Original Research Article

~~Nutritional value and Amino acid profile of dried *Cucumeropsis mannii* Seeds~~Nutritional value and amino acid profile of dried seeds of *Cucumeropsismannii* (Cucurbitaceae)

Abstract

Aims:to assess the biochemical, phytochemical and amino acid profile of the flour from dried seeds of *Cucumeropsismannii* grown in Côte d'Ivoire (West Africa).

Study design: Experimental

Place and duration of study: Sample:Laboratory of Nutrition and Food Security, NanguiAbrogoua University

Methodology: *Cucumeropsismannii* seeds were obtained for this study from an experimental field in Gagnoa (Côte d'Ivoire). In March 2022, seeds were planted and after 7 months, the mature fruits that lead to the complete drying of the plant were harvested.

Results: The biochemical composition of the seeds revealed that they contain varying proportions of carbohydrates, fibers, ash, total sugars with contents of 9.28 ± 0.79 %; 2.72 ± 0.30 %; 3.12 ± 0.38; 2.34 ± 0.05, respectively. High levels of lipids, proteins, dry matter and energy were observed in seed flour with values of 47.46 ±1.55 %; 31.80 ± 1.16 %; 94.38 ± 0.6 %; 591.46 ± 1.17 kcal /100 g DM. The resulting flour reached a pH of 6.5. The study of phytochemicals showed varying levels of oxalate (0.32 g/100g DM), tannins (3.02 g TAE/ 100g DM), total polyphenols (8.12 mg GAE / g DM), total flavonoids (27.5 mg QE/g DM) and carotenoids (2.9 µg/100g DM). Furthermore, they were potential sources of essential amino acids, including histidine (905.6 mg/100g), isoleucine (844.5 mg/100g), threonine (730.1mg/100g), phenylalanine (550.0 mg/100g), valine (469.9 mg/100g), leucine (456.6 mg/100g), and methionine (358.5 mg/100g).

Conclusion: The overall result implies that *Cucumeropsismannii* seeds could be added to the food preparations of malnourished children.

Key words: C*ucumeropsismannii*, phytochemicals, amino acids, lipids, protein

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Comment [Rev.2]: Please provide details of the most important conclusions of your work. One sentence is not enough!

1. INTRODUCTION

Agriculture is the basis of human development and could be an appropriate solution to the worldwide food shortage particularly in the developing countries. Today, recommendations from institutions and organisations, including the FAO, to increase the productivity and quality of the agricultural sector in developing countries focus on underutilised crops [1]. Among these are the cucurbits, which are plants with a high content

of balanced protein and are cheap compared to animal protein.Indeed, the Cucurbitaceae are a remarkable family of plants that deserve attention for their multiple economic, cultural, medicinal and botanical importance. In some cultures, the seeds, leaves and roots are consumed. According to some studies, the seeds are rich in lipids, proteins and carbohydrates [2, 3]. Cucurbits have also been overlooked; however, underutilised plants in Africa are suitable for a wide range of agro-ecosystems and cropping systems [1]. Research by Zoro et al [4] identified five species of cucurbits in Côte d'Ivoire, including *Cucumeropsismannii*. Known as the white-seeded melon, commonly called "n'vièle" in Côte d'Ivoire [4], it originates from tropical Africa, where it is prized for its oilseeds, grown for food and as a source of oil. However, *C.manni* seeds are still underexploited due to scientific ignorance about their nutritional potential. This research aims to determine the nutritional characteristics of *C.mannii* seeds grown in Côte d'Ivoir

2. MATERIAL AND METHODS

2.1. ~~vegetable~~ Plant material

The biological material for this study was *Cucumeropsismannii* seed which come from an experimental field in the locality of Gagnoa(Côte d'Ivoire).

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2.2. Preparation of simples

Cucumeropsismannii was harvested at leaf wilt to indicate fruit maturity and ripening. The latter underwent a hemispherical cut and were left to decompose for one or two weeks, until the pulp softened to facilitate the extraction of the seeds. The seeds were then separated from the fruit pulp, washed with water and dried in the oven at 45°C for 3 days. They were manually peeled and the almonds were finely ground to obtain powders that will be sieved (250 µm diamater) and put in plastic bags for storage before the analysis tests.

