Available online at http://ajol.info/index.php/ijbcs

Int. J. Biol. Chem. Sci. 8(3): 1075-1088, June 2014

ISSN 1997-342X (Online), ISSN 1991-8631 (Print)

International Journal of Biological and Chemical Sciences

Original Paper

http://indexmedicus.afro.who.int

Potentials in vegetable oils and various nutrients of eighteen varieties of Niger Cucurbitaceae

Haoua SABO [1*], Hassimi SADOU[1], Ibrahim Adamou AMOUKOU[2], Mousbahou MALAM ALMA[1] et Saadou MAHAMANE [3]

[1]*Department of Chemistry, Faculty of Sciences, ABDOU Moumouni University, BP: 10662. Niamey. Niger.*
[2] *Faculty of Agronomy, ABDOU Moumouni University, BP: 10662. Niamey, Niger.*
[3] *Department of Biology, Faculty of Sciences, ABDOU Moumouni University, BP: 10662. Niamey. Niger.*
[*]*Corresponding author, E-mail: hseinisabo@yahoo.fr*

ABSTRACT

Citrullus Colocynthis and *Lagenaria siceraria* are two species of Cucurbitaceae whose seeds are used for the production of dough, cakes and edible oils in Niger. Yield in seeds of 18 varieties belonging to these two species were assessed on the Faculty experimental field. The average berries production was 17 berries per plant the first year in contrast 6 the second year. The best productivity was achieved with C*itrullus colocynthis* which gave 82 berries per plant the 1st year. The average yield in seeds was 180.15 kg/ha the first year and 704.30 kg/ha the second year. The determination of the physicochemical characteristics showed water, ashes, fat, and protein contents which vary respectively from 7 to 9.50%, 4.13 to 4.84%, 18 to 47% and 11 to 35%. The yield in seeds oil varied from 13.7 to 134 L per ha in the first year and 0.26 liters to 800 L per ha the 2nd year. These are the first studies on Cucurbitaceae which link agronomic and physicochemical characteristics of seeds. They showed very important nutrient contents and oil yield, and even higher than some conventional oilseeds. Extraction of oils from these seeds could meet the need of the populations.

Keywords: Cucurbitaceae, Niger, yield, seeds, oils, food security.

INTRODUCTION

Only five types of seeds provide more than 93% of the world oil production: soybean, cotton, rape, sunflower, copra, palmist and groundnut. 70% of the oil withdrawn from these seeds are used for human consumption under various forms: margarine, fats, seasoning oils, frying ... (WHO, 2004; FAO, 2007). This production cannot meet consumers' needs. Also, with the low production, we are facing the paradox of a form of inadequate use of these resources with the competition between biocarburant and feeding (Barilla, 2012). Niger, as a sahelien country is facing that kind of situation. More than 95% of edible vegetable oils is imported from almond. The local production of groundnuts seeds is on small scale basis. We therefore have to diversify vegetable oils sources. The only possible solution is to adopt local and effective resources availability approach and geographical contexts. For sustainable development, it is necessary to optimize natural resources. The agricultural

DOI : http://dx.doi.org/10.4314/ijbcs.v8i3.21

system in Niger is affected by several weaknesses, due particularly to current and foreseen climate change impact. There is therefore a need to diversify sources by giving priority to those which were adapted to climate hazards. That is why we put highlight on Cucurbitaceae studies. The Cucurbitaceae family is of many species distributed in all continents. Almost 100 genders and more than 750 species are available worldwide (Kouonon et al., 2009; Ismail et al., 2010). In Niger, there are ten genders and eighteen species among which cultivated are wild species (Sabo et al., 2005a, 2005b; Sadou et al., 2007). Cucurbitaceae's fruits are a source of carbohydrate, while their seeds give oil with similar properties to those of commercial fat (Fokou and Tchouanguep, 2004; Achu et al., 2005; Mariod, 2008; Nyam et al., 2009; Beshir and Babiker, 2009; Mohammed, 2011; Oloyede et al., 2012). They are used throughout the world since hundred years as vegetables, oil sources and protein (Sabo et al., 2005a, 2005b**;** Applequist et al., 2006; Sadou et al., 2007; Fas, 2008; Abiodun and Adeleke, 2010). However, few studies are interested in the link between the agronomic characteristics and the yield in diverse nutrients taking into account the varietal aspect to value these seeds. This work is focused on two species: *Citrullus colocynthis* (Linn.) Schrad and *Lagenaria siceraria* (Molin.) Standl, which products and by-products are frequently used in human feeding in Niger. The seeds are used for dough, cakes and edible oils production in the Zinder region. The seeds of *Citrullus colocynthis* (Linn.) Schrad represent an important source of income for the population.

Thus, the study was carried out on the one hand to determine berries and seeds yields and on the other hand the nutrient contents of seeds according to the varietal aspect.

MATERIALS AND METHODS

Presentation of the experimental site

The tests were carried out at the Faculty of Sciences and Technology of Abdou Moumouni University of Niamey experimental station (13°30'N; 2°08'E; 216 a.s.l) (Figure 1). The soil is made of alluvial sediment deposits (mud, sands, gravels, stones). The climate is characterized by a rainy season (from June to October), a cold dry season (from November to February) and a hot dry season (from March to May). The rain in average is about 522.3 mm per year. (National Institute of Statistics, 2010).

