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Physico-chemical properties and mineral composition of four cultivar seed flours from *Citrullus lanatus* (Cucurbitaceae) cultivated in Côte d'Ivoire

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Abstract

This paper reports the physico-chemical properties and mineral composition of four cultivarseed flours from*Citrulluslanatus*var. *citroides* (Thumb.) Matsum. & Nakai cultivated in Côte d'Ivoire, namely *WlewleS*, *Wlewle M*, *Wlewle B*and *Bebu*. The crude fat, crude protein, crude fiber, carbohydrateand starch contents from *C. lanatus*seeds, within the range of 41.48 to 56.08%, 21.78 to 30.42%, 2.56 to 17.14%,10.45 to 26.30% and 7.29 to 20.71%, respectively, varied significantly ($p \leq 0.05$) among the cultivars tested. The levels of moisture, ash, total and reducing sugars in the cultivar seeds tested were found to be 3.60-5.53%, 2.60-3.99%, 2.23-3.28% and 0.95-1.34%, respectively.The pH and caloric values obtained were 5.71-6.50 and 574.88-651.16 kcal/100g, respectively.The *C. lanatus*seed flours contains an appreciable value of copper (336.23-1772.97 mg/kg), potassium (264.72-368.51 mg/kg), magnesium (126.94-182.13 mg/kg) and calcium (45.31-60.77 mg/kg). Most of the properties of the seed flours analyzed varied significantly ($p \leq 0.05$) among the cultivars tested.The seed flours produced seems to be interesting for food and pharmaceutical industries.

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Introduction

In developing countries such as Côte d'Ivoire, the exploitation of local resources is one of the best ways to address the insufficient food production (Shackleton *et al.,* 2002).Plantsconstitutethe largest part of thefood resources forhuman and especially for animals.Indeed,these are the mainbasic componentsfor a well balanced dietbecause oftheir greatwealthfoodandlow production costcompared toanimal and fishresources(Enzonga-Yoca *et al.,* 2011).

Cucurbits are among the most economically important crops worldwide and are grown in both temperate and tropical regions (Paris, 2001; Sanjur *et al.,* 2002; Loukou *et al.,* 2007; Koffi *et al.,* 2010). In Sub-Saharan Africa, the indigenous species are prized for their oleaginous seeds that are consumed as thickeners of a traditional soup called*pistachio* soup in Côte d'Ivoire and*egusi* soup in Nigeria and Benin. In Côte d'Ivoire, surveys made in various departments, have allowed to identify five species of *pistachio*:*Citrillus lanatus*, *Cucubita moschata*, *Cucumeropsis mannii*, *Curcumis melo* and *Lagenaria siceraria*(Zoro Bi *et al.,* 2003; Koffi *et al.,*2013a).These species areneglectedandrelegated tominoror orphancrops(Chweya and Eyzaguirre, 1999; IPGRI, 2002).However, they are rustic plants, characteristics of farming systems that do not use fertilizer or herbicide; which significantly reduces the cost of seeds production and may contribute to their extension(Zoro Bi *et al.,* 2006).Cucurbits cultivated for seed consumption are reported to be good source of lipids (~60%) and proteins (~30 %) (Loukou *et al.,* 2007; Enzonga-Yoca *et al.,* 2011; Koffi *et al.,*2013a).

Edible oil can also be extracted from the seeds. Commonly found in many traditional cropping systems, the plant is well adapted to extremely divergent agro-ecosystems and various cropping systems characterized by minimal inputs (IPGRI, 2002; El Tahir and Taha Yousif, 2004). *C. lanatus* thus represents an excellent plant model for which improved cropping systems implementation can insure the economic prosperity of rural women that are the main producers in tropical Africa(Zoro Bi *et al.,* 2003).

