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Full Length Research Paper

Nutritive value of some Cucurbitaceae oilseeds from different regions in Cameroon

Mercy Bih Achu[1]*, Elie Fokou[1], Clergé Tchiégang[2], Martin Fotso[3], Felicité Mbiapo Tchouanguep[4]

[1]Department of Biochemistry, Faculty of Science, P. O. Box 812, University of Yaounde I, Cameroon.
[2]ENSAI/IUT, Ngaoundere, Cameroon.
[3]CRAN, IMPM, Ministry of Scientific and Technical Research, Yaounde, Cameroon.
[4]Department of Biochemistry, Faculty of Science, University of Dschang, Cameroon.

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The nutritive value of five species of Cucurbitaceae (egusi) seeds from different bio-climatic regions in Cameroon was studied. These seeds are *Cucumeropsis mannii, Cucurbita maxima, Cucurbita moschata, Lagenaria siceraria* and *Cucumis sativus.* The results show that the nutritional value of these seeds does not depend on the climatic region but on the species. Their moisture, crude fibre and ash levels are similar to those of soybean, peanuts, sesame and sunflower seeds, but their carbohydrate levels are lower. The Cucurbitaceae seeds and their defatted cakes are rich in proteins (28 to 40.49 and 61 to 73.59% respectively). They also contain high lipid levels similar to those of the other oilseeds. These seeds can thus be considered as sources of proteins and oils.

Key words*:* Cucurbitaceae, nutritive value, different bio-climatic regions.

INTRODUCTION

Good nutrition is a basic human right. In order to have a healthy population that can promote development, the relation between food, nutrition and health should be reinforced. In developing countries, one of the ways of achieving this is through the exploitation of available local resources, in order to satisfy the needs of the increasing population.

Knowledge of the nutritive value of local dishes, soup ingredients and local foodstuffs is necessary in order to encourage the increased cultivation and consumption of those that are highly nutritive. This consumption will help to supplement the nutrients of the staple carbohydrate foods of the poor who cannot afford enough protein foods of animal origin. Several studies have been carried out in Cameroon including that of Teugwa et al. (1992) who determined the chemical composition of some traditional dishes of the Far North Province of Cameroon (“Gniri/Follèré”, “Gniri/Lalo” and “Gniri/Tasba”, where “Gniri” is millet fufu complemented with soups prepared with different leafy vegetables) and found that these dishes were unbalanced due to excess carbohydrates and shortage of lipids, but with good levels of proteins, minerals and fibres. The authors also indicated that the nutritive value of these meals could be improved by increasing the quantity of vegetable sauce and reducing that of millet fufu per plate. Tchiégang et al. (2000) also analysed the chemical and functional properties of the kernels and defatted cakes of *Ricinodendron heudelotii* and *Tetracarpidium conophorum*, which are two under-exploited oilseeds, largely consumed by the western and coastal populations of Cameroon. They showed that these oilseeds were good sources of lipids and proteins and that their defatted cakes could be used as protein supplement in human nutrition. Also, Ponka et al. (2005) in a study of the methods of preparation and nutritional evaluation of dishes consumed by people living in a rural area, which is a malaria endemic zone in Camerooon

*Corresponding Author.E-mail: lohmercy@yahoo.fr.

(Ngali II), found that a higher consumption of dishes made from leguminous seeds, egusi seeds, green leafy vegetables, and low consumption of tubers, unripe bananas and plantains will lead to a good nutritional balance.

Egusi seeds have also been shown to be highly nutritive. Martin (1998) showed that Cucurbit seeds are possible oil and protein sources for small scale household use in the Hot Humid Tropics. They contain about 50% oil and 35% proteins. Most of the oil is made up of unsaturated fatty acids, thus of high nutritional value. The proteins are mainly of the globulin type and are deficient in lysine and sulphur-bearing amino acids. Their protein efficiency ratios increase with the addition of lysine. Vodouhé and Capo-Chichi (1998) also showed that egusi has a high nutritional value, provides good quality oil and good groundcover. Unfotunately, the crop does not benefit from national or international research activities. Younis et al. (2000) showed that *Cucurbita pepo* seeds are rich in oil, protein, α-tocopherols and carbohydrates The oil contains 4 dominant fatty acids which are palmitic (13.3%), stearic (8%), oleic (29%) and linoleic (47%) acids, with 78% of unsaturated fatty acids. Also, in a preliminary study on egusi seeds carried out by Fokou et al. (2004), it was shown that these seeds are good sources of proteins (especially *C. mannii,* 41.6%), lipids (especially *C. sativus*, 57.34%) and calcium (especially *C. moschata,* 269.67 mg/100 g). In addition to the good nutritional value of these seeds, they are effective soup thickeners and when cooked and dried, can serve as snacks. Moreso, they are less expensive and widely distributed and can therefore be easily cultivated and consumed or sold by the masses.

This work is, therefore, aimed at evaluating the nutritional value of egusi seeds collected from different bio-climatic regions of cultivation in Cameroon. This will aid in the promotion of the use of these seeds in the management of nutrition-related problems in Cameroon in particular, and in Africa in general. It consists of analysing the content in moisture, crude proteins, total lipids, ash, crude fibres and carbohydrates in the whole seeds, and soluble nitrogen and total protein contents in the defatted seeds.

MATERIALS AND METHODS

Collection and treatment of samples

The egusi samples were collected from different bio-climatic regions throughout the country. These regions are Sahel, High Savanna, Rain forest and Swamp forest regions. The seeds; *Cucumeropsis mannii*, *Cucurbita maxima, Cucurbita moschata, Lagenaria siceraria* and *Cucumis sativus*, were bought already dried under local conditions by the sellers (farmers). Where the seeds could not be found, the fruits were bought from the farmers during periods of harvest and the seeds extracted from them, washed, sun-dried and decorticated. These seeds were transported in polythene bags to the laboratory, where they were cleaned with filter paper to remove all traces of dust and insects, dried in an Oven at 100 – 105℃ to constant weight. They were ground in an electric grinder (Blender mill/grater 3), placed in airtight bottles and stored in the dessicator for analysis.

Assays

The moisture content was determined by drying in an oven at 100 – 105℃ to constant weight (AOAC, 1980). The crude protein content was evaluated by digestion of the sample; nitrogen determination by a spectrophotometric method described by Devani et al. (1989) and the crude protein content was obtained by multiplying the quantity of nitrogen by the coefficient 6.25. Total lipids were determined by continuous extraction in a Soxhlet apparatus for 8 h using hexane as solvent, ash by incinerating in a furnace at 550℃, crude fibres by sequential hot digestion of the defatted sample with dilute acid and alkaline solutions and total carbohydrates by difference (AOAC, 1980). The soluble nitrogen was estimated by extraction in trichloroacetic acid and determination of the quantity of nitrogen by the method of Devani et al. (1989) and the total proteins of the defatted samples obtained by calculation. All the analyses were done in triplicate.

Statistical Analyses

The statistical analyses of data were by Analysis of Variance (ANOVA) using 5% level of significance. The statistical package used was SPSS 7.5. The Chi-square test enabled us to see the correlation between the samples and the regions of origin. A One-way ANOVA enabled us to see the significant differences between the nutrients and a t-test done by comparing the samples 2 by 2 was used to locate these differences.

RESULTS AND DISCUSSION

The results of analyses are represented on Tables 1 and 2 below. Table 1 shows the nutritive contents of the whole seeds and Table 2 shows the soluble nitrogen and total protein levels of the defatted seeds. The moisture content is expressed in grams per 100 grams of fresh weight (g/100 g f. w.) and the contents in crude proteins, total lipids, ash, crude fibres and carbohydrates in grams per 100 grams of dry weight (g/100 g d. w.) The soluble nitrogen is expressed in g/100 g of total nitrogen of defatted seeds and total protein content of the defatted seeds is expressed in g/100 g of defatted seed. The moisture contents of these egusi seeds range from 5.65 *(C. sativus*) to 8.21% fresh weight (*C. moschata*) (Table 1). The Chi-Square test revealed that these moisture levels of seeds from the different regions do not depend on the origin of the seeds but on the species ($p<0.05$). The t-test revealed that the moisture level of *C. moschata* is significantly higher than ($p<0.05$) those of the other seeds. The moisture content of *C. lanatus* is 5.7% (FAO, 1970), which is similar to our values and it is quite closed to that of *C. sativus.* These values are also similar to those obtained by Kershaw and Hackett (1987) for other edible oilseeds such as cottonseeds (6.46%), peanuts (4.58%), palm kernel (5.31%), sesame (4.60%), soybean (11.07%) and sunflower seeds (6.58%). They are lower

Table 1. Nutritive content of whole egusi seeds.

Samples	Parameters Regions	Moisture Content (g/100g f.w.)	Protein Content (g/100g d.w.)	Lipid Content (g/100g d.w.)	Ash Content (g/100g d.w.)	Crude Fibre Content (g/100g d.w.)	Carbohydrate Content (g/100g d.w.)
Cucumeropsis mannii	High Savanna	5.43	41.18	47.48	4.21	3.56	3.57
	High Savanna	6.37	40.63	40.76	3.56	3.43	11.61
	High Savanna	6.43	34.64	50.52	3.96	3.56	7.32
	Rain Forest	6.44	41.39	40.33	3.66	5.24	9.38
	Rain Forest	6.73	43.38	41.77	3.11	3.62	8.12
	Swamp Forest	7.54	41.75	48.26	3.92	3.44	2.63
	Average	**6.49 ± 0.62[b]**	**40.49 ± 2.75[a]**	**44.85 ± 4.03[b]**	**3.74 ± 0.35[b]**	**3.81 ± 0.64[b]**	**7.11 ± 3.14[a]**
Cucurbita maxima	High Savanna	4.53	34.64	51.65	3.47	3.61	6.63
	High Savanna	7.04	34.63	49.79	4.11	2.47	9.0
	Rain Forest	9.24	35.52	45.72	4.27	4.25	10.24
	Average	**6.94 ± 1.92[a]**	**34.93± 0.42[b]**	**49.05± 2.48[b]**	**3.95± 0.35[b]**	**3.44± 0.74[b]**	**8.62± 1.50[a]**
Cucurbita moschata	High Savanna	5.71	32.98	53.85	4.36	2.76	6.05
	High Savanna	9.2	29.33	53.06	4.21	4.43	8.97
	Rain Forest	8.66	35.88	41.90	5.13	4.09	13.0
	Swamp Forest	9.29	29.92	54.45	5.3	2.9	7.43
	Average	**8.21± 1.47[a]**	**32.03 ± 2.62[b]**	**50.81± 5.17[b]**	**4.75± 0.47[a]**	**3.54± 0.73[a]**	**8.86± 2.60[a]**
Lagenaria siceraria	Sahel	5.98	34.81	49.01	3.63	3.59	8.96
	High Savanna	6.21	32.74	49.87	3.23	3.81	10.35
	High Savanna	6.35	34.47	49.31	3.74	5.53	6.96
	Swamp Forest	5.83	34.76	52.15	4.10	3.24	5.76
	Average	**6.09±0.20[b]**	**34.19±0.85[b]**	**50.08±1.23[b]**	**3.68±0.31[b]**	**4.04±0.88[b]**	**8.01±1.77[a]**
Cucumis sativus	High Savanna	5.67	25.75	56.13	3.36	3.75	11.02
	High Savanna	7.12	31.08	49.15	3.44	3.45	12.88
	Rain Forest	4.14	29.55	53.83	3.15	4.63	8.84
	Swamp Forest	5.33	25.96	56.53	3.11	3.41	11.0
	Swamp Forest	6.01	31.08	53.14	4.28	5.52	6.32
	Average	**5.65±0.97[b]**	**28.68±2.38[c]**	**53.76±2.64[a]**	**3.47±0.42[b]**	**4.15±0.81[b]**	**10.01± 2.25[a]**

*Each value in the table is a mean of 3 replications.

than those of coconut seeds, 14.3% (FAO, 1982). The low moisture levels of these seeds enable them to be preserved for long periods of time.

The protein contents of the egusi seeds studied range from 28.68 (*C. sativus*) to 40.49% dry weight (*C. mannii*) (Table 1). The seeds of *C. sativus* generally have the lowest protein values while those of *C. mannii* generally have the highest protein values irrespective of the region of cultivation of these seeds (Table 1). Also, the Chi-Square test revealed that the protein contents of these seeds do not depend on the region of origin ($p>0.05$). A One-way analysis of variance shows a significant difference in the protein contents of these seeds. The t-test analysis of the protein contents of the various species shows that the protein content of *C. mannii* is significantly higher than ($p< 0.05$) those of the other seeds. A significant difference is also observed between the protein contents of *C. maxima* and *C. sativus* and between that of *L. siceraria* and *C. sativus.* The protein content of *C. lanatus* (water melon) was shown to be 25.8% (FAO, 1970), which is similar to our values for *C. sativus.* The protein content of *C. moschata* or *C. pepo* was also assayed by Idouraine et al. (1996) to be 34.5 - 44.4%. These values are similar to those of *C. maxima* and *L. siceraria* but higher than the values for *C. sativus* (28.68%) from Cameroon. The results of our seeds also compare well with those obtained by Martin (1998) who showed that cucurbit seeds have 35% of proteins, and those of Vodouhè and Capo-Chichi (1998) who showed that egusi seeds have a protein content of 30-40% comparable to peanuts with a protein content of 23-30%. This value is closed to our estimates for *C. sativus.* The protein contents of cucurbit seeds from Niger were shown by Silou et al. (1999) to be from 13% (*C. lanatus*) to 34% (*C. pepo*). This value of 34% is closed to the values for *C. maxima* and *L. siceraria* while that of 13% is lower than the values for cucurbit seeds from Cameroon. The value for *L. siceraria* from Niger is 16.9%, which is very much lower than that of *L. siceraria* from Cameroon (34.19%). These values are higher than those of other oilseeds as cashew nuts (22.8%), cottonseed (21.9%), and sesame (18.7%) (FAO, 1982). The values are also similar to that of the African pear (25.9%) (Omoti and Okiy, 1987). Protein content of *C. mannii* are similar to that of soybean (40%) by Valnet (1985). On the whole, these egusi seeds are seen to be very rich in proteins especially those of *C. mannii*. This specie can, therefore, be especially good for children, pregnant and lactating mothers and old people who need more proteins in their diet for growth, maintenance and repair of worn out tissues.