Vegetal material

It is made of 18 varieties among which 17 (LS1 to LS17) of *Lagenaria siceraria* species and one variety of *Citrullus collocynthis* species (Table 1). They are very diverse and consistent of climbing and creeping varieties. Berries could be large or small, of various shapes (calabash, gourd, ladle ...) of smooth or rough appearance (Figure 2).

The seeds could be found in Niamey markets and other places of Niger (Zinder, Doutchi, Keita and Goubèye) (Table 1).

Vernacular names are given in two languages (Hausa and Zarma) commonly spoken in Niger (Fabregues, 1979).

Methods

Seeds preparation

The fruits were cut into two with a knife. Then the seeds embedded in the pulp are manually harvested, and then broken to remove teguments. This operation concerned all the *Lagenaria siceraria* seeds. *Citrullus colocynthis* seeds in small sizes were not concerned as difficult to handle and the tegument is highly connected to the kernel, which makes operations delicate. Finally, the kernel obtained was crushed for subsequent analyses.

Water content determination

The water content was determined on the milling by drying oven (Memmerl Mark) at 103 °C during one night (about 12 hours) according to AOAC (1984). The water content, expressed in weight percentage, is given from the relation:

Table 1: Composition of plant material in the form and/or appearance of the berry, vernacular names and provenance.

Variety	Form and/ or berry Aspect	Djerma	Haoussa	Provenance
LS 1	guitar	Souta'n	Chantu	Katako Market, Niamey
LS 2	rough	Kassakassa	Sana'a	Big Market Niamey
LS 3	Smooth	Kassakassa	Sana'a	Katako Market, Niamey
LS 4	Great gourd	Gassu	Koriya	Zinder
LS 5	Great ladle	Gombo	Liddeye	Big Market Niamey
LS 6	small gourd	Zoloo	Djandama	Katako Market, Niamey
LS 7	great gourd	Zoloo	Djandama	Big Market Niamey
LS 8	Small ladle	Gassu	Koriya	Doutchi
LS 9	Ladle with small bit	Gombo	Liddeye	Doutchi
LS 10	Ladle with great bit	Gombo	Liddeye	Doutchi
LS 11	rough	Kassakassa	Sana'a	Doutchi
LS 12	smooth	Kassakassa	Sana'a	Doutchi
LS 13	great gourd	Zoloo	Djandama	Keita
LS 14	Cucumberlike	-	Zoungourou	Niamey
LS15	rough	Kassakassa	Sana'a	Goubèye (Doutchi)
LS 16	rough	Kassakassa	Sana'a	FAST Site
LS 17	rough	Kassakassa	Sana'a	Goubèye (Doutchi)
CC	smooth	Kaney	Kafurdu/Guna	FAST Site

LS = *Lagenaria siceraria* (Molin.) Standl, CC = *Citrullus colocynthis* (Linn.) Schrad.

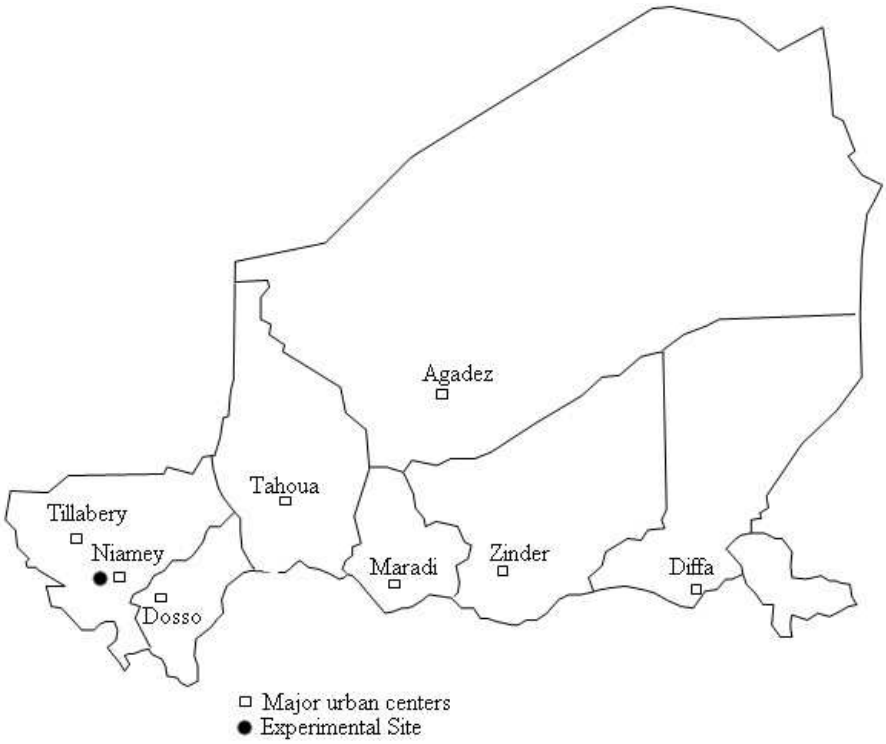

Figure 1: Major urban centers and experimental site.

Figure 2: Form of studied berry varieties.

$$\text{Water}(\%) = \frac{m_0 - m}{m_0} X100$$

m_0 = initial milling mass (5 g)

m = mass of milling after oven drying and cooling in a desiccator (g)

Total ashes content determination

Ashes are obtained after mineralization by dry milling at 550 °C for six hours in the oven (Hereaus brand) according to AOAC (1984). The ash content, expressed in weight percentage, is obtained from the relation:

$$\text{Ashes}(\%) = \frac{m_1}{m_0} X100$$

m_0 = initial mass of milling (5 g). m_1 = mass of obtained ashes (g)

Total protein content determination

Total proteins were determined according to the Kjeldahl method reported by Wolf (1968). This method consists first of all of mineralizing proteins, then distilling and measuring out the formed ammoniac.