*Citrilluslanatus*is cultivatedin Côte d'Ivoire for its edible kernels which are used as a soup thickener.Soup of *C. lanatus* is highly valued by sub-saharan african traditional societies. In Côte d'Ivoire, this soup is highly valued by the Akan during rejoicing times such as new year, births and wedding ceremonies(Zoro Bi *et al.,* 2003).Their fruits are round or oval, uniformly light green or mottled light. Two groups according to the morphology of the seeds were reported for this species. The first morphotype (*Wlewle*), including three cultivars (defined on the basis of seed size), is characterized by glossy seeds with a tapered proximal extremity. In the second morphotype (*Bebu*), including one cultivar, the seeds have a flat ovoid shape with rugged and thick ends(Zoro Bi *et al.,* 2003; Koffi *et al.,*2013b).

Research towards promotion of these crops has focused primarily on agronomic evaluation, estimation of the amount of genetic diversity and determination of the degree of genetic differentiation (Zoro Bi *et al.,* 2003; Djè *et al.,* 2006; Zoro Bi *et al.,* 2006; Djè *et al.,* 2010). Nevertheless,Zoro Bi *et al.* (2006) reported a review of the inter- and intra-species diversity of cucurbit species withparticular nutritional characteristics. This is truein particularfor *C.lanatus*speciesas itrefers to bothwatermelonand oleaginous varieties(Koffi *et al.,*2013b).

Loukou *et al.* (2007) studied the biochemical characterization of three different oleaginous seed species [*Citrullus lanatus* var. *citroides* (Thumb.) Matsum. &Nakai, *Cucumeropsis mannii* Naudin and *Cucumis melo* var. *agrestis* L.] of cucurbits widely cultivated and distributed in Côte d'Ivoire. Moreover, researches have been carried out on the characterization of seed oil and nutritional compositions of seeds from these cucurbit species (De Melo *et al.,* 2000; Badifu, 2001; Enzonga-Yoca *et al.,* 2011; Gbogouri *et al.,* 2011), but to our knowledge no study concerning thebiochemical attributes of different cultivarsfrom cucurbit species cultivated in Côte d'Ivoire has been undertaken.

The present study was conducted to determine physico-chemical properties and mineral composition of four cultivarseeds of *Citrullus lanatus* (Cucurbitaceae) cultivated in Côte d'Ivoire.

Materials and methods

Materials

The seeds of four (4) Cultivarsfrom *Citrulluslanatus*var. *citroides* (Thumb.) Matsum. & Nakai have beenstudied: three (3) named *Wlewle* with different seed sizes,small seeds(*Wlewle S*), mediumseeds (*Wlewle M*) and big seeds(*WlewleB*); and one (1) named*Bebu*with thickened margin seeds. The fresh fruit of *Citrullus lanatus* were randomlyharvested at maturityfrom an experimental plot located on the site of the University NanguiAbrogoua, Abidjan-Côte d'Ivoire(West Africa). After fermentation, seeds were extracted, washed and sun-dried.The cleaned dried seeds were hulled or not and finally ground prior to analysis.

All other chemicals and reagents used were of analytical grade and purchased from Sigma Chemical Co. (St. Louis, MO).

Physico-chemical properties

Moisture content of *Citrulluslanatus* seeds was by drying in an oven at 105°C during 24 h to constant weight (AOAC, 1995). The crude protein content was calculated from nitrogen contents (N x 6.25) obtained using the Kjeldahl method by BIPEA (1976).The crude fat content was determined by continuous extraction in a Soxhlet apparatus for 6 h using hexane as solvent (AOAC, 1995). Ash content was determined by incinerating flour (5 g) in a furnace at 550°C for 24 h, then weighing the residue after cooling to room temperature in a desiccator (AOAC, 1995). The ethanol-soluble sugars extraction was determined as described by Martínez-Herrera *et al.* (2006). The method described by Dubois *et al.* (1956) was used for the total sugars content analysis. The reducing sugarscontent was determined according to the method of Bernfeld (1955) using 3.5 dinitrosalycilic acid. Crude fiber was determined by the Van Soest *et al.* (1991) method.Carbohydrate content was determined by difference that is by deducting the mean values of other parameters that were determined from 100. Therefore:

% carbohydrate = 100-(% moisture + % ash + % crude protein + % crude fat).

The starch content was calculated using the following equation:

% starch = (%carbohydrate - % total sugar) x 0.9 ; with 0.9 = ratio starch / glucose

The energy (caloric value) was estimated by summing the multiplied values for crude protein, fat and carbohydrate by their respective factors (4, 9 and 4) given by Atwater and Benedict (1902). The pH was determinedaccording to the methodofMedoua *et al.* (2008).

Mineral composition

A Perkin-Elmer, Model 250, modified inductively coupled argon plasma - mass spectrometry (ICP-MS) was used for the simultaneous determination of mineral content(Houk *et al.,* 1980). The mineral constituents in the seeds were determined by wet-ashing 0.5 g each of sample, taken from the treatment groups, with a mixture of nitric acid 50% (v/v), hydrogen peroxide 30% (v/v) and hydrochloric acid. The results were expressed as mg/kg dry weight basis (mean ± SD) based on at least three replicate analyses.

Statistical analysis

Three separate samples from each cultivar were taken and analyses on each sample were conducted. Data were assessed by analysis of variance (ANOVA) and Duncan Multiple Range Test with a probability $p \leq 0.05$ performed using the STATISCA Software version 7.

Results and discussion

Physico-chemical characteristics of seeds

The physico-chimical analysis values of the four cultivar seeds(*Wlewle S*, *Wlewle M*, *Wlewle B*and *Bebu*) from *Citrullus lanatus* studied are shown in Table 1. The moisture content of the four seed cultivars from *C. lanatus*ranged from 3.60 (*Wlewle S*) to 4.05% (*Bebu*) and 5.30 (*Wlewle S*) to 5.53% (*Bebu*) for hulled seed and unhulled seed flours, respectively (Table 1). Cultivar*Bebu*exhibited the highestvalue which was significantly different (p≤0.05) from other cultivars and it could be explainedby thekernel weightandthe thick edgesof the seeds. However, within a same cultivar, we noted that the moisture content of flours from hulled seeds is lower than unhulled seeds (5.30-3.60%, 5.33-3.66%,5.46-3.71% and 5.53-4.05% for cultivar *Wlewle S*, *Wlewle M*, *Wlewle B*and *Bebu*, respectively).

Table 1. Some physico-chemicalproperties of four cultivars of *Citrulluslanatus*seedflours.

	Cultivars							
Parameter	*Wlewle S*		*Wlewle M*		*Wlewle B*		*Bebu*	
	Unhulled	Hulled	Unhulled	Hulled	Unhulled	Hulled	Unhulled	Hulled
Moisture (%)	5.30 ± 0.15^{a}	3.60 ± 0.09^{c}	5.33 ± 0.11^{a}	3.66 ± 0.13^{c}	5.46 ± 0.07^{a}	3.71 ± 0.05^{c}	5.53 ± 0.09^{a}	4.05 ± 0.13^{b}
Crudeprotein (%)	22.54 ± 0.65^{cd}	25.32± 1.18^{cd}	21.78 ± 0.34^{d}	26.58 ± 0.49^{bc}	25.48 ± 0.41^{bcd}	29.05 ± 0.95^{ab}	24.09 ± 0.57^{cd}	30.42 ± 0.76^{a}
Crude fat (%)	51.31 ± 0.57^{ab}	56.08± 2.16^{a}	48.35 ± 0.46^{bc}	55.62 ± 0.49^{a}	43.20 ± 0.25^{cd}	51.43 ± 1.05^{ab}	41.48 ± 0.40^{d}	49.24 ± 0.77^{b}
Crudefiber (%)	16.87 ± 0.23^{b}	4.52 ± 0.13^{d}	16.63 ± 0.11^{b}	3.13 ± 0.09^{d}	17.14 ± 0.12^{a}	2.65 ± 0.08^{e}	13.59 ± 0.18^{c}	2.56 ± 0.13^{e}
Ash (%)	2.75 ± 0.08^{c}	3.71 ± 0.43^{ab}	2.95 ± 0.01^{c}	3.69 ± 0.26^{ab}	3.17 ± 0.07^{ab}	3.99 ± 0.16^{a}	2.60 ± 0.04^{c}	3.94 ± 0.18^{a}
Carbohydrate (%)	18.10 ± 1.33^{ab}	11.29 ± 1.40^{b}	21.59 ± 1.02^{ab}	10.45 ± 0.96^{b}	22.69 ± 1.22^{ab}	11.82 ± 0.77^{b}	26.30 ± 1.95^{ab}	12.35 ± 1.42^{b}
Total sugars (%)	3.04 ± 0.02^{b}	2.31 ± 0.03^{d}	3.18 ± 0.03^{a}	2.35 ± 0.01^{d}	3.02 ± 0.02^{b}	2.72 ± 0.03^{c}	3.28 ± 0.014^{a}	2.23 ± 0.02^{d}
Reducingsugars (%)	1.34 ± 0.01^{a}	1.01 ± 0.01^{de}	1.13 ± 0.01^{c}	0.95 ± 0.02^{e}	1.23 ± 0.01^{b}	1.01 ± 0.02^{de}	1.30 ± 0.02^{a}	1.03 ± 0.01^{d}
Starch (%)	13.55 ± 0.51^{b}	8.08 ± 0.95^{c}	16.56 ± 0.06^{ab}	7.29 ± 1.76^{c}	17.70 ± 0.03^{ab}	8.19 ± 0.67^{c}	20.71 ± 1.02^{a}	9.10 ± 0.05^{bc}
Energy (kcal/100g)	624.35± 0.95^{ab}	651.16±1.08^{a}	608.63± 5.38^{b}	648.70± 2.48^{a}	591.68 ± 1.85^{ab}	626.35± 5.27^{ab}	574.88± 2.75^{ab}	614.24± 3.66^{ab}
pH	6.00 ± 0.01^{c}	6.43 ± 0.01^{a}	5.71 ± 0.01^{d}	5.80 ± 0.05^{d}	6.14 ± 0.01^{b}	6.47 ± 0.01^{a}	6.04 ± 0.01^{bc}	6.50 ± 0.01^{a}

Values given are mean ± standard deviation of triplicate determination. Means with different letters within the same row denote significant differences among cultivars (p≤0.05).

These moisture levels obtained (3.60-5.53%) were comparable to literature values of 3.68 to 5.21% (Hassimi *et al.,* 2007; Loukou *et al.,* 2007; Abiodun and Adeleke, 2010; Gbogouri *et al.,* 2011), while lower range of values were observed in different varieties of Pakistan watermelon seeds [*Citrulluslanatus* (Thunb.)] (2.16-3.24%)(Raziq *et al.,* 2012)and in three different species of Nigerian melon seed (1.41-1.55%)(Egbebi, 2014). However, high values were reported for seed flours of jackfruits (*Artocarpusheterophyllus*) (6.09%) (Ocloo *et al.,* 2010) and Chinese bottle gourd (*Lagenariasiceraria*) (6.52%)(Olaofe and Adeyeye, 2009). Moisture provides a measure of the water content of the seed flour and for that matter its total solid content. It is also an index of storage stability of the flour. The lower the moisture content of flour, the better its shelf stability and hence the quality. Moisture content of flour generally is depended upon the duration of the drying process.

The crude protein content of the four cultivar seeds studied ranged from 21.78 (*Wlewle M*) to 25.48% (*Wlewle B*) for unhulled seed flours and from 25.32 (*Wlewle S*) to 30.42% (*Bebu*) for hulled seed flours, with significant differences (p≤0.05) between the lowest value 21.78% (*Wlewle M*) and the highest value 30.42% (*Bebu*). Flours from hulled seeds showed a higherprotein contentthan that of unhulled seeds.Theresults obtained for these four *C. lanatus*cultivars agree with the findings of Olaofe *et al.* (1994) who reported a range of 23.7-30.68% in melon, pumpkin and gourd seeds. Anwar *et al.* (2011)also reported a range of 19.36-26.21% in winter melon (*Benincasa hispida*) fruit. The protein values (21.78-30.42%) were lower than the values (about 33-39%) reported by Abiodun and Adeleke (2010) and Egbebi (2014)for four melon seed varieties and inthree melon seed speciesof Nigeria, respectively. However, thesevalues were higher than the values (13.19-26.86 %) reported by Hassimi *et al.* (2007)for the seeds of *Citrulluscolocynthis,Cocciniagrandis, Cucumismetuliferus* and *Cucumisprophetarum* from Niger.Therefore, *C. lanatus* seeds could be an alternative source of dietary protein and would be a better supplement in enhancing the amino acid profile in highly malnourished areas, especially in African countries like Côte d'Ivoire where the majority of the populace live on starchy foods.

Crude fat content of cultivar seed flours investigated ranged from 41.48 (*Bebu*) to 51.31% (*Wlewle S*) and 49.24 (*Bebu*) to 56.08% (*Wlewle S*) for unhulled and hulled seeds, respectively. Within a same cultivar, the crude fat content of flours from unhulled seeds is lower than hulled seeds. Cultivar *Wlewle S*had the highest fat value whereas cultivar *Bebu*exhibited the least value, which was significantly different (p≤0.05) from the other cultivars.Crude fat of cultivar seeds showed to be the most important biochemical component in the flours.This result agrees with that of Abiodun and Adeleke (2010) and Egbebi (2014)that fat content of melon seedspecies ranged from 40.26-45.21% and 44.00-55.00%, respectively. These values were higher than the valuereported by De Melo *et al.* (2000)andHassimi *et al.*(2007)for *Cucumismelo* hybrid AF-522 seed (30.83-32.30%)and for seeds of *Citrulluscolocynthis, Cocciniagrandis, Cucumismetuliferus* and *Cucumisprophetarum*(14.48-24.62%), respectively. The results showed that the cultivars (*Wlewle S*, *Wlewle M*, *Wlewle B*and *Bebu*) from *C. lanatus*have high fat contents, thus the seeds are classified as excellent sources of dietary oil (Abiodun and Adeleke, 2010). Then, *C. lanatus*species is an interesting oleaginous crop for which the implementation of improved cropping systems should result in the economic well-being of rural people in Côte d'Ivoire.

The ash content ranged from 2.60 (*Bebu*) to 3.17% (*Wlewle B*) and 3.69 (*Wlewle M*) to 3.99% (*Wlewle B*) for unhulled and hulled seeds, respectively. Seeds of cultivar *Wlewle B*had higher value in ash content and were significantly different (p≤0.05) from other cultivars. The ash content of flours was higher inhulled seeds compared to unhulled seeds, within a same cultivar, but no significant differences (p≤0.05) were observed with hulled seeds. The ash content (2.60-3.99%) was moderate but lower than 5.02-11.81% in winter melon (*Benincasa hispida*) fruit seed (Anwar *et al.,* 2011). The results obtained were comparable to those from several studies, highlighting that oleaginous edible-seeded cucurbits are generally low in ash contents (Hassimi *et al.,* 2007; Loukou *et al.,* 2007; Olaofe and Adeyeye, 2009; Gbogouri *et al.,* 2011; Egbebi, 2014). Ash content gives an indication of minerals present in a particular food sample and it is very important in many biochemical reactions which aid physiological functioning of major metabolic processes in the human body (Bamishaiye *et al.,* 2011).This suggests that the *C. lanatus* seedwould provide essential minerals for body mechanism and development.

Table 1 showed that there were no significant difference (p≤0.05) in the total sugars and reducing sugars contents of the four *C. lanatus* cultivar seed flours. The contents of total and reducing sugars ranged from 2.23 to 3.28 and 0.95 to 1.34, respectively.

The crude fiber contents of the tested cultivar seeds ranged from 2.56 (*Bebu*) to 4.52% (*Wlewle S*) and 13.59 (*Bebu*) to 17.14% (*Wlewle B*) in hulled and unhulled seeds, respectively. Cultivar *Bebu*was significant different (p≤0.05) from other cultivars due to the low value in crude fiber. Then, the crude fiber values of *C. lanatus*seed flours decreased significantly (p≤0.05) following hulling of seeds. Crude fiber contents of hulled seeds (2.56-4.52%) were similar to values reported by Loukou *et al.* (2007) for three indigenous cucurbit species cultivated in Côte d'Ivoire (2.30-2.94%) and by Abiodun and Adeleke (2010) for four melon seeds varieties of Nigeria (1.66-2.16%). But, in peanut landrace *A. hypogae*,Loukou *et al.* (2007) reported value (17.14%) similar to those of unhulled seeds of *C. lanatus* (13.59-17.14%). However, crude fiber contents of 4.29-6.60% were reported by Raziq *et al.* (2012), whileEgbebi (2014)reported crude fiber of 4.50-6.00%. The crude fiber contains indigestible materials which can reduce constipation by increasing bowel movement.

Carbohydrate content varied significantly among the four cultivar seeds analyzed. The lowest values were observed with cultivar *Wlewle S*(18.10%) in unhulled seeds and cultivar *Wlewle M*(10.45%) in hulled seeds that differed significantly.The highest values were observed with cultivar *Wlewle B*(22.69% and 11.82% for unhulled and hulled seeds, respectively) and cultivar *Bebu*(26.30% and 12.35% for unhulled and hulled seeds, respectively) which were significantly different (p≤0.05).This could be dueto the starch concentration and size of cultivar seeds.Indeed, the starch concentration increases with the increasing of size from seeds (hulledor not).However, hulled seed flours had lower values in total and reducing sugars, carbohydrate and starch contents compared to unhulled seed flours.The carbohydrate values obtained (10.45-26.30%) were comparable to values as reported in literature (De Melo *et al.,* 2000; Loukou *et al.,* 2007; Olaofe and Adeyeye, 2009; Abiodun and Adeleke, 2010; Gbogouri *et al.,* 2011), but were higher than that of peanut landrace *Arachis hypogae* (6.39%) (Loukou *et al.,* 2007).The high percentage of carbohydrates in *C. lanatus*seed flour makes it an energy food.

The caloric value (energy) of*C. lanatus*seed flours ranged between 574.88 and651.16 kcal/100g, with significant differences (p≤0.05). The lowest values were observed with cultivar *Bebu*and the highest value with cultivar *Wlewle S*in hulled and unhulled seeds. Highcaloric values were obtained with hulled seed flours.These could be explained by the high protein and fat contents of these hulled seed flours. Thecaloric values obtained werehigher than those reported by Oclooet *al.* (2010)for Jackfruit seed flour (382.79 kcal/100g) and by Gbogouri *et al.* (2011) for three indigenous cucurbit seeds from Ivory Coast.

The pH values of *C. lanatus*seed flours were about 5.7 to 6.5(Table 1). Ocloo *et al.* (2010)reported for Jackfruit seed floura pH value of 5.78. pH value gives a measure of the acidity or alkalinity of the flour. The levels of these indices are used to estimate the quality of the flour.

Table 2. Mineral composition of four cultivars of *Citrulluslanatus*seedflours.