2.3. Chemical Analysis

The pH of the dried seed powder was determined according to the method described in AOAC [5]. The AOAC method [6] was used to determine the moisture content after drying at 105°C for 24 hours to constant weight and the total ash content was determined by incinerating in a 550°C furnace. The AOAC method [6] was again used to determine crude fibre, and fat extraction in a Soxhlet apparatus for 8 hours using hexane for the determination of lipid content; while Nitrogen was done by Kjeldahl method and crude protein content subsequently calculated by multiplying the nitrogen content by a factor of 6.25. Ethanol-

soluble sugars from *Cucumeropsismannii* powder were extracted using the technique described by Martinez-Herrera et al., [7]; then total sugars were determined by Dubois *et al.* [8] using phenol and sulphuric acid. Available carbohydrate levels were determined using the difference method described by FAO [9] as following:

Total carbohydrate (%) = 100 % - [(%)moisture + (%) protein + (%) fat + (%) fibre + (%) ash)]

The theoretical energy value was determined using the method outlined by Atwater and Rosa [10] from the specific coefficients for proteins, lipids and carbohydrates as following:

Energy value (Kcal/100g DM) = 4 x (%) protein + 9 x (%) lipids + 4x (%) carbohydrates

2.4. Antinutrients Analysis

Tannin were determined as reported by Bainbridge *et al.* method [11]. The principle of the assay is based on the fact that tannic acid in the presence of vanillin (0.1 mg/mL) and 70% of sulphuric acid gives a red coloration when the absorbance was measured at 500 nm. The tannins content of *C. mannii* was expressed as tannic acids equivalent (TAE). while oxalate and carotenoids were defined as indicated by AOAC [6] and FAO [12] respectively. Total polyphenols were measured according to Makkar *et al.*, [13]; Cicco *et al.*, [14] using the Folin Ciocalteu reagent. The absorbance is measured at 725 nm in the spectrophotometer and the results of polyphenols content were subsequently calculated as Gallic acid equivalent (GAE). As for flavonoids, they were determined as described by Meda *et al*. [15] using Quercetin as standard. The absorbance was measured at 415 nm; then flavonoid content of *C. mannii* was expressed as Quercetin equivalent (QE).

2.5. Amino acid analysis

The amino acid composition of sample was determined using a high-performance liquid chromatograph (HPLC), Applied Biosystems Model 172 A (AppleraCoporation, Foster City, California, USA) equipped with a RP-18 PTC column (2.1mm 22cm). Prior to injection, the proteins in sample were previously hydrolyzed by HCL 6 M with phenol (1%) at 150°C for 60 minutes in the Pico-Tag system (Waters, Milford, Mass., U. S.A.) The amino acid phenylisothiocyanate derivatives obtained were eluted by HPLC. Sodium acetate (105Mm,

PH 4.6; 30%) and acetonitrile (70%) were used as elution buffers. A calibration chromatogram was established for the standard available amino acids.

2.6. Statistical analysis

Statistical analysis of the data was performed using Statistical version 7.1 software package.All measurements were carried out in triplicate. Differences between means were separated using Student test with the least significance difference fixed at 0.05. ~~Statistical analysis of the data was performed using Statistical version 7.1 software package.~~

3. RESULTS AND DISCUSSION

3.1. Proximate composition

The proximate composition of *Cucumeropsismannii* seed flour was shown in table 1. The percentage protein of 31,80 ± 1,16 was comparable to the value reported for melon seeds (31.1 %) and squash seeds (33.0 %) [16] but lower than the results of *C. mannii* seeds (37.4-37.9 %) in Nigeria [17, 18]. Studies proved that, proteins were essential macronutrients for humans, with a key role in building and repairing the body [19]. The crude fibre of *C. mannii* seed (2.72 %) in this study was similar than those reported by Ogunbusola*et al*., [17] and peanut seeds [20]. Adequate intake of crude fiber might have a helpful physiological role such as low incidence of colon cancer [21]. However, this low fibre content of powders from *Cucumeropsismannii* seeds suggests that it would not be sufficient to meet the estimated human fibre needs of 14.2-17.5 g/day [22]. As a result, it should be combined with other fiber-rich dietary sources to prevent various chronic diseases [23]. The moisture content of *C. mannii* seed (5.62 ± 0,6 %) was also similar to 5.53 ± 0,35 % [17], for *C. mannii* in Nigeria and previously comparable to 5.01 ± 0,01 reported by Mohaammed*et al*., [24]) in *Cucurbita maxima*. This low moisture content showed that the quality of this powder could protected it against the development of microorganisms. Indeed, according to Aryee *et al*. [25], the moisture content is a very important parameter in the storage of flours, since a moisture content greater than 12 % would promote the growth of microorganisms. *Cucumeropsismanii* powder showed a slightly acidic pH of 6.50, which certifies that the powder could be stored for as long without risk of deterioration. With respect to the lipid content of *C. manni* seeds, studies indicated a relatively high level (47.46 %) comparable to those reported by Ogunbusola*et al*. [17] (45.06 ± 1.25 - 48.57 ± 0.76 %). Thus, *C. mannii* seeds could be classified as oilseeds that can be used as a source of vegetable oil for industrial and domestic purposes. The ash content (3.12 ± 0.38 %) was lower for the values reported for *Benincasa*

hispida seeds (5.02- 11.81 %)[26] but similar to *M. oleifera* seeds (3.5 %) [18]. Therefore, *Cucumeropsismannii* seeds could provide minerals essential to the proper functioning and development of the body. Concerning available carbohydrates content (9.28 ± 0.79 %), the rates investigated in this study were higher than those of *C. manni* (5.7 %) [18]) of the Congo and *C. ecirrhosus* seeds (18.69 ± 0.82 %) from Nigeria [27]. The energy value of *Cucumeropsismannii* powder (591.46 ± 1.17 Kcal/ 100 g DM) was comparable with *C. ecirrhosus* seeds (601.7 Kcal/100g) [27]; almost lower to that of peanut paste (626 Kcal/100g) [28]; but higher with those reported for *Cucurbita maxima* (438.84 ± 0.07 Kcal/100g DM) [24] in Nigeria. The low level of total sugars (2.34 ± 0.05 %) observed was similar to that of *Citrullus lanatus* (2.23 %) from N'guetta *et al*., [29]. This suggests that *Cucumeropsismannii* powder is a poor source of total sugars.

Table 1: Pproximate analysis of*Cucumeropsismannii* seeds flour

Parameter	**values**
Moisture (%)	5.62 ± 0.60
pH	6.50 ± 0.00
Ashes (%)	3.12 ± 0.38
Protein (%)	31.80 ± 1.16
Lipids (%)	47.46 ± 1.55
Crude Fiber (%)	2.72 ± 0.3
Carbohydrates (%)	9.28 ± 0.79
Total sugars (%)	2.34 ± 0.05
Energie value (Kcal/100g DM)	591.46 ± 1.17

Values represent the mean ± standard deviation of three measurements (n = 3)

3.2. Phytochemical compound

Table 2 shows the result for the anti-nutrient composition of *Cucumeropsismannii* flour seeds. The total polyphenols in *Cucumeropsismannii* powder (8.12 mg/g) in this study were lower than those of *Cucumeropsismannii* (0.39 %) [30] in Cameroon. High polyphenols could increase the chelation capacity of these phenols and make nutrients and minerals in

particular unavailable. Tannins have antioxidant, anti-mutagenic and anti-cancer properties ~~anti-oxidant properties, antimutagenic and anti-cancer activities~~ [31].

The tannin content of *Cucumeropsismannii* powder (3.02 g/100g) was higher than those reported by Ogunbusola*et al*., [17] with *Cucumeropsismannii* (15.4 mg/100g) and *Cucumeropsis edulis* (4.69-29.11 mg EC/100g DM) obtained by Yété*et al*., [32]. However, they remain well below the recommended limit values of 1 mg/100 g DM, which influence protein bioavailability [33]. According to Kataria *et al*., [34], heat treatments of cooking reduce the level of tannins and denature insoluble tannin-nutrient complexes. A research by Gülçin*et al.*, [35] opined that tannins provided neuroprotective, cardioprotective and even antitumoral activities. Levels of flavonoids in this study were also lower than *Cucurbita maxima* (46.05 %) and *Citrullus lanatus* (41.57 %) seeds [36]. This concentration of flavonoid powder from *Cucumeropsismannii* could protect the body from oxidative stress-related diseases, coronary artery disease and cancer [37]. The carotenoid (2.9 µg/100g DM) content was lower that the value recorded by Okorie [38] in white melon seed flour (Nigeria). It implies that the flour of *Cucumeropsismannii* can reduce the risk of cardiovascular disease [39].

Table 2 : Anti-nutrients composition of *Cucumeropsis mannii* seeds flour

Parameter	Values
Flavonoïdes totaux (mg QE/g DM)	27.51 ± 0.03
Polyphénols totaux (mg GAE/g DM)	8.12 ± 0.09
Tanins (g TAE/100g DM)	3.02 ± 0.80
Oxalates (g/100g DM)	0.32 ± 0.02
Caroténoïdes (µg/100g DM)	2.9 ± 0.11

Values represent the mean ± standard deviation of three measurements (n = 3); DM: dry matter; Quercetin equivalent (QE); Gallic acid equivalent (GAE);tannic acids equivalent (TAE)

3.3. Amino acid profiles

The amino acid content for*Cucumeropsismannii* seeds flour (table 3) indicated that histidine, leucine, isoleucine, methionine; phenylalanine, threonine, valine, aspartate, alanine, glycine, ~~acide~~acid? glutamate, tyrosine, serine and arginine were presents. In addition, the amino acids profile of *Cucumeropsismannii* seeds flour showed that it contained both essential and non-essential amino acids; which would confirm that these proteins were of high quality.

However, lysine has not been identified. Results have shown that aspartic acid (968.1mg/100g) was the most abundant of non- essential amino acids in melon seeds flour; while histidine (905.6 mg/100g) was the most abundant essential amino acids. the findings were similar to those of some authors who suggest that aspartic acid and glutamic acid were the most abundant amino acids in legume and nuts [40]. Essential amino acids were known for their significant physiological role in childhood growth [41]. Indeed, the proportion of arginine and histidine and over amino acids indicated that the seeds of *Cucumeropsismannii* may be useful in formulating weaning food [42]. Some amino acids, such as phenylalanine, leucine, aspartate, serine, arginine and tyrosine, have been said to have anti-sickling properties [43]. Researchers further explained that the anti-sickling effect of certain amino acid such as phenylalanine may be as a result of its anti-oxidative effects and also its ability to remove free radicals [44]. Results from this study would confirm that *Cucumeropsismannii* proteins includes a significant proportion of essential amino acids. They could address children's and adult's protein needs in both developed and developing countries.

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Table 3: Aamino acids composition of *Cucumeropsismannii* seed flour

Amino acid	Values (mg/100g)
Histidine	905.6 ± 0.03
Isoleucine	844.5 ± 0.11
Leucine	456.6 ± 0.01
Méthionine	358.5 ± 0.04
Phénylalanine	550.0 ± 0.10
Thréonine	730.1 ± 0.02
Valine	469.9 ± 0.05
Aspartic acid	968.1 ± 0.06
Alanine	840.3 ± 0.32
Glycine	787.3 ± 0.22
Glutamic acid	771.3 ± 1.12
Tyrosine	769.4 ± 0.14
Serine	617.7 ± 0.27
Arginine	254.2 ± 0.33
Total essential amino Acids (ΣEAA)	616.45 ± 0.05

Total non Essential amino Acids (ΣNEAA)	715.47 ± 0.32

Values represent the mean ± standard deviation of three measurements (n = 3)

4. CONCLUSION

~~*Cucumeropsis mannii* seeds investigated in this study contained high percentage of nutrients such as proteins and lipids making them a good source of energy for human nutrition. The result of this finding also showed appreciate quantities of tannins, flavonïds and polyphenols. In addition, the presence of affordable quantities of tannins and carotenoids, would represent a major nutritional asset because of their antioxidant power. However, *C. manni* seeds contained also a valuable source of essential amino acids that could provide important health benefits. It might be appreciated for animal and human nutrition.~~

The *Cucumeropsismannii* seeds investigated in this study contained a high percentage of nutrients such as proteins and lipids, making them a good source of energy for human nutrition. The result of this finding also showed the presence of appreciable amounts of tannins, flavonoids and polyphenols. In addition, the presence of affordable quantities of tannins and carotenoids would represent a major nutritional asset because of their antioxidant power. However, *C. manni*seeds also contain a valuable source of essential amino acids, which could provide important health benefits. This could make them valuable for animal and human diets.

Statement of informed consent

Every participant in the study gave their informed consent.

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