The total nitrogen and protein contents are given by the following formula:

The percentage of nitrogen is given by the relation:

$$N(\%) = \frac{V_{H_2SO_4} X0.2X1.4}{WS}$$

$V_{H_2SO_4} = H_2SO_4$ volume in cm^3, 0.2 = Normality of H_2SO_4, WS = weight of sample in gram.

The proteins content is determined by multiplying the nitrogen content by 6.25.

Proteins (%) = N (%) x 6.25

6.25 = conversion factor to go from nitrogen to protein content, empirical data which assume to proteins a richness of about 16%.

Total fat content determination

Lipids were extracted according to the IUPAC (1968) by soxlhet through hexane percolation (Hexane N for analysis: ANALPUR Labosi EEC No. 203-777-6) during six (6) hours.

After extraction, the solvent is evaporated by an evaporator. The flask is placed at the drying oven during 1 h to remove the remaining solvent and then cooled in a desiccator. The flask is weighed up to the constant weight and the fat content is expressed in weight percentage according to the relation below. The oils are kept in the freezer for further analysis.

$$\text{Fats} = \frac{P_3 - P_2}{P_1} X100$$

P_1 = mass of the sample (in gram), P_2 = Mass of empty flak (gram) P_3 = mass of the flask containing oil (gram).

Contents in fats and densities obtained were used to calculate oil yields per hectare for each variety.

Statistical analysis

Analysis of variance was made for all characters observed by Statitix software. In case of significant difference between varieties ($p < 0.05$), averages comparison test (Tukey HSD test) were conducted for the concerned characters in order to determine the groups of homogeneous varieties. Then, a correlation analysis was made among the various characters.

RESULTS

Results of the analysis of variance

Analysis of variance showed that there are significant differences between varieties ($p < 0.05$) for all measured parameters on both years except water content for the 1st year (Table 2).

Comparison of averages for yield parameters

According to Table 3, the number of berries per plant, the comparison of averages highlight two homogeneous groups in 1st year. A weak production in berries was observed in *Lagenaria siceraria* varieties (3-10 berries) and an important production for C*itrullus colocynthis* (an average of 83 berries). In the 2nd year, the same trend is observed but with three groups for all varieties. *Citrullus colocynthis* has always been the most productive with 16 berries per plant. The comparison of averages showed four groups on the basis of number of seeds per berry. For the previous characters, *Citrullus colocynthis* variety distinguished with 473 seeds per berry. The less productive in seeds were LS4 and LS5 with 107 and 104 seeds. For the yield in seeds, two groups were made in the first year and three in the second year. The most successful varieties were *Citrullus colocynthis* and LS3 the first year and LS7 the 2nd year. The less successful were LS4 in the first year and LS9 the 2nd year. The results show high yields of fruits and seeds of *Citrullus colocynthis*. This reflects the importance of this variety that is grown primarily for its seeds which have a high market value.

Comparison of averages for chemical components

According to Table 4, the difference is not significant between varieties for the water content the 1st year. In the 2nd year, 3 groups were formed with very humid LS4 seeds. The contents in ashes were about 4% for all varieties on the two years. For the fat contents with three groups of varieties the 1st year and many the 2nd years, the richest varieties in oil were LS2, LS3 and LS10. In proteins contents, the most important varieties were LS2 and LS13 and they were of 6 groups in the 1st year and 5 in the 2nd year. For these two

last parameters, *Citrullus colocynthis* is the less rich. The high ash content shows that these seeds were rich in minerals. Depending on the species, the varieties of *Lageanria siceraria* were the richest in oil. *Citrullus colocynthis* has weak oil content. This was compensated with a high number of seeds.

Comparison of averages for the oil yield components

For Table 5, the weight of 100 unhulled and hulled seeds, 4 groups were made in the 1st year and 10 in the 2nd year. This led to a kernel/seeds relationship which vary from 60 to 85% the 1st year and 52 to 83% the 2nd year. The heaviest seeds were obtained with LS4 and the less with *Citrullus colocynthis*. As far as oil yield was concern, 2 groups were made in 1st year and 3 in 2nd year. On the two years LS3, LS7 and CC varieties gave the best oil yield. The less productive in oil were LS4 and LS9 for both tests. The analysis of results showed that, seeds which contained more kernels gave the best oil yields.

Results of the correlation analysis between the studied characters

According to Tables 6 and 7, very positive as well as very negative correlations were observed between different variables. More specifically for yield parameters, positive correlations were observed between seeds yield and the number of berries per plant (r = 0.51 1st year and 0.85 2nd year). A negative correlation between the fat content and the number of seeds per berries (r = -0.50).

Table 2: Analysis of variance for measured parameters.

