2 ± 0,01bc	0.51 ± 0,01ab	0.11 ± 0,01ab	0.03 ± 0.01A	18 ± 1 ^{b}	6 ± 1b	7 ± 1b	83 ± 1b	69 ± 1d	684 ± 1b
Y4	0.18 ± 0,01c	0.35 ± 0,01ab	0.09 ± 0,01bc	0.02 ± 0.01A	14 ± 1 ^{c}	6 ± 1b	6 ± 1b	90 ± 1a	54 ± 1g	480 ± 1c
Y5	0.22 ± 0,01ab	0.39 ± 0,01ab	0.07 ± 0,01cd	0.02 ± 0.01A	13 ± 1c	6 ± 1b	7 ± 1b	80 ± 1c	116 ± 1b	171 ± 1d
Y6	0.19 ± 0,01c	0.69 ± 0.01A	0.05 ± 0,01de	0.01 ± 0,001a	4 ± 1of	5 ± 1b	6 ± 1b	44 ± 1st	63 ± 1f	116 ± 1st
Y7	0.19 ± 0,01c	0.65 ± 0.01A	0.04 ± 0.01 ^{e}	0.01 ± 0,001a	3 ± 1st	5 ± 1b	6 ± 1b	34 ± 1f	65 ± 1EF	134 ± 1of

Table VI. Antioxidant power , Oxygen Radical Absorbance Capacity (ORAC) and Gallic acid equivalent (GAE) *Boscia* seeds *senegalensis* of Bambèye

Méthodcentury	ORAC (µMTroloxeq)	GAE (ppm)
Ybrut	1104.4 ± 0.1f	1262.5 ± 0.1f
Y1	1963.4 ± 0,1e	1335.1 ± 0.1d
Y2	2434.9 ± 0.1C	1294.1 ± 0,1ge
Y3	600.4 ± 0.1 g	665.4 ± 0.1 f
Y4	incomplete	1913.7 ± 0.1H
Y5	5080.8 ± 0.1A	1609.1 ± 0.1A
Y6	1982.8 ± 0.1d	701.9 ± 0.1C
Y7	3039.7 ± 0.1 B	1867.8 ± 0.1 g

Table VII. Antioxidant Power, Oxygen Radical Absorbance Capacity (ORAC) and Gallic acid equivalent (GAE) *Boscia* seeds *senegalensis* from Banibangou

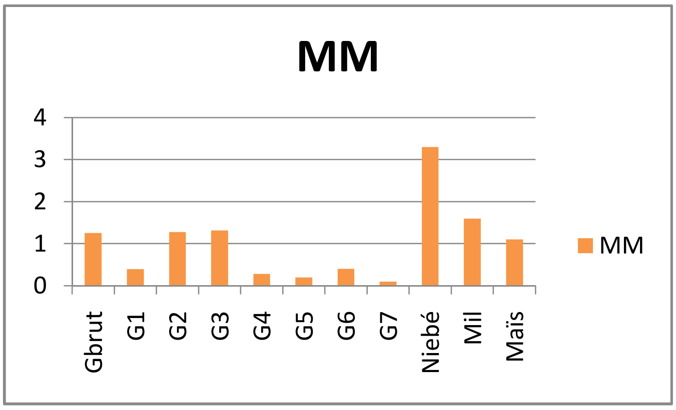
Méthodcentury	ORAC (µMTroloxeq)	GAE (ppm)
Gbrut	1427.3 ± 0.01A	2085.7 ± 0.1A
G1	189.2 ± 0,01de	86.4 ± 0.1H
G2	145 ± 0,01e	99.3 ± 0.1 g
G3	356.6 ± 0,01cd	120.9 ± 0.1 f
G4	380 ± 0,01c	143.1 ± 0,1e
G5	1082.6 ± 0,01b	523.6 ± 0.1 B
G6	105.9 ± 0,01e	148.3 ± 0.1d
G7	242.7 ± 0,01cde	216.3 ± 0.1C

Table VIII. Phytic acid content of *Boscia* seeds *senegalensis* of Banibangou and Bambèye