Minerals (mg/kg)	Cultivars							
	Wlewle S		*Wlewle M*		*Wlewle B*		*Bebu*	
	Unhulled	Hulled	Unhulled	Hulled	Unhulled	Hulled	Unhulled	Hulled
Calcium	45.31±0.34	52.13±0.12	45.54±0.59	51.94±0.15	60.77±0.09	50.60±0.28	54.25±0.24	58.72±0.32
Copper	881.21±1.16	336.23±2.63	632.20±0.89	355.81±3.57	1375.96±0.95	1772.97±0.99	407.60±1.28	669.71±1.11
Iron	6.27±0.56	6.40±0.47	17.19±0.23	8.22±0.98	6.17±1.08	4.38±1.85	6.86±0.77	7.32±0.45
Magnesium	154.84±0.89	171.54±0.36	143.37±0.57	138.88±0.64	126.94±0.98	159.55±0.27	127.89±0.76	182.13±0.23
Phosphorus	3.40±1.47	5.60±0.97	2.00±3.08	3.10±3.01	2.8±2.77	3.90±1.89	2.30±3.23	3.90±2.49
Potassium	311.91±1.39	327.37±1.45	291.96±1.83	267.98±2.87	292.53±2.16	330.01±1.05	264.72±2.97	368.51±3.01
Selenium	0.2±0.03	0.2±0.02	0.4±0.11	0.1±0.06	0.2±0.02	0.2±0.03	0.2±0.03	0.3±0.05
Sodium	16.10±2.04	13.68±2.15	15.83±2.11	20.04±1.95	17.74±1.99	11.97±2.45	16.80±2.06	14.07±2.17
Zinc	5.39±1.03	3.25±0.62	4.77±0.95	4.44±0.89	8.49±2.25	12.29±2.34	3.48±0.86	4.23±0.99

Values given are mean ± standard deviation of triplicate determination.

Mineral composition

The mineral composition, expressed in mg per kg, of flours from the four cultivar seedsof *C. lanatus*was reported in Table 2.These four cultivars were significantly different (p≤0.05) in their mineral composition. The results showed that the seed flours of the studied cultivars would represent potential sources in mineral and notably in calcium, copper,potassium and magnesium, the scarcity of which constitute a problem in public health.However, the calcium (45.31-60.77 mg/kg), potassium (264.72-368.51 mg/kg) and magnesium (126.94-182.13 mg/kg) content were lower to thosereported in previously work.Hassimi *et al.* (2007)showed that the seeds of four varieties of Cucurbitaceous in Niger were an important source of potassium (465-1205 mg/100g), calcium (247-569 mg/100g), magnesium (210-289 mg/100g) and phosphorus (30-49.1 mg/100g).According to Olaofe *et al.* (2008), the most important minerals in *Luffacylindrica*were potassium (930 mg/100g) and phosphorus (700 mg/100g).Ocloo *et al.* (2010) reported values 14781 mg/kg (potassium), 3380 mg/kg(magnesium) and 3087 mg/kg (calcium) for Jackfruits (*Artocarpusheterophyllus*) seed flours.The mineral content of three indigenous cucurbit seeds was rich in potassium (500-806 mg/100g), calcium (46-1426 mg/100g) and magnesium (202-366 mg/100g)(Gbogouri *et al.,* 2011).It is interesting to note that the level in copper (336.23-1772.97 mg/kg)of the four studied *C. lanatus*cultivars was relatively much higher than those reported in other varieties of cucurbitaceous (Hassimi *et al.,* 2007; Ocloo *et al.,* 2010).Micronutrients, such as copper, zinc and selenium are essential components of the body's antioxidant defense that play an important role in prevention of free radical-induced damage (Evans and Halliwell, 2001).

Conclusion

Thephysico-chemical properties and mineral compositionof the seed flours were appraised for the four cultivars of *Citrullus lanatus* (Cucurbitaceae) grown in Côte d'Ivoire.

The experimental results reported in this paper revealed that all mineral contents varied significantly ($p \leq 0.05$), whenno significant difference ($p \leq 0.05$) were observed among the cultivar seeds tested in some physico-chemical attributes. However, the hulling of seeds has significant ($p \leq 0.05$) effet on these important components and cultivar *Bebu*seems to be significantly different ($p \leq 0.05$) from other cultivars.

The four cultivar seeds could be potential sources of nutrients mainly of proteins, oils, fiber, carbohydrates and mineral elements (calcium, copper, potassium and magnesium) and thus could be consumed for dietary energy purposes.

It would be interesting, in further investigation, to establish the constituent fatty acids profile of the oil and the amino acids profile of the proteins for the studied seeds in order to appreciate their possible nutritional interest.

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