Parameter	Year	DF	SS	MS	F	P
NBPP	Year 1	5	15421.20	3084.23	7.91**	0.00
	Year 2	17	728.59	42.85	1.95*	0.04
NSB	Year 1	5	324082	64816.50	16.94**	0.00
	Year 2	17	1381245	81249.70	37.39**	0.00
SY(kg/ ha)	Year 1	5	756907	151381	9.56**	0.00
	Year 2	17	$2.126.10^{+7}$	1250731	3.01**	0.00
WHUHS (g)	Year 1	5	1248.50	249.70	1498**	0.00
	Year 2	17	941.23	55.36	202**	0.00
WHHS (g)	Year 1	4	275.06	68.76	1032**	0.00
	Year 2	16	484.38	30.27	467**	0.00
ASHES	Year 1	5	0.72	0.14	5.16 **	0.00
	Year 2	17	1.39	0.07	3.65**	0.00
WATER	Year 1	5	0.55	0.11	2.01 ns	0.14
	Year 2	17	20.10	1.18	24.6 **	0.00
PS	Year 1	5	882.79	176.55	116**	0.00
	Year 2	17	1577.97	92.82	4.63**	0.00
F	Year 1	5	1441.77	288.35	89.5 **	0.00
	Year 2	17	3011.44	177.14	47.3**	0.00
REH(l/ha)	Year 1	5	$4.59.10^{+7}$	$9.19.10^{+6}$	11.8**	0.00
	Year 2	17	$2.45.10^{+9}$	$1.44.10^{+8}$	2.90**	0.00

DF = Degree of freedom, SS = Sum Score, MS = Mean score, F = Fisher, P = probability, ** Significant at 1% ns = not significant. NBPP: number of berries per plant; NSPB: number of seeds per berry; SY: seeds yield; WHUS: Weight of a hundred unhulled seeds; WHHS: Weight of hundred hulled seeds ASH: Ash, PS : protein substances, F: fat; YIO: yield in oil.

Table 3: Means comparison of varieties averages for the number of berries/plant, number of seeds / berry and seeds yield.

Variety	Number of berries/plant		Number of seeds / berry		Seeds yield	
Year	1st year	2nd year	1st year	2nd year	1st year	2nd year
LS1	2.33±1.15b	2.33±1.15b	156.67±50.64bc	161.56±85.09cdefg	54.33±22.27b	353.84±257.73ab
LS2	2.33±1.53 b	2.33±1.5 b	123.33±37.87bc	54.22±33.28fg	41.66±11.65b	84.76±80.04b
LS3	10.00±0.00b	10.00±0.00 b	291.00±61.44b	282.00±59.27c	436.33±158.01a	1277.5±589.51ab
LS4	3.66±1.53b	3.66 ±1.53 b	106.33±94.24c	436.67±24.88b	9.33±5.95b	150.62±141.19ab
LS5	2.33± 2.31 b	2.33 ± 2.31 b	103.33±25.77c	43.00±10.39g	37.33±34.12b	54.84±38.20b
CC	82.33±49.54a	16.00±14.00a	472.67±115.00a	746.45±69.32a	499.67±260.82a	133.78±116.41ab
LS6		5.33±1.53ab		155.11±16.44cdefg		1176.7±1089.94ab
LS7		5.66 ±1.53ab		241.78±52.92cde		2069.7±1583.90 a
LS8		3.00 ±1.00ab		221.33±46.80cde		31.57±1062.16b
LS9		1.33±0.58b		113.78±4.29efg		6.12±216.01b
LS10		5.33±3.21ab		66.33±19.47fg		839.12±581.48ab
LS11		8.66 ±1.53ab		129.89±77.73defg		735.3 ±28.55ab
LS12		10.33±9.29ab		147.78±37.68cdefg		1147.2±204.31ab
LS13		2.00 ±1.00ab		121.11±24.54defg		182.17±882.03ab
LS14		6.00±1.00ab		172.56±45.04cdefg		886.51±997.62ab
LS15		4.66 ±2.08ab		262.89±130.81cd		1202.2±28.06ab
LS16		9.66±2.52ab		196.56±22.34cdef		186.0±20.34ab
LS17		4.66±8.02ab		136.44±30.39defg		486.20±2.82ab
Average ± SD	17.16±34.60	5.70±5.32	208.89±150.52	204.97±166.96	180.15±235.97	704.79±826.75

LS = *Lagenaria siceraria* (Molin.) Standl; CC = *Citrullus colocynthis* (Linn.) Schrad; There is no significant difference between averages which have the same letters in each column. SD = Standard deviation.

Table 4: Comparison of varieties averages for water, ashes, fats and protein contents.

Variety	WATER (%)		ASHES (%)		FATS (%)		PROTEIN (%)	
Year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
LS1	7.49±0.38a	9.55±0.16a	4.60±0.06a	4.32±0.09bc	38.05±2.76b	35.35e±0.60fg	26.82±1.14bc	30.45±2.29ab
LS2	7.37±0.30a	7.21±0.21c	4.13±0.12b	4.44±0.232abc	47.25±0.48a	43.83±0.44abc	33.33±2.55a	30.33±4.04ab
LS3	7.21±0.21a	7.71±0.23c	4.44±0.23ab	4.84±0.115a	40.45±1.82b	46.09±0.17a	26.11±0.49c	25.20±2.29abc
LS4	7.17±0.12a	9.53±0.18a	4.67±0.07a	4.55±0.05abc	40.93±0.98b	25.19±1.22ij	29.53±0.48b	21.64±0.71abc
LS5	7.42±0.16a	7.67±0.30c	4.74±0.26a	4.65±0.01abc	38.16±2.64b	45.48±0.54ab	29.50±0.86bc	34.71±2.33ab
CC	7.69±0.11a	8.45±0.24b	4.41±0.17ab	4.69±0.23ab	18.40±0.47c	19.47±1.73j	11.33±0.34d	12.40±1.75c
LS6		7.54±0.10c		4.68±0.12ab		40.00±3.15bcdef		29.02±2.02ab
LS7		7.79±0.11bc		4.22±0.06c		41.12±0.26abcde		34.33±17.19ab
LS8		7.69±0.32c		4.41±0.29abc		40.12±0.36bcef		31.06±0.35ab
LS9		7.50±0.38c		4.56±0.16abc		31.37±1.62gh		26.73±3.36ab
LS10		7.42±0.26c		4.74±0.12ab		46.91±5.14a		21.29±0.69bc
LS11		7.61±0.21c		4.60±0.12abc		41.15±2.26abcde		29.83±1.82ab
LS12		7.61±0.12c		4.45±0.14abc		30.82±0.52ghi		29.15±1.50ab
LS13		7.42±0.23c		4.48±0.07abc		41.46±3.73abcd		35.21±0.21a
LS14		7.60±0.11c		4.80±0.12ab		34.23±1.05fg		30.57±2.21ab
LS15		7.35±0.19c		4.66±0.11abc		26.93±1.22hi		28.44±0.50ab
LS16		7.54±0.11c		4.74±0.16ab		38.49±0.29cdef		31.48±0.52ab
LS17		7.70±0.06c		4.61±0.09abc		35.88±0.86defg		31.13±1.39ab
Mean±SD	7.39±0.27	7.79±0.67	4.50±0.25	4.58±0.21	37.20±9.33	36.88±7.75	26.10±7.28	28.50±6.59

LS = *Lagenaria siceraria* (Molin.) Standl; CC = *Citrullus colocynthis* (Linn.) Schrad ; There is no significant difference between averages which have the same letters in each column, SD = Standard deviation.

Table 5: Comparison of averages of various varieties for the weight of 100 unhulled and hulled seeds and the oil yield per hectare.

Variety	Weight of Hundred of Unhulled Seeds (g)		Weight of Hundred Hulled Seeds (g)		Relationship Kernel/seed		Oil yield (L/ha)	
Year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
LS1	13.00±0.34b	8.56 ±0.13g	11.00±0.17b	5.10±0.15j	84±0.01	59±0.02	19.58±7.71b	85.14±64.14b
LS2	9.66 ±0.31c	7.88±0.70g	7.00±0.37d	4.12±0.23k	73±0.01	52±0.05	16.36±4.22b	23.09±23.50b
LS3	12.00±0.18b	16.80±0.15bc	8.00±0.22c	13.71±0.22b	67±0.01	81±0.01	133.37±42.53a	41.12±249.37ab
LS4	30.66±0.47a	14.58±0.61de	18.66±0.35a	8.47±0.41h	60±0.01	58±0.00	2.69±1.62b	25.51±24.35b
LS5	9.66±0.21c	4.99±0.15h	8.00±0.08c	3.07±0.16l	85±0.01	61±0.05	13.70±12.03b	17.89±13.69b
CC	4.00±0.02d	4.57±0.23h	-	-	-	-	102.74±51.50a	28.37±23.17b
LS6		16.92±1.42ab		8.93±0.13hg		53±0.05		99.43±302.87ab
LS7		18.42±0.25a		15.34±0.20a		83±0.00		800.54±639.56a
LS8		14.40±0.11de		9.70±0.19efg		67±0.01		9.63±465.86b
LS9		12.52±0.41f		7.13±0.21i		56±0.01		1.21±74.68b
LS10		12.51±0.30f		10.15±0.14def		81±0.01		64.86±132.77ab
LS11		8.64±0.59g		6.77±0.25i		78±0.02		266.53±8.66ab
LS12		17.26±0.42ab		12.07±0.08c		69±0.02		76.53±49.43ab
LS13		15.30±0.42cde		10.47±0.41de		68±0.01		58.19±178.50b
LS14		14.69±0.30de		9.05±0.07gh		61±0.01		208.58±230.65ab
LS15		13.91±0.77ef		9.54±0.39fg		68±0.03		243.53±9.68ab
LS16		16.71±0.46bc		9.03±0.44gh		54±0.01		436.78±6.32ab
LS17		15.95±0.13bcd		10.57±0.14d		66±0.01		129.94±0.48ab
Mean±SD	13.68±8.71	13.04±4.24	11.03±4.41	9.02±3.12	74.25±9.70	62.38 ±18.21	48.07±57.05	212.05±283.11

LS =*Lagenaria siceraria* (Molin.) Standl, CC = *Citrullus colocynthis* (Linn.) Schrad. There is no significant difference between averages which have the same letters in each column, SD = Standard deviation.

Table 6: Correlation coefficients between the different variables in the 1st year.

	NBP	NSB	SY (kg/ha)	WHUS(g)	WHHS(g)	WATER	ASHES	P	F
NS/B	**0.60**								
SY	**0.85**	**0.81**							
WHUHS	-0.01	-0.20	-0.24						
WHHS	-0.13	-0.25	-0.33	**0.97**					
WATER	-0.15	-0.17	-0.22	-0.31	-0.24				
ASHES	0.04	-0.30	-0.11	0.32	0.39	0.04			
PS	-0.47	-0.47	**-0.53**	-0.03	-0.09	0.15	-0.36		
F	-0.04	-0.17	-0.13	-0.08	-0.20	-0.15	**-0.69**	**0.71**	
OY	**0.85**	**0.82**	**0.99**	-0.27	-0.36	-0.20	-0.13	**-0.53**	-0.11

In bold, significant at the 5% level. NBP: number of berries per plant; NSB: number of seeds per berry; SY: Seeds yield; WHUS: Weight of hundred unhulled seeds; WHHS: Weight of hundred hulled seeds; ASH: Ashes; P: protein, F: fat; OY: Oil yield.

Table 7: Correlation coefficients between the different variables in the 2nd year.

	NBP	NSB	SY (kg/ha)	WHUS(g)	WHHS(g)	WATER	ASHES	P	F
NS/B	**0.28**								
SY	**0.51**	0.22							
WHUHS	**0.31**	**0.45**	**0.43**						
WHHS	0.26	**0.39**	**0.48**	**0.87**					
WATER	0.09	**0.59**	-0.11	-0.05	-0.09				
ASHES	-0.03	-0.05	**-0.00**	0.02	-0.04	-0.20			
PS	-0.23	-0.23	-0.06	-0.08	-0.07	-0.16	- 0.18		
F	-0.22	**-0.50**	0.03	-0.24	-0.03	**-0.37**	0.09	0.15	
OY	**0.41**	0.19	**0.94**	**0.38**	**0.53**	-0.10	-0.01	-0.15	0.20

In bold, significant at the 5% level. NBP: number of berries per plant; NSB: number of seeds per berry; SY: Seeds yield; WHUS: Weight of hundred unhulled seeds; WHHS: Weight of hundred hulled seeds; ASH: Ashes; P: protein, F: fat; OY: Oil yield.

DISCUSSION

In this study the Cucurbitaceae seeds were analyzed in the perspective to be used as new sources of edible vegetable oils for the Nigerien population. The seeds of these two species were already used in human feeding. The only *Citrullus colocynthis* variety is cultivated for its seeds which have a good market value and is an important income source for the population. Among the 17 varieties of *Lagenaria siceraria*, one variety (LS4) is cultivated for its berries and seeds. The others are cultivated for the immature berries which are much consumed as raw or boiled or/ in different cooking. These berries allow farmers on food and nutritional plan to overcome the difficult period before harvest. The oils of these seeds were extracted in small-scale just for household consumption.

During this study, at the harvest, we noted a variability of *Lagenaria siceraria* berries production from one variety to another. *Citrullus colocynthis* was more productive than *Lagenaria siceraria*. This production dropped in the 2nd year. This could be due to the abundant rainfall. But *Citrullus colocynthis* is a variety whose culture does not require much water. Enoch (2006) reported that varieties of *Citrullus* produce three to four berries per plant, those of *Lagenaria* produce one to three berries per plant. According to Djé et al. (2006), the very low production of berries could result from fertilization problem related to a small number of pollen seeds put on the stigma.

For seeds production, the most productive varieties were CC, LS3 and LS4. The lowest number of seed was obtained with LS5 for the two years. This could be due to the form of the berries. In contrast to other LS, all the seeds were concentrated in the bulging base (which gives to it its ladle form). Whereas for the others, the seeds were uniformly distributed throughout the berry. The average production in seeds was 181 kg/ha the 1st year and 705 kg/ha the 2nd year for the two species. However, very interesting values were noticed in C*itrullus colocynthis* which was cultivated for its seeds: 500 kg/ha year 1 and 117 kg/ha year 2. Enoch (2006) showed that the yield per hectare of studied varieties ranged from 83 to 600 $kg.ha^{-1}$.

Measurements made showed that the weight of 100 seeds was higher in *Lagenaria siceraria* varieties. The lowest weights were obtained with *Citrullus colocynthis*. The values obtained were similar to those of Enoch et al. (2006). They reported that the weight of 1000 unshelled seeds was higher for *Lagenaria* varieties than for other species. For Kplakata varieties 1000 unshelled seeds weigh 345.67 ± 56.61 g and 1000 shelled seeds weigh 140.50 g ± 8.23. After, shelling seeds contain interesting proportions of kernel. Indeed, the relationship kernel/seeds was more than 50% for all *Lagenaria siceraria* seeds. This ratio determines the interest of shelling or not. The ratio kernel/seed was reported by Enoch et al. (2006). Aklamkpa varieties *(L. siceraria*) have ratios kernel / tegument of 64.56%. *Citrullus colocynthis* seeds have not been shelled in current study, because seeds were small on the one hand and the tegument was thin on the other hand. This would complicate the shelling operation. These results were reported by Enoch et al. (2006). The Ratio kernel/seed is higher for *Citrullus* varieties (78.52% for Kakoun and 73.66% for Kilonon). According to this author, this means that this species has a fairly light tegument. However, research in Niger farming area concluded that, a practice which consists of roasting the seeds before shelling. Ziyada and Elhussierr (2008), with *Citrullus lanatus* Var. Colocynthoide found a small percentage of teguments in comparison with kernels (43-40:57-60) and colocynth seeds (53-55: 45-47).