Methods	Concentration (µg / ml)± SD	Methods	Concentration (µg / ml) ± SD
GrossG	36.84 ± 0.01d	Y gross	40.17 ± 0.01h
GI	37.71 ± 0.01c	Y I	31.69 ± 0.01i
GII	26.51 ± 0.01h	Y II	110.45 ± 0.01d
GIIi	36.31 ± 0.01e	Y III	109.54 ± 0.01g
GIV	30.14 ± 0.01f	Y IV	109.88 ± 0.01f
GV	27.96 ± 0.01g	Y V	111.98 ± 0.01b
GVI	69.38 ± 0.01a	Y VI	110.18 ± 0,01e
GVII	44.58 ± 0.01b	Y VII	111.69 ± 0.01c

Table IX. Comparison of the mineral content intervals of the seeds of our study to those of the Niger dilo(Kim *et al.,* 1997) and Sudan Mukheit (Salih *et al.,* 1991)

Minéral	Samplel	Dilo	Sample3	Mukheit	Notre étude
		Sample2 (pg/ g dry wt)			
As	<5.0[b]	<5.0	<5.0	NRc	
Ca	196[d]	175	499	600	0,04-016%
Cr	<5.0	<5.0	<5.0	NR	
Cu	9.9	<5.0	<5.0	10.0	6-15ppm
Fe	53.4	44.1	61.1	15.0	54-137ppm
K	<5.0	510	887	100	0,02-1,27%
Mg	27.2	12.8	84.9	100	0,01-0,12%
Mn	<5.0	<5.0	Il.1	5.0	3-34ppm
Mo	<5.0	<5.0	<5.0	NR	
Na	22.1	18.8	16.0	<100	87-6091ppm
Ni	<5.0	<5.0	<5.0	NR	
P	1980	1940	2650	1100	0,18-0,3%
Se	<5.0	<5.0	<5.0	NR	
Si	<5.0	<5.0	<5.0	NR	
Zn	58.8	46.7	75.1	46.0	36-159ppm



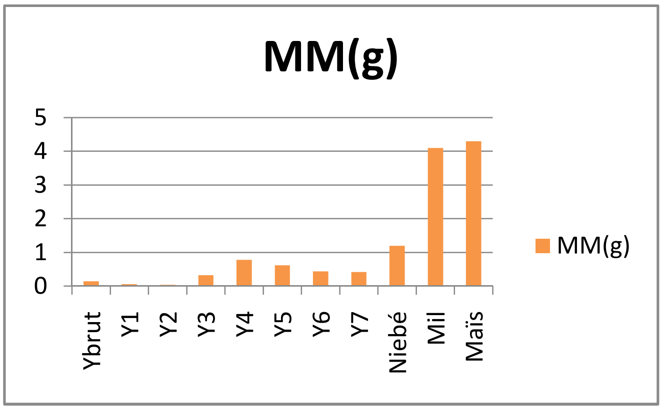


Figure 2. Comparison of mineral contents of treated seed of Boscia Senegalensis with and millet, maize and cowpea seeds

However, methods bbg II, III, IV and V caused a significant decrease in this content. Thus, the methods bbg I, VI and VII cause a significant increase against methods bbg II, III, IV and V significantly reduce this content. For the bbye treatment methods, significant increases in the pythic acid content are noted with the exception of the bbye I method (Table VIII). The latter method causes a significant decrease in the Pythic acid content.

DISCUSSION

The seeds of *Boscia senegalensis* are very bitter and unfit for consumption. Populations have developed various strategies to make them edible. In the course of this study, the influence of treatment methods on the nutritional value of grains is analyzed. The contents of materials mineral have varied from 0.01-0.03%, fat 0.01 to 1.31% of the proteinaceous materials of 16.11 to 22.82%. The oxidative power with ORAC of 105.9-5080, 8% and the GAE of 86.4-2085.7% increased with the different methods of treatment. The elements minerals have seen their rate decreased. Very few studies have examined the mineral contents of *seeds Bosciasnegalensis*. A comparison with the few studies encountered is made in Table IX. Compared to the results of the literature, low levels of mineral elements are obtained in the seeds of *Boscia senegalensis* from Niger (Dilo and our study) and Sudan (Mukheit). To locate the seeds of *Boscia senegalensis* compared to foods commonly used in Niger, comparisons are made with millet, maize and cowpea in the diagrams that follow.

The mineral contents are close to those of cereals, for Gbrut, G2 and G3.

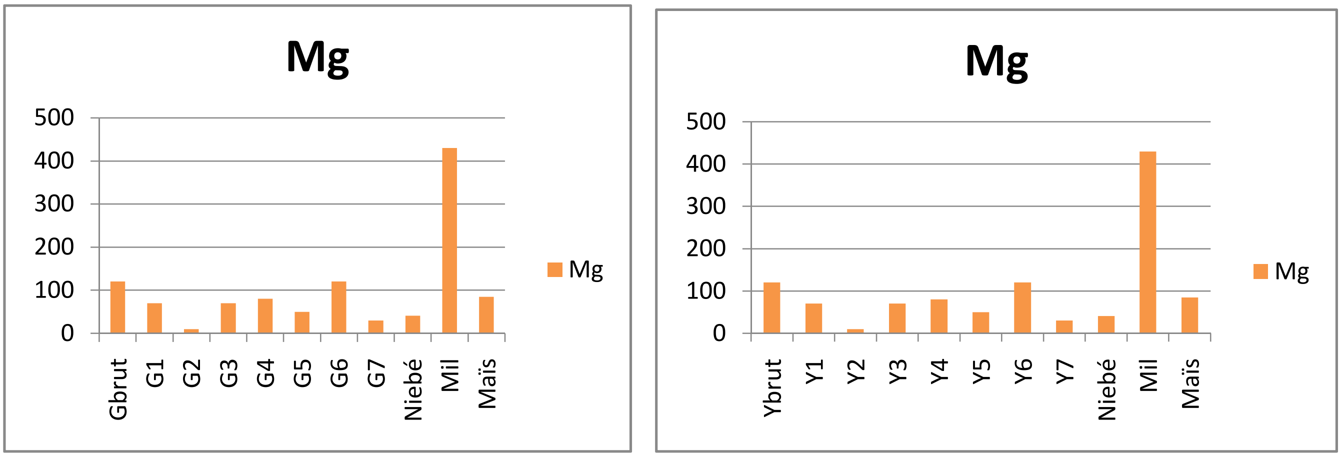


Figure 3. Comparison of magnesium contents of treated seed of BosciaSenegalensis with and millet, maize and cowpea seeds.

Millet is richer in magnesium than corn kernels and cowpea

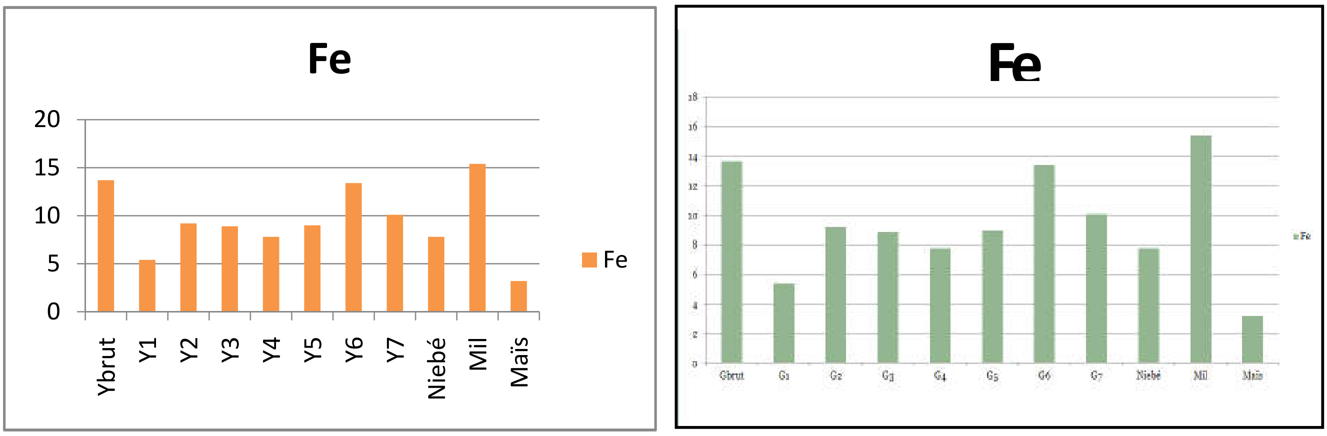


Figure 4: Comparison of iron levels of treated seed of Boscia Senegalensis with and millet, maize and cowpea seeds

Higher levels than maize and cowpea are found in untreated seeds

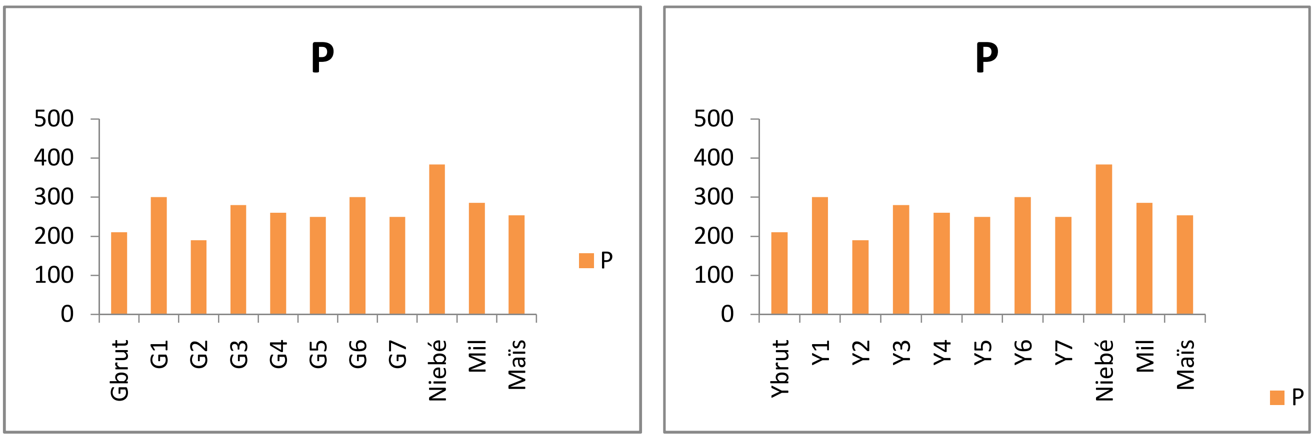


Figure 5. Comparison of phosphorus levels of treated seed of Boscia Senegalensis with and millet, maize and cowpea seeds

Apart from cowpea, which stands out slightly, phosphorus levels are practically the same in treated seeds, millet and maize.

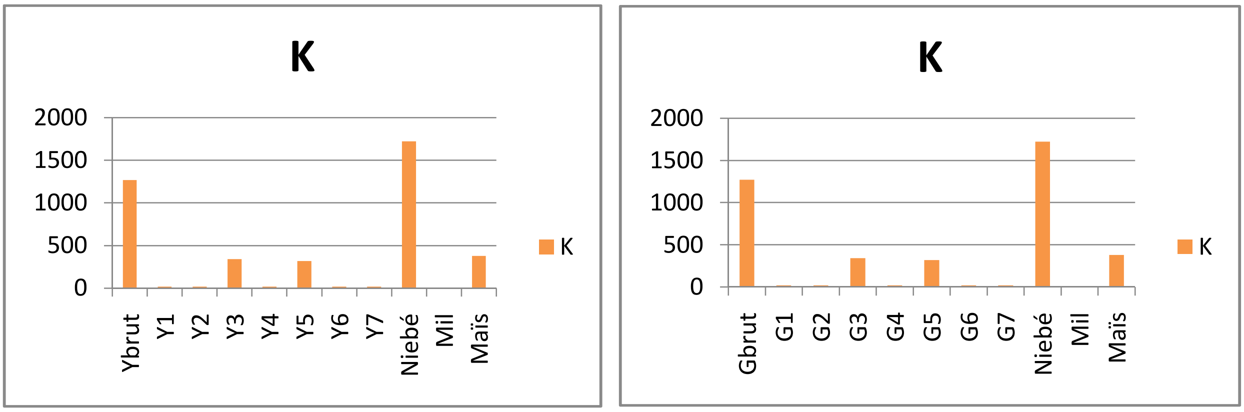


Figure 6. Comparison of potassium levels of treated seed of BosciaSenegalensis with and millet, maize and cowpea seeds. The best grades are found in the crude and are close to those of cowpea

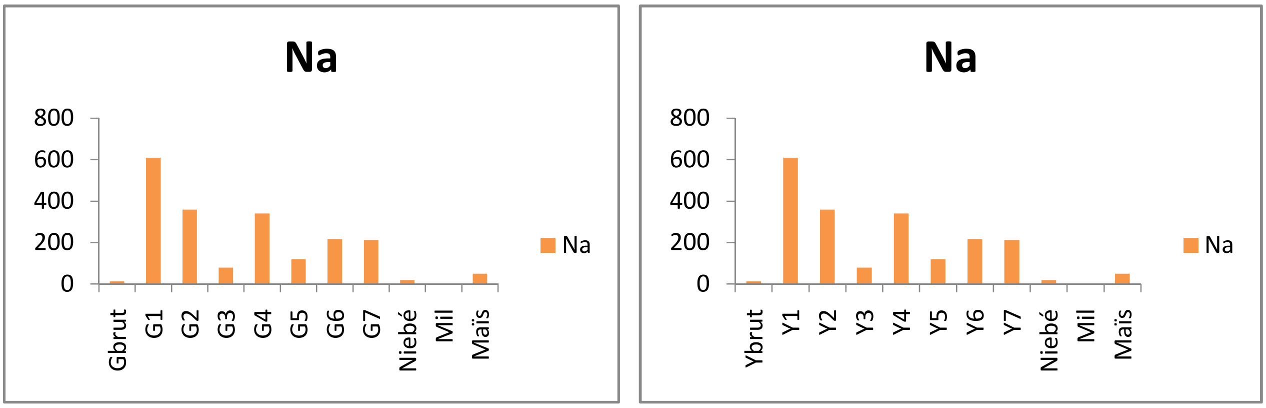


Figure 7. Comparison of sodium levels of treated seed of BosciaSenegalensis with and millet, maize and cowpea seeds. The treatment methods give good sodium levels, higher than those of cowpea, corn, millet and especially G1 and Y1

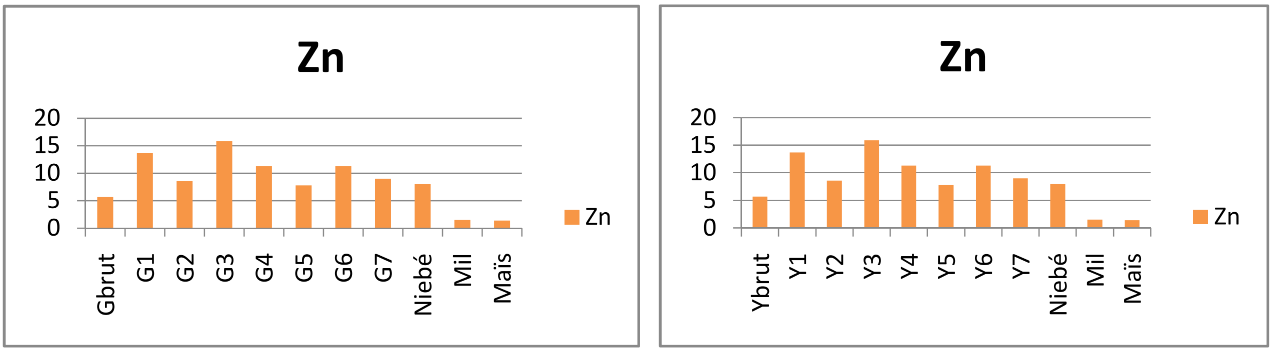


Figure 8. Comparison of zinc levels of treated seed of BosciaSenegalensis with and millet, maize and cowpea seeds.

As for the previous mineral, the treated Bosciasenegalensis seeds are better

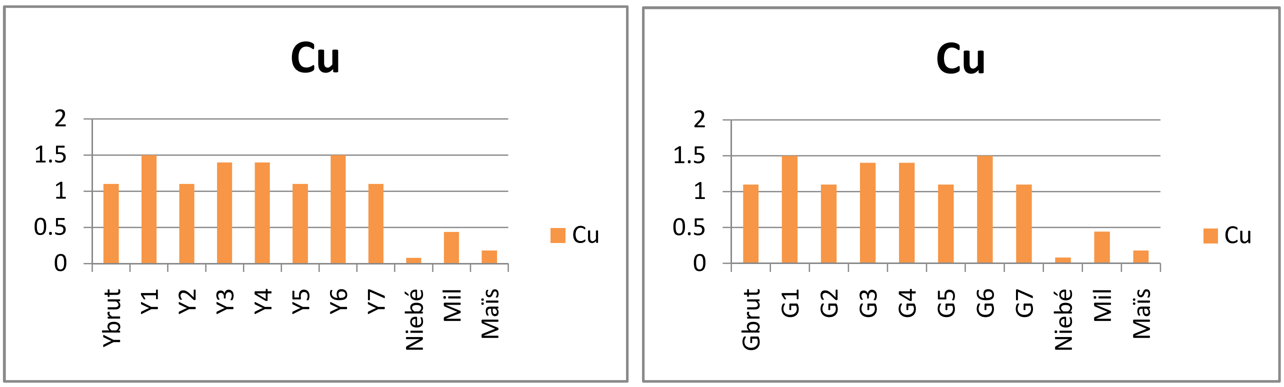


Figure 9. Comparison of Copper Levels of Treated BosciaSenegalensis Seeds and Millet, Corn and Cowpea Seeds Copper mineral element is more present in treated and untreated seeds than in untreated seeds

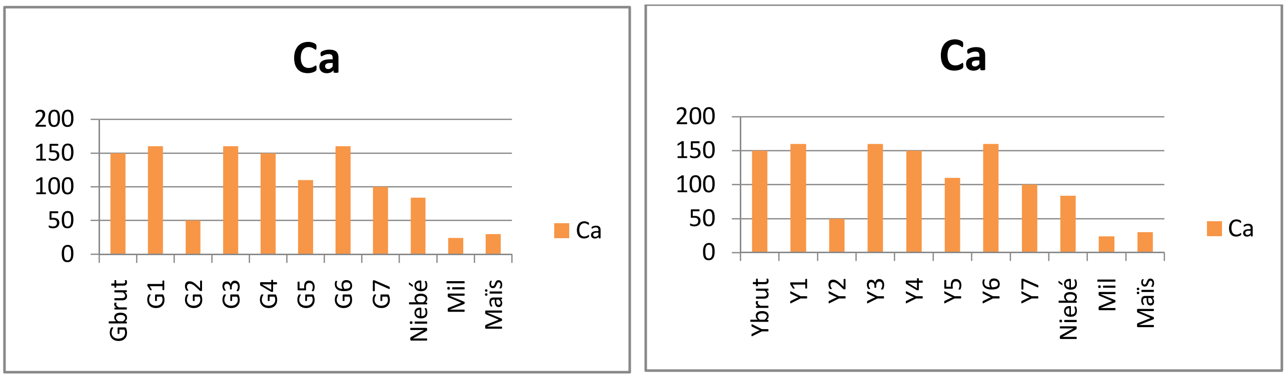


Figure 10 Comparison of calcium levels in treated seed of Bosciasenegalensis and millet, maize and cowpea seeds Bosciasenegalensis seeds, any treatment method combined, are better than staple foods (millet, maize and cowpea)

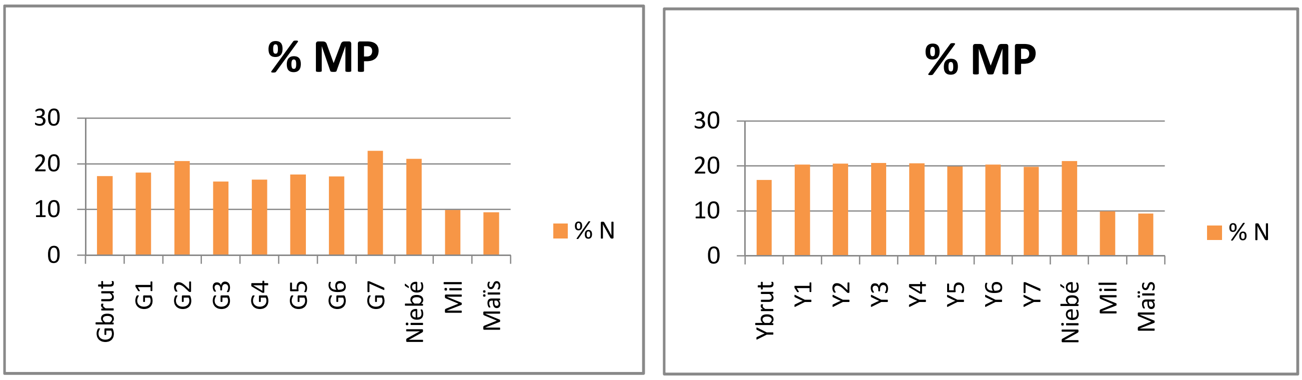


Figure 11. Comparison of protein contents of treated seed of Boscia Senegalensis with millet seed, maize and cowpea Almost the same levels as cowpea for Bambèye and higher for G7 and G2, but significantly higher than cereals

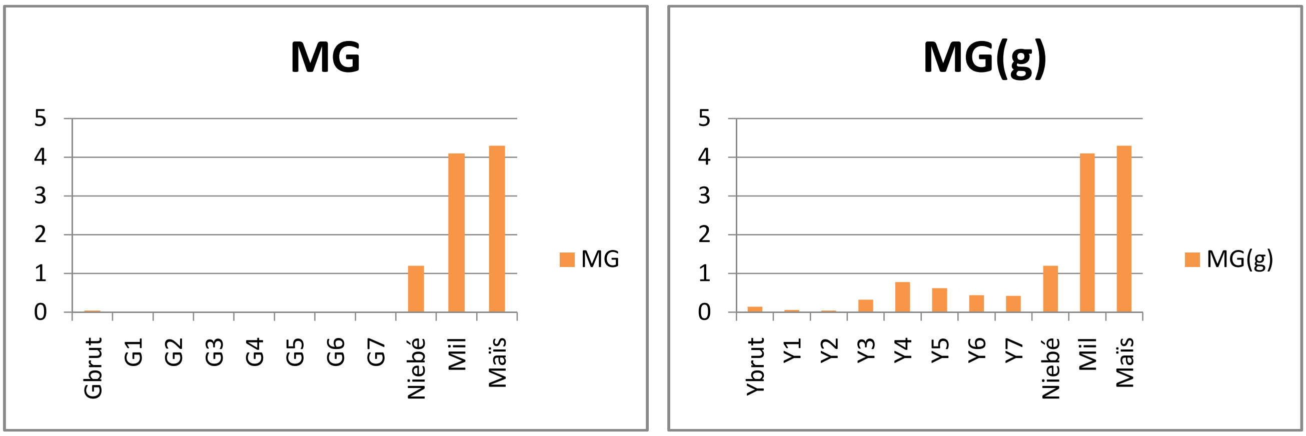


Figure 12. Comparison of fat contents of treated seed of Boscia Senegalensis with and seeds of millet, maize and cowpea

The seeds of *Boscia senegalensis* are very low in fat, in front of millet, maize and cowpeas. Regarding, phytic acid, treated Boscia seeds contain, and it is desirable to improve the methods of treatment to reduce these levels.

Conclusion

This study has highlighted the influence of removing bitterness methods on the nutritional value of *Boscia senegalensis* seeds. There was great variability depending on the nature of the nutrients. Almost all water-soluble nutrients are entrained in the wash water. Bambeye's treatment methods have increased proteins levels. It's the opposite that happened with the minerals. The antioxidant activity has increased with the treatments. Compared with fast food, *Boscia senegalensis* seeds are better in proteins and some minerals (Fe, Zn, Ca) it is better in proteins and in certain mineral elements (Fe, Zn, Ca). Seeds consumption helps prevent protein malnutrition and iron, zinc and calcium deficiencies, which pose public health problems in Niger. The antioxidant power, confers them possible uses in the prevention of proliferative diseases.

REFERENCES

Abdel Latif E. Mahmoud and Sakina M. Yagi, Kari I, Cecilie S, Drissa D. 2004. An ethnopharmacological survey of plants used for wound healing in Dogonland, Mali, West Africa, *Journal of Ethnopharmacology,* 92, 233-244

Ambuta, JM. K; Valentin, C. and Laverdière, MR. 1996. Fallows and erosion crusts in the Sahel. Drought,7 : 269-275.

Arbonnier, M. 2000. Trees, shrubs and lianas from dry areas of West Africa. CIRAD, MNHN, IUCN; 541p.

Baumer, M. 1981 Role of *Boscia senegalensis (Pers.) Lam.ex Poiret* (Pers.) Lam. in the African rural economy : its consumption by livestock. *Breeding and Medicine Review Veterinary Tropical Countries,* 34 (3) : 325-328

Becker, B. 1983. The contribution of wild plants to human nutrition in the Ferlo (Northern Senegal); Agroforestry Systems, 1 (3): 257-267.

Booth, FEM and Wickens, GE. 1988. Non-timber uses of arid zone trees and shrubs in Africa. FAO Conservation Guide, No. 19, 185 p.

Dicko, MH., Leeuwen, MJFS-V., Traoré, AS., Hilhorst, R. and Beldman, G. 2001. Polysaccharide hydrolases from leaves of *Boscia senegalensis(Pers.) Lam.exPoiret* : Properties of endo - (1-3) -bd- Glucanase. *Applied Biochemistryand Biology, 94: 225-241.*

Ermias L, Ensermu K, Tamrat B and Haile Y. 2008. An ethno botanical study of medicinal plants in ManaAngetu District, Southeastern Ethiopia, *Journal of Ethnobiology and Ethnomedicine,* 4 : 10

Ichaou, B. 2000. Dynamics and productivity of the forest structures of western Nigerian plateaus. PhD Thesis, University Paul Sabatier Toulouse III, Specialty: Tropical Plant Ecology; 231p

IGDoka and SMYagi, 2009. Ethnobotanical Survey of Medicinal Plants in West Kordofan (Western Sudan), *Ehnobotanical Leaflets,* 13: 1409-1416..

Julia A. Cook, Dorothy J. Vander Jagt, Andrzej P, Garba M, Robert S, Mark M, and Robert H, 2000. Nutrient and Chemical Composition of Wild Plant Foods of Niger, *Journal of Food Composition And Analysis,* 13, 83-92.

Kim, TR; Pastuszyn, A., Vanderjagt, DJ., Glew, RS., Millison, M. and Gllew, RH. 1997. The nutritional composition of seeds from *Boscia senegalensis (Pers.) Lam. ex Poiret*(dilo) from the Republic of Niger. *Journal of food composition and analysis, 10 (1): 73-81.*

Mamounata O. BELEM1Joséphine YAMEOGO, 2017. Souleymane OUEDRAOGO, Ethnobotanical Study of *Boscia senegalensis* (Pers.) Lam. ex Poiret (Pers.) Lam (Capparacea e) in the Department of Banh, Loroum Province, northern Burkina Faso, *Journal of Animal and Plant Sciences,* Vol.34, Issue 1: 5390-5403

Mirutse G and Tilahun T. 2013. Ethnobotanical study of plants used in the management of livestock by Afar people of Ada'ar District, Afar Regional State, Ethiopia, *Journal of Ethnobiology and Ethnomedicine,* 2013, 9 : 8

Moumouni N R. Kim, Andrzej P, Dorothy J. Vanderjagt, Robert S. Glew, Mark M, and Robert H. Glew, 1997. The Nutritional Composition of Seeds from *Boscia senegalensis (Pers.) Lam.ex Poiret* (*Dilo*) from the Republic of Niger, *Journal of food composition and analysis*, 10, 73-81.

Musa S. Musa, Fathelrhman E. Abdelrasool, Elsheikh A. Elsheikh, Lubna AMN Ahmed, 2011. Ethnobotanical study of medicinal plants in the Blue Nile State, Southeast Sudan, *Journal of Medicinal Plants Research,* Vol. 5 (17), pp. 4287-4297.

Ould M, H. 2009. ADA, A. Contribution to the study of medicinal plants of mauritania, *Ann.Univ.Lome (Togo), Science Series, Volume XVII: 9-27*

Pakuy P, Berit S, Khadra M. 2006. traditional medicine in Central Sahara: Pharmacopoeia of Tassili N'ajjer, *Journal of Ethnopharmacology*, 105, 358-367

Saadou, M. 1996. Niger vegetation. In : The environment in Niger. Sahelian Studies and Research Collection, RESADEP / PANOS. pp. 51-61.

Salih, OM., Nour, A. and Harper, DB. 1991. Chemical and nutritional composition of two famine food sources used in Sudan, mukheit (*Boscia senegalensis (Pers) ex Lam.. Poiret*) and Makhat (*Doberaroxburghi*). *J Sci -Food-Agric, 57 (3). 367-377.*

Valet, S. 2000. New strategy of sustainable eco - development by the management and the valorization of the water report. *Drought ;11 (4) : 239-247.*

Von Maydell, HJ. 1983. Trees and shrubs in the Sahel: their characteristics and uses; 531P.

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