The egusi oils extracted are pale yellow in colour while those from melon and pumpkin seeds are green. They are all fluid at room temperature. The lipid contents of these egusi seeds range from 44.85% (*C. mannii*) to 53.76% d.w. (*C. sativus*). A One-way analysis of variance shows a significant difference in the lipid contents of these seeds. A t-test Comparison of the different lipid levels shows the lipid level of *C. sativus* is significantly higher than ($p<0.05$) those of the other seeds. The lipid levels of the rest of the seeds show no significant difference ($p>0.05$). From Table 1, it can be observed that the seeds of *C. mannii* with the highest protein contents have the lowest lipid levels while those of *C. sativus* with the lowest protein levels have the highest lipid contents. As observed with the moisture and protein levels, the lipid levels do not depend on the region of cultivation but on the species as revealed by the Chi-Square test ($p<0.05$). Phillips (1977) showed that the oil content of melon (egusi) seeds is 45-48%, which falls within our range of values. The lipid contents of these egusi seeds are also similar to those obtained for these seeds from Congo (Kinkela and Bezard, 1993). The lipid contents for *C. pepo* and *L. siceraria* are 50.81 and 50.08% respectively, while the values for these two species range from 42-57% as shown by Kinkela and Bezard (1993). Our values are also similar to those obtained by Murkovic et al. (1996) for *C. pepo* seeds with oil content of 41.8-54.9%. Idouraine et al. (1996) also showed that the oil content of *C. pepo* is 34.5-43.6%. These are similar to 44.85% for *C. mannii* but lower than the values for the other seeds from Cameroon. These values too are lower than the value of 59% for egusi, *C. lanatus* (Cherry, 1998) but similar to 50% for cucurbit seeds (melons, squashes, pumpkins) (Martin, 1998). Our values are higher than those for cucurbit seeds from Niger (Silou et al., 1999), which range from 9-34%. The lipid values of these seeds are similar to those of sunflower (45.6%), sesame (53.5%) (FAO, 1982), peanuts (47.5%), but higher than those for soybean (19.1%) (Oyenuga, 1968), the African pear (31.9%) (Omoti and Okiy, 1987) and *Coula edulis* (33.5-36%) (Tchiégang et al., 1998). These egusi seeds generally have high levels of oils and can therefore be considered as good sources of vegetable oils. This can be seen from the works of Kinkela (1990) who showed that oil extracted from egusi seeds is of linoleic type with an average of 68.5% linoleic acid. This high level of polyunsaturated fatty acids in these oils can be very helpful in reducing the level of cardiovascular diseases.

The ash content of the egusi seeds studied ranges from 3.47 (*C. sativus*) to 4.75% d.w. (*C. moschata*). A Chi-Square test also shows that the ash levels of the samples do not depend on the region of origin ($p>0.05$). A one-way analysis of variance shows a significant difference in the ash contents of these seeds. A t-test comparison of the ash levels of the samples shows that the ash level of *C. moschata* is significantly higher than that of the other seeds ($p<0.05$). The highest levels of ash are generally seen in *C. moschata* irrespective of the region of cultivation. These values are lower than the value of 5.1-6.3% obtained by Idouraine et al. (1996) for *C. pepo* seeds. The ash content of the egusi seeds from Niger varies from 2 to 5% (Silou et al., 1999), which is similar to those of egusi seeds from Cameroon. These values are similar to those of peanuts (2.79%), soybean (5.06%) (Oyenuga, 1968), cottonseed (4%), sesame (3.8%) and the sunflower seed (4.1%) (FAO, 1982).

The crude fibre contents range from 3.44% (*C. maxima*) to 4.15% (*C. sativus*). These values too do not depend on the zone of cultivation in Cameroon, but on the species as revealed by Chi-Square analysis. A one-way analysis of variance shows that there is no significant difference ($p>0.05$) between the crude fibre levels of all the samples. These values are similar to those for pumpkin seeds (2%; Platt, 1962). They are also similar to those of soybean (5.17%), peanuts (5.15%) (Oyenuga, 1968), sesame (4.6%) and sunflower (3.4%); but much lower than those of cottonseeds (10.8%) (FAO, 1982), and the African pear (17.9%) (Omoti and Okiy, 1987). These crude fibres, which are made up of cellulose, hemicellulose, pectin and chitin, play an important role in the formation of bulk in the intestines, which stimulates peristalsis and prevents constipation (Uddoh, 1980).

The carbohydrate levels range from 7.11 (*C. mannii*) to 10.01% (*C. sativus*). The values do not depend on the region of cultivation as shown by Chi-Square analysis ($p>0.05$). A one-way analysis of variance shows that there is no significant difference ($p>0.05$) between the carbohydrate levels of all the samples. These values are similar to those of pumpkin seeds (5.05 %) by Health Notes (2001). Our values are also similar to values for pumpkin seeds (10%; Platt (1962) especially *C. sativus.* These values are lower than those of peanuts (18.6 %) (Oyenuga, 1968), cashew nuts (26.2%), coconut (32.7%), cottonseed (46.7%), sesame (20.2%) and sunflower seeds (26%) (FAO, 1982).

The soluble nitrogen contents of the defatted seed range from 4.60 *(C. maxima)* to 8.54% *(C. sativus*) (Table 2). A t-test shows a significant difference ($p<0.05$) between the soluble nitrogen values of *C. sativus* and those of the other seeds. The total protein contents of the

Table 2. Soluble nitrogen and Total protein contents of Defatted Egusi seeds.

Samples	Parameters / Regions	Soluble nitrogen (g/100g of total nitrogen of defatted seed)	Total Protein (g/100g of defatted seed)
Cucumeropsis mannii	High Savanna	6.33	78.38
	High Savanna	6.98	68.6
	High Savanna	8.27	70.0
	Rain Forest	4.19	69.41
	Rain Forest	5.03	74.5
	Swamp Forest	6.33	80.71
	Average	**6.19 ± 1.31 [b]**	**73.59 ± 4.65[a]**
Cucurbita maxima	High Savanna	2.89	71.65
	High Savanna	6.53	69.08
	Rain Forest	4.37	65.42
	Average	**4.60 ± 1.49 [b]**	**68.72 ± 2.56[a]**
Cucurbita moschata	High Savanna	5.1	71.46
	High Savanna	5.21	62.48
	Rain Forest	9.33	61.76
	Swamp Forest	6.04	65.66
	Average	**6.42 ± 1.72 [b]**	**65.34 ± 3.83[a b]**
Lagenaria siceraria	Sahel	5.21	68.18
	High Savanna	7.48	65.31
	High Savanna	10.36	67.98
	Swamp Forest	5.34	72.59
	Average	**7.10 ± 2.09 [b]**	**68.52 ± 2.61[a]**
Cucumis sativus	High Savanna	8.3	58.73
	High Savanna	9.16	61.2
	Rain Forest	7.23	63.94
	Swamp Forest	8.96	59.74
	Swamp Forest	9.05	65.94
	Average	**8.54 ± 0.72a**	**61.91 ± 2.67 [b]**

* Each value in the table is a mean of 3 replications.

defatted egusi seeds range from 61.87 (*C. sativus*) to 73.59% (*C. mannii*) (Table 2). This further shows that the seeds of *C. mannii* are very rich in proteins. A one-way analysis of variance shows a significant difference in the total protein contents of these seeds. The t-test shows a significant difference ($p<0.05$) between the total protein levels of *C. sativus* and those of the other seeds. Generally these defatted seeds are seen to have high protein values. These values are similar to protein values obtained by Sharmer et al. (1986) for the defatted cucurbit seeds, *C. melo* (musk melon) (62.1%), *Citrullus vulgaris* (water melon) (76.1%), *C. moschata* (pumpkin) (73.3%). Lazos (1992) also showed that the defatted seed flours of *C. pepo* and *C. maxima* have potential food use because of their protein content of 61.4%. This value is within our range of values. The total nitrogen content of the defatted cake of *Coula edulis* is 2.1-2.4 (Tchiégang et al., 1998), giving total protein levels of 13.12-15%, which is much lower than the values for egusi seeds.

This work has enabled us to conclude that the nutritive value of egusi seeds from Cameroon does not depend on the bio-climatic region of cultivation but on the species of seed. These seeds can be considered as sources of proteins (especially whole seeds of *C. mannii* and all the defatted seeds), oils (especially *C. sativus*) and minerals (especially *C. moschata).* The seeds of *C. mannii* and the defatted seeds can be used to prepare food for children, pregnant and lactating mothers as well as old people. While those of *C. moschata* can be used in diets to prevent against some mineral deficiencies.

This will aid to fight against malnutrition, especially protein-calorie malnutrition, thus leading to better nutrition and health in Cameroon and Africa as a whole.

Further research is being conducted to study the detailed physicochemical composition of the seeds and oils, the nutritional quality of the proteins and lipids, and the effect of some anti nutritional factors on the quality of the proteins of these seeds.

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