Physicochemical analyses results of our study confirmed the potentialities of these seeds. Indeed, the water contents were almost less than 8%. The composition in ashes observed, showed that these seeds were rich in minerals; they are also rich in fat and proteins contents. Results of chemical analysis have been reported by other authors. Thus, Abiodun and Adeleke (2010) in *Cucumeropsis manni* (Naudin), Cucumis *sativus*, *Leganaria*

siceraria and *Cucumeropsis edulis* found 33.80-39.96%, 40.26-45.21%, 3.35-4.89% and 4.78-5.21, respectively, as protein contents, fat, ashes and water. Ziyada and Elhussierr (2008) reported 35.5% in lanatus and 20-26% in colocynth seeds. For Mercy et al. (2005) and Fokou et al. (2009), the *L. siceraria* fats content vary from 49 to 52.15%. In *Citrullus colocynthis*, Beharav et al. (1998) showed that fats content ranged from 17.1 to 19.5%. Badifu (2001), found in *Citrullus colocynthis* contents: in water 9%, proteins 35%, fats 50%, ashes 3%, in *Lagenaria siceraria*, water 8%, protein 31%, fats 42%, and ashes 3% **.** Recently Jiao et al. (2014) reported 44.61% fat in *Cucurbita pepo*. Oloyede et al. (2012) in *Cucurbita pepo* obtained 23 g/100 g. Previous studies in Niger Cucurbitaceae seeds observed in twelve *Lagenaria* varieties according to the provenance: 31.87 to 39.96% proteins, 43.17 to 51.79% fat, 2.77 to 5, 29% ashes (Sabo et al., 2005a). In two *Luffa* species, the results higtlighted: 39.74-40.00% protein, 36.02-38.03% fat and 4.93-5.22% ash (Sabo et al., 2005b). Sadou et al. (2007) reported in *Citrullus colocynthis, Coccinia grandis, Cucumis metuliferus* and *Cucumis prophetarum* 13.19-26.86% protein, 14.48-24.62% fat and 2.00-4.46% ashes. All these results demonstrate the potentialities in different nutrients of Cucurbitaceae seeds. They have oil contents especially similar to those of sesame 48 to 53% (Amoukou et al., 2013) and groundnut (36% -37%).

Concerning, oil yield, the correlation test showed that the lowest levels of fats were obtained with varieties of many seeds. It is the case of *Citrullus colocynthis* with which more seeds were produced the 1st year, these were poor in fats. The only study that put emphasis on yield, reported that 103 to 400 L/ha in *Citrullus colocynthis* (Beharavet al., 1998), which is conform to our results. Comparatively to conventional oilseed, analyzed Cucurbitaceae seeds were not also bad. The palm oil yield were 5000 L/ha per year; sunflower 662 liters of oil per hectare, colza 572 liters oil / ha.

Conclusion

This study highlighted agronomical and nutritional potentialities of Niger Cucurbitaceae seeds. There is a significant variability of these characteristics depending on varieties. In Niger, these varieties are cultivated for socio-economic interest that berries and seeds provide. The study revealed that berries and seeds production varied from one variety to another. Unfortunately, there is little research work for this family. The best yields in berries and seeds were obtained through *Citrullus colocynthis* followed by LS3 and LS4. It was found that the low yield in *Lagenaria siceraria* berries and seeds was compensated by berries and seeds of large sizes and heavy contrary to *Citrullus colocynthis* that has produced seeds of small sizes.

Despite the interesting agronomical potentialities of these varieties, many parameters need to be better detailed, including berries and seeds yield and the cycle of these plants. Production should be encouraged given their high food and commercial values. In addition, a strong correlation was found between the yield of berries (number and weight average of a berry) and the yield in seeds and oil. The best oil yields were obtained with *Citrullus colocynthis*, LS3, LS7, LS6, LS10, LS11, LS12, LS14, LS15 and LS16 varieties of *Lagenaria siceraria*. Based on these results, we can just encourage the production of oil from these seeds on a large scale and encourage manufacturers to work for their pummeling. This may without doubt contribute to fight against poverty through the creation of jobs. Studies should be conducted to see at which moment we have the maximum oil production to help guide producers on the good harvest period.

ACKNOWLEDGMENTS

We are grateful to Abdou Moumouni University of Niamey for its financial support through research funds N°460, and International Funds of Sciences (IFS) E/4331-1.

REFERENCES

AOAC. 1984. *Official Method of Analysis of the Association of Official Analytical Chemist.* Ed AOAC: Washington DC; 24003 P.

Abiodun OA, Adeleke RO. 2010. Comparative Studies on Nutritional Composition of Four Melon Seeds Varieties. *Pak. J. Nutr.*, **9**(9): 905-908.

Achu MB, Fokou E, Tchiegang C, Fotso M, Tchouanquep FM. 2005. Nutritive value of Some Cucurbitaceae oilseeds from different regions in Cameroon. *Afr. J. Biotechnol.*, **4**(11): 1329-1334.

Amoukou IA, Bouréima S, Lawali S. 2013. Agro-morphological characterization and comparative study of two methods of sesame oil extraction (*Sesamum indicum* L). *Afr. Agron.*, **25**(1): 71-82.

Applequist WL, Avula B, Schaneberg BT, Wang YH, Khan IA. 2006. Comparative fatty acid content of seeds of four *Cucurbita* species grown in a common (shared) garden. *J. Food Comp. Anal.*, **19**(6-7): 606-611.

Badifu GIO. 2001. Effect of processing on proximate composition, Antinutritional and Toxic Contents of Kernels from Cucurbitaceae Species Grown in Nigeria. *J. Food Comp. Anal.*, **14**: 153-161.

Barilla Center for Food and Nutrition. 2012. *Eating Planet*. Edizioni Ambiente: Milan, Italy.

Beharav AD, Shabelsky E, Yaniv Z. 1998. Evaluation of *Citrullus colocynthis*, a native desert plant in Israel, as a potential source of edible oil. *J. Arid Environ.*, **40**: 431-439.

Beshir AA, Babiker SA. 2009. Digestibility of Sudanese Desert lambs fed Diets of Different Proportions of WaterMelon (*Citrullus lanatus*) Seeds Cake. *Res. J. Animal & Vet. Sci.*, **4**: 30-34.

Djé Y, Kouonon LC, BI ZIA, Gnamien GY, Baudoin JP. 2006. Study of the African melon (*Cucumis melo* L. var agrestis Naudin, Cucurbitaceae.) botanical, agronomic and floral biology characteristics. *Biotechnol. Agron. Soc. Environ.*, **10**(2):109-119.

Enoch ADG, Fanou N, Kouke A, Avohou H, Vodouhe RS, Ahanchede A. 2006. Agronomic evaluation of three Egusi species (Cucurbitaceae) used in food in Benin and development of a model for predilection yield. *Biotechnol. Agron. Soc. Environ.*, **10**(2): 121-129.

Fabregues PB. 1979. *Niger Plants Lexicon* (2nd edn). IMVT: Paris.

FAO. 2007. Food outlook, global market analysis, consulted 05-28, 2014, http://www.fao.org/docrep/010/ah876e/ah876e00.htm

Fas D. 2008. Performance and haematological evaluation of weaner rabbits fed loofah gourd seed meal (*Luffa cylindrica*). *Afr. J. Food Agric. Nutr. Dev.*, **8**(4): 451-463.

Fokou E, Achu MB, Kansci G, Ponka R, Fotso, Tchiegang C, Tchouanguep FM. 2009. Chemical properties of some cucurbitaceae oils from Cameroon. *Pak. J. Nutr.*, **8**: 1325-1334.

Fokou E, Achu MB, Tchouanguep MF. 2004. Preliminary nutritional evaluation of five species of egusi seeds in cameroon. *Afr. J. Food Agric. Nutr. Dev.*, **4**: 1-11.

Ismail M, Mariod A, Bagalkotkara G, Lingb HS. 2010. Fatty acids composition and antioxidant activity of oils from two cultivars of Cantaloupe extracted by supercritical fluid extraction. *Grasas Y Aceites.*, **61**(1): 37-44.

IUPAC (International Union for Pure and Applied Chemistry). 1968. Analysis methods unified by section of fats "International Union of Pure and Applied Chemistry". 1 B 2, IUPAC.

Jiao J, Li ZG, Gay YQ, Li XJ, Wei FD, FuYJ, MaW. 2014. Microwave -assisted aqueous enzymatic extraction of oil from pumpkin seeds and assessment of physicochemical properties icts, fatty acid composition and antioxidant activities. *Food Chem.*, **147**: 17-24.

Kouonon LC, Jacquemart AL, Zoro Bi AI, Bertin P, Baudoin JP, Dje Y. 2009. Reproductive biology of the andromonoecious Cucumis melo subsp. agrestis. *Ann. Bot.,* **104**:1129-1139.

Mariod A, Matthäus B. 2008. Fatty acids, tocopherols, sterols, phenolic profiles and oxidative stability of *cucumis melo* var. *agrestis* oil. *J. Food Lipids.,* **15**: 56–67.

Mohammed BT. 2011. Socio-economic analysis of melon production in Ifelodun Local Government Area, Kwara State, Nigeria. *J. Dev. Agric. Econ.,* **3**(8): 352-367.

National Institute of Statistics. 2010. *Statistical Yearbook 2006-2010*. NIS: Niamey.

Nyam, Tan CP, Lai OM, Long K, Che Man YB. 2009. Physicochemical properties and bioactive compounds of selected seeds oils. *Food Sci. Technol.,* **42**(8): 1396-1403.

Oloyede FM, Agbaje GO, Obuotor EM, Obisesan IO. 2012. Nutritional and antioxidant profiles of pumpkin (*Cucurbita pepo* Linn.) Immature and mature fruits as Influenced by NPK fertilizer. *Food Chem*.**, 135**: 460-463.

Sabo H, Sadou H, Saadou M, Leger CL. 2005a. Overall chemical compositions of seeds and physico-chemical characteristics of *luffa cylindrica* and *Luffa aegyptiaca* oils of Niger. *J. Soc. West Afr. Chim.,* **020**: 119-133.

Sabo H, Sadou H, Saadou M, Leger CL. 2005b. Chemical composition of seeds and physico-chemical characteristics of the oils of twelve varieties of *Lagenaria siceraria* from Niger. *J. Soc. West Afr. Chim.,* **020**:11-30.

Sadou H, Sabo H, Alma MM, Saadou M, Leger CL. 2007. Seeds chemical content and physico- chemical characteristic of the seed oils *from citrullus colocynthis, coccinia grandis, Cucumis Cucumis metuliferus and prophetarum* of Niger. *Bull. Chem. Soc. Ethiop.,* **21**(3): 323-330.

WHO. 2004. Fruit and Vegetables for Health. Report of a Joint FAO/WHO Workshop, 1–3 September, Kobe, Japan.

WOLF JP. 1968. *Manual of Fats Analysis*. Ed Azoulay: Paris.

Ziyada AK, Elhussien SA. 2008. Physical and Chemical Characteristics of *Citrullus lanatus* Var. Colocynthoide Seed Oil. J. *Phys. Sci.,* **19**(2): 69-75.