International Journal of Science Academic Research
Vol. 04, Issue 08, pp.6127-6131, August, 2023
Available online at http://www.scienceijsar.com
ISSN: 2582-6425

Research Article

CHEMICAL ANALYSIS OF FLOURS OF THE SEED KERNEL OF *CUCUMIS MELO* L. AND *CUCUMEROPSIS MANNII* NAUDIN CULTIVATED IN THE PORO REGION, NORTH OF CÔTE D'IVOIRE

[1, *]Libra Michel Archange, [2]Koné Daouda and [1]Assoi Sylvie

[1]Laboratory of Biotechnology and Valorization of Agroressources and Natural Substances,
University Peleforo Gon Coulibaly, PO Box 1328 Korhogo Côte d'Ivoire
[2]Laboratory of Biocatalysis and Bioprocessing, UFR of Sciences and Food Technologies,
University Nangui Abrogoua, PO Box 02 BP 801 Abidjan Côte d'Ivoire

Received 25th June 2023; **Accepted** 19th July 2023; **Published online** 30th August 2023

Abstract

This current study aimed to determine the proximate composition, anti-nutritional factors, and mineral composition of *Cucumis melo* and *Cucumeropsis mannii* seed kernels cultivated in the Poro region, in northern Côte d'Ivoire. The protein content of the kernel flour was found to be high, with 31.93 ± 0.01% for *Cucumis melo* and 45.36 ± 0.15% for *Cucumeropsis mannii*. The crude fiber and the ash content were 4.62 ± 0.76% and 1.58 ± 0.01% for *Cucumis melo* respectively, and 4.03 ± 0.88% and 2.15 ± 0.01% for *Cucumeropsis mannii* as well. Polyphenolics, tannins, and phytate content of *Cucumis melo* were 65.52 ± 0.50 mg GAE/100 g, 12.26 ± 0.39 %, and 37.41 ± 0.56 % respectively while for *Cucumeropsis mannii* they were 91.44 ± 0.16 mg GAE/100 g, 21.60 ± 0.75 % and 37.15 ± 0.46 % respectively.Flours of the seed kernel of *Cucumis melo* and *Cucumeropsis mannii* are rich sources of macro elements such as Calcium (2549.00 ± 0.57 - 2492.00 ± 2.00mg/100 g), potassium (1879.00 ± 1.00 - 1891.00 ± 1.00mg/100 g), phosphorous (620.00 ± 1.00 - 656.66 ± 5.77 mg/100 g), Magnesium (373.00 ± 1.00 – 370.33 ± 0.57mg/100 g) as well as microelements namely zinc(19.11 ± 0.00 - 15.02 ± 0.00 mg/100 g), and iron (9.03± 0.00 - 8.39 ± 0.00 mg/100 g). This research study highlights the nutritional value of flours produced with *Cucumis melo* and *Cucumeropsis mannii* seed kernels and thus provides useful data that could serve as the basis for their incorporation in food formulation.

Keywords: *Cucumis melo* L. and *Cucumeropsis mannii* Naudin, kernels, seeds, Korgogo

INTRODUCTION

Melons such as *Cucumis melo and Cucumeropsis manni* are cucurbit crops that belong to the family of Cucurbitaceae represented by 21 genera. The genus of Cucurbita contains 960 species (Milind & Satbir, 2011; Jeffrey, 1978). Nowadays, sixty-five cucurbit species are known in West Africa among which twelve are cultivated (Zoro Bi *et al*. 2003). In Côte d'Ivoire, five domesticated species have been described namely *Cucumeropsis mannii*, *Cucumis melo*, *Citrullus lanatus*, *Cucurbita pepo*, and *Lagenaria siceraria* (Djè Bi *et al.,* 2011; Zoro Bi *et al*. 2003). *Cucumeropsis mannii* and *Cucumis melo* are the most economically important species widely grown in the savannah region of Côte d'Ivoire, especially in the Poro region. The cultureof cucurbits is generally practiced by the women mostly to getthe seeds which are locally named "*Tahou*" in Senoufo, "*Lilleu*" in Bété, and "*Wrê-wrê*" in Baoulé. The cucurbit seeds are usually planted, during the rainy season between the months of April and July, in association with maize, groundnut, and potato. During their growth, the plants produce climbing vines up to 4m long and bear small yellow male and female flowers with less than centimeter-long petals. The shape of the cucurbit fruits is either anegg-like shape or an elongated oval-like shape, up to about 19 cm long and 8 cm wide. The fruits are cream in color with green streaks and generally need three to four months to mature before harvesting (Loukou *et al*., 2007). Seeds are usually collected from the matured fruits.

Corresponding Author:** ***Libra Michel Archange,
Laboratory of Biotechnology and Valorization of Agroressources and Natural Substances, Peleforo Gon Coulibaly University of Korhogo, PO Box 1328 Korhogo Côte d'Ivoire.

Thus, after being separated from the flesh, the seeds are washed with tap water, dried, shelled, and winnowed to collect the kernels. In Cote d'Ivoire, these kernels are generally consumed during feats and ceremonies of rejