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*Full Length Research paper*

# Macronutrient composition of three cucurbit species cultivated for seed consumption in Côte d'Ivoire

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**Dry seeds from three indigenous cucurbits [*Citrullus lanatus* var. *citroides* (Thumb.) Matsum. & Nakai., *Cucumeropsis mannii* Naudin, and *Cucumis melo* var. *agrestis* L.] largely cultivated in Côte d'Ivoire and consumed as sauce thickeners were analyzed for their proximate composition and compared to a local landrace of peanut (*Arachis hypogae* L.). The protein contents were 29.23±1.74, 36±2.17, 29.55±2.09, and 24.79±0.44% for *C. lanatus*, *C. mannii*, *C. melo*, and *A. hypogaea*, respectively. The highest estimates of fat content was observed with *C. lanatus* (56.67±4.90%) followed in decreased order by the peanut (48.17±1.60%), *C. mannii* (45.89±4.73%), and *C. melo* (42.67±3.43%). The carbohydrate content for *C. lanatus* was 9.87±3.52% and *C. mannii* and *C. melo* had 13.86±3.64 and 23.18±4.80%, respectively. *C. melo* was then the highest in carbohydrate content whereas *A. hypogaea* has the lowest value (6.39±2.66%). The crude fibre contents for *C. lanatus*, *C. mannii*, and *C. melo* averaged 2.87±1.07, 2.30±0.85, and 2.94±0.75%, respectively. The three cucurbit species were markedly low in fibre value, compared to the analyzed peanut (17.14±3.82%). As expected on the basis of several published data, ash content of seeds from indigenous cucurbits was generally low: 1.33±0.52% (*C. lanatus*), 2.50±1.38% (*C. mannii*), and 1.67±0.82% (*C. melo*).**

**Key words:** Ash, carbohydrate, cucurbits, fat (oil), fibre, protein.

## INTRODUCTION

Cucurbits are among the economically most important vegetable crops worldwide and are grown in both temperate and tropical regions (Pitrat et al., 1999; Paris, 2001; Bisognin, 2002; Sanjur et al., 2002). In sub-Saharan Africa, the indigenous species are prized for their oleaginous seeds consumed as thickeners of a traditional soup called *egussi* soup in Nigeria or Benin and *pistachio* soup in Côte d'Ivoire. Cucurbits cultivated for seed consumption are reported to be rich in nutrients (Oyenuga and Fetuga, 1975; Akobundu et al., 1982; Samant and Rege, 1989; Badifu and Ogunsua, 1991; Badifu, 1993; Schafferman et al., 1998; de Mello et al., 2000, 2001), well adapted to extremely divergent agro-ecosystems and various cropping systems characterized by minimal inputs (van Epenhuijsen, 1974; Eyzaguirre, 1995; IPGRI, 2002; El Tahir and Taha Yousif, 2004). Despite their agronomic, cultural and culinary importance, these plants lack attention from research and development so that they are categorized as orphan crops (Chweya and Ezaguirre, 1999; IPGRI, 2002). The limit of proper knowledge, especially of their nutritive value, methods of production, preservation, and utilization, is an important deterrent to their wider production, which should result in food security and increased incomes for peasants.

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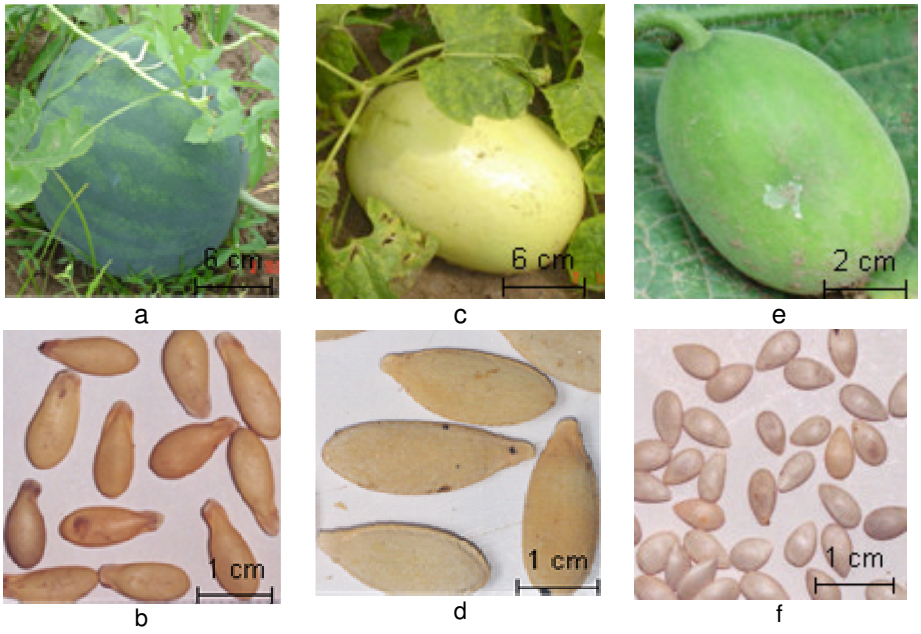


**Figure 1.** Fruit and seeds of *Citrullus lanatus* var. *citroides* (Thumb.) Matsum. & Nakai. (a, b), *Cucumeropsis mannii* Naudin (c, d), and *Cucumis melo* var. *agrestis* L. (e, f).

In the framework of a collaborative project involving Gembloux Agronomical University (Belgium) and University of Abobo-Adjamé (Côte d'Ivoire) and using the main edible-seeded cucurbit species cultivated in Côte d'Ivoire as plant materials, efforts are being developed to collect data allowing the implementation of improved cropping systems. In this context, evaluating the nutritive potentials of the plant materials is of practical interest, since it provides comprehensive data that are useful for breeding scheme implementation and management decisions. The purpose of this paper is to provide data on the nutritive potentials of the three cucurbit species widely cultivated in Côte d'Ivoire for seed consumption. Data are compared to those from a peanut landrace that is their major competitor crop in the target zones.

## MATERIALS AND METHODS

### Plant materials and sample preparation

Three edible-seeded cucurbits [*C. lanatus* var. *citroides* (Thumb.) Matsum. & Nakai., *C. mannii* Naudin, and *C. melo* var. *agrestis* L.] were used (Figure 1). Seeds were obtained from the collection of the University of Abobo-Adjamé (Abidjan, Côte d'Ivoire). The selected plant materials (accessions) were representative of the three agro-ecological zones (South, East, Centre) in which they are regularly cultivated in Côte d'Ivoire. Two accessions were selected per zone, resulting in six samples per species. To obtain sufficient number of seeds, each species was grown during its appropriate cropping season in 2003 at the experimental farm of the University of Abobo-Adjamé (latitude 5°23N, longitude 4°00W, and altitude 7 m). Disease and pest control was carried out using a carbamate-based insecticide applied at emergence, flowering and fruiting period of each species. After harvest, the fruits were split using a machete. The split fruits were placed on the ground with the inner part downward, and covered with a plastic awning until the solid flesh starts to decay. The seeds were then extracted, washed, sun-dried, and shelled manually to obtain the kernels. For each species and each accession, three samples of such kernels weighting about 25 g were used for the analyses. Dried kernels of a peanut (*A. hypogaea* L.) landrace widely cultivated in the target zones were also analyzed for comparison purpose.

### Proximate composition analysis

All determinations were carried out in triplicate, except for peanut (duplicate). This resulted in 18 determinations per nutrient for each cucurbit species (six samples analyzed each in triplicate) and 12 determinations for peanut (six samples analyzed each in duplicate). Kernel moisture contents were measured by the high-temperature oven method: 130°C for 2 h (ISTA, 1996). Crude protein, fat, fibre, and ash were determined on the dry weight basis of kernel samples following the standard methods of Association of Official Analytical Chemists (AOAC, 1980). Carbohydrate was calculated by difference. Total protein was calculated from Kjeldahl nitrogen using a 6.25 conversion factor. Fat fractions were extracted from powered kernel samples in a Soxhlet extractor using diethyl ether as a solvent.

### Statistical analysis

Data were analyzed by one-way analysis of variance procedure of Minitab® statistical package for Windows, version 13 (Minitab, 2000). Differences in means were examined using the least significant difference (LSD) test. Prior to analysis, data on moisture and crude protein were logarithm transformed.

**Table 1.** Proximate composition of kernels from raw seeds of three indigenous cucurbits and a peanut landrace*.

| Composition (%) | Species | | | |
|---|---|---|---|---|
| | ***C. lanatus*** | ***C. mannii*** | ***C. melo*** | ***A. hypogaea*** |
| **Moisture** | | | | |
| Range | 4.90-9.98 | 2.42-7.61 | 6.04-9.02 | 3.77-4.14 |
| Mean (± SD) | 6.43±1.50$^{b}$ | 5.03±1.91$^{a}$ | 7.39±1.03$^{b}$ | 3.94±0.10$^{a}$ |
| **Protein (*N* x 6.25)** | | | | |
| Range | 27.12-32.37 | 32.37-39.37 | 27.12-33.25 | 24.50-25.37 |
| Mean (± SD) | 29.83±1.74$^{b}$ | 36.21±2.17$^{c}$ | 29.55±2.09$^{b}$ | 24.79±0.44$^{a}$ |
| **Fat** | | | | |
| Range | 48.00-66.00 | 34.00-58.00 | 38.00-50.00 | 46.00-50.00 |
| Mean (± SD) | 56.67±4.90$^{c}$ | 45.89±4.73$^{b}$ | 42.67±3.43$^{a}$ | 48.17±1.60$^{b}$ |
| **Carbohydrate**$^{\dagger}$ | | | | |
| Range | 5.68-16.07 | 8.18-23.45 | 12.39-30.05 | 2.71-9.97 |
| Mean (± SD) | 9.87±3.52$^{a}$ | 13.86±3.64$^{b}$ | 23.18±4.80$^{c}$ | 6.39±2.66$^{a}$ |
| **Fibre** | | | | |
| Range | 1.22-4.14 | 0.97-3.41 | 1.46-4.14 | 11.88-23.29 |
| Mean (± SD) | 2.87±1.07$^{ab}$ | 2.30±0.85$^{a}$ | 2.94±0.75$^{b}$ | 17.14±3.82$^{c}$ |
| **Ash** | | | | |
| Range | 1.00-2.00 | 1.00-5.00 | 1.00-3.00 | 2.5-4.8 |
| Mean (± SD) | 1.33±0.52$^{a}$ | 2.50±1.38$^{bc}$ | 1.67±0.82$^{ab}$ | 3.52±0.84$^{c}$ |

*Means ± SD of six samples each analyzed in triplicate (cucurbits) or duplicate (peanut). In a row, mean values followed by the same superscript were not significantly different ($P \geq 0.05$).
$^{\dagger}$Carbohydrate was calculated by difference.

## RESULTS AND DISCUSSION

The results related to the proximate composition of the species analyzed are presented in Table 1**.** The moisture contents differed significantly among the four species ($F = 14.34$; $P < 0.001$). The multiple comparison tests carried out highlighted two groups: the first group containing *C. lanatus* and *C. melo* was higher in moisture content than the second group composed of *C. mannii* and *A. hypogaea*. The moisture estimated in *C. melo* was comparable to the values reported by de Melo et al. (2001) whereas the estimates obtained for *C. lanatus* and *C. mannii* were lower than those reported by Badifu (2001). The differences observed could be attributed to intraspecies variability or the procedures of drying seeds (Enoch et al., 2004; Bankole et al., 2005).

The protein contents averaged 29.23±1.74, 36±2.17, 29.55±2.09, and 24.79±0.44% for *C. lanatus*, *C. mannii*, *C. melo*, and *A. hypogaea*, respectively. Statistical analyses showed that the protein content of the analyzed cucurbit species was significantly higher than this of peanut. Among the cucurbits, the higher value was observed with the kernels of *C. mannii* and no significant difference was found between *C. lanatus* and *C. melo*. The estimates obtained for *C. mannii* and *C. lanatus* were similar to these reported by Badifu (2001) but higher than those published by Samant and Rege (1989) and Badifu (1991). For *C. melo*, similar values were obtained by Samant and Rege (1989). However, our estimates for this species were higher than those obtained with plant materials from Brazil (de Mello et al., 2000, 2001) but lower than certain varieties from Nigeria (Oyenuga and Fetuga, 1975).

The mean fat contents varied from 42.67±3.43 (*C. melo*) to 56.67±4.90 (*C. lanatus*). Statistical test (LSD) highlighted significant difference between the three cucurbit species. We also noted that the fat contents from *C. mannii* and *A. hypogaea* were similar (Table 1). The estimates obtained for *C. lanatus* and *C. mannii* were comparable to the values reported by Oyenuga and Fetuga (1975), Samant and Rege (1989), Badifu and Ogunsua (1991), and Badifu (1991) but higher than these published by Badifu (1993, 2001). The values obtained for *C. melo* were higher than these from studies reported elsewhere (de Mello et al., 2000, 2001). Then, of the three cucurbit species analyzed in this study, *C. lanatus* was higher in fat content, compared to the local landrace of peanut. It is worth noting that we showed from previous investigations (Zoro Bi et al., 2003, 2006) that *C. lanatus* was one of the most widely indigenous cucurbits cultivated and consumed in Côte d'Ivoire. Such results, coupled with results obtained from the present study sug-

gested that this 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.

Carbohydrate contents varied significantly among the four plant species analyzed ($F = 45.46$; $P < 0.001$). The lowest values were observed with *C. lanatus* and *A. hypogaea* and these two species did not differ significantly. The highest estimates were obtained with *C. mannii* (13.86±3.64) and *C. melo* (23.18±4.80) that differed significantly. Similar values were reported for varieties originating from Brazil (de Mello et al., 2000), India (Samant and Rege, 1989), and Nigeria (Onyeike and Acheru, 2002).

Overall, fibre and ash contents calculated for the three cucurbit species were significantly low, compared to this of the local peanut landrace. Any species from the studied cucurbits was particularly higher or low than the others with respect to fibre and ash contents. The results obtained were comparable to those from several studies, highlighting that oleaginous edible-seeded cucurbits are generally low in fibre and ash contents (Oyenuga and Fetuga, 1975; Badifu and Ogunsua, 1991; Badifu, 2001; Onyeike and Acheru, 2002).

## Conclusion

This work represents preliminary investigations devoted to screening three African cucurbit oilseeds for their contents in macronutrients. The study showed that *C. mannii* (36.21±2.17%) was the highest in protein content whereas *C. lanatus* (56.67±4.90%) had the highest value of fat. Concerning carbohydrate and crude fibre, the highest estimates were observed with *C. melo*: 23.18±4.8 and 2.94±0.75%, respectively. With a mean value of 2.50 ± 1.38%, seeds of *C. mannii* presented the highest content in ash. With respect to fat content, *C. lanatus* appeared to be the most potentially valuable indigenous cucurbit, since it was higher than the local peanut landrace that is their major competitor crop in the target zones. This result suggested that investigations aimed at the improved cropping systems implementation should be devoted to *C. lanatus*.

Data obtained from this preliminary study provided opportunities for further researches concerning several points of interest: chemical and physical analyses of oils from the three species, the effect of processing on proximate composition, the contents of kernels in antinutritional and toxic components, and the fatty and amino acids composition of kernels.

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## REFERENCES

Akobundu ENT, Cherry JP, Simmons JG (1982). Chemical, functional and nutritional properties of Egussi (*Colocynthis citrullus*) seed protein products. J. Food Sci. 47: 829-835.

AOAC (1980). Official Methods of Analysis, 12th/Ed. Washington, DC: Association of Official Analytical Chemists.

Badifu GIO (1991). Chemical and physical analyses of oils from four species of Cucurbitaceae. J. Am. Oil Chem. Soc. 68: 428-432.

Badifu GIO (1993). Food potentials of some unconventional oilseeds grown in Nigeria - A brief review. Plant Food Hum. Nutr. 43: 211-224.

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.

Badifu GIO, Ogunsua AO (1991). Chemical composition of kernels from some species of Cucurbitaceae grown in Nigeria. Plant Food Hum. Nutr. 41: 35-44.

Bankole SA, Osho A, Joda AO, Enikuomehin OA (2005). Effect of drying method on the quality and storability of 'egusi' melon seeds (*Colocynthis citrullus* L.). Afr. J. Biotechnol. 4: 799-803.

Bisognin DA (2002). Origin and evolution of cultivated cucurbits. Ciêcia Rural 32: 715-723.

Chweya JA, Ezaguirre PB, eds. (1999). The biodiversity of traditional leafy vegetables. Rome: IPGRI.

de Mello MLS, Bora PS, Narain N (2001). Fatty and amino acids composition of melon (*Cucumis melo* var. *saccharinus*) seeds. J. Food Comp. Anal. 14: 69-74.

de Mello MLS, Narain N, Bora PS (2000). Characterisation of some nutritional constituents of melon (*Cucumis melo* hybrid AF-522) seeds. Food Chem. 68: 411-414.

El Tahir IM, Taha Yousif M (2004). Indigenous melons (*Cucumis melo* L.) in Sudan: a review of their genetic resources and prospects for use as sources of disease and insect resistance. Plant Genet. Res. Newsl. 138: 36-42.

Enoch AD, Ehsan DM, Sognon V, Florent E (2004). Investigating the effects of low input drying procedures on maize (*Zea mays* L.), cowpea (*Vigna unguiculata* L.) and bambara groundnut (*Vigna subterranea* (L.) Verdc.) seed quality in Benin. Plant Genet. Res. Newsl. 140: 1-8.

Eyzaguirre PB (1995). *In situ* conservation and sustainable use of minor vegetable and fruit species. In: Engels JMM (ed) *In situ* conservation and sustainable use of plant genetic resources for food and agriculture in developing countries. Bonn-Röttgen. IPGRI/DSE, pp 104-116.

IPGRI (2002). Neglected and underutilized plant species: strategic action plan of the International Plant Genetic Resources Institute (IPGRI), Rome: IPGRI.

ISTA (1996). International rules for seed testing. Seed Science and Technology, vol 24. Supplement Rules.

Minitab (2000). Minitab statistical software. Minitab Inc., Sales (USA).

Onyeike EN, Acheru GN (2002). Chemical composition of selected Nigerian oil seeds and physicochemical properties of the oil extracts. Food Chem. 77: 431-437.

Oyenuga VA, Fetuga BL (1975). Some aspects of the biochemistry and nutritive value of watermelon seeds (*Citrullus vulagaris* Schrad). J. Sci. Food Agric. 26: 843-854.

Paris HS (2001). Characterization of the *Cucurbita pepo* collection at the newe Ya'ar research center, Israel. Plant Genet. Res. Newsl. 162: 41-46.

Pitrat M, Chauvet M, Foury C (1999). Diversity, history and production of cultivated cucurbits. Acta Hort. 492: 21-28.

Samant SK, Rege DV (1989). Carbohydrate composition of some cucurbit seeds. J. Food Comp. Anal. 2: 149-156.

Sanjur OI, Piperno DR, Andres TC, Wessel-Beaver L (2002). Phylogenetic relationships among domesticated and wild species of

*Cucurbita* (*Cucurbitaceae*) inferred from a mitochondrial gene: implications for crop plant evolution and areas of origin. Proc. Natl. Acad. Sci. 99: 535-540.

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

Van Epenhuijsen CW (1974). Growing native vegetables in Nigeria, Rome: FAO.

Zoro Bi I, Koffi KK, Djè Y (2003). Caractérisation botanique et agronomique de trois espèces de cucurbites consommées en sauces en Afrique de l'Ouest : *Citrullus* sp., *Cucumeropsis mannii* Naudin et *Lagenaria siceraria* (Molina) Standl. Biotechnol. Agron. Soc. Environ. 7: 189-199.

Zoro Bi IA, Kouamé KK, Djè Y, Malice M, Baudoin J-P (2006). Indigenous cucurbits of Côte d'Ivoire: a review of their genetic resources. Sci. Nat. 3: 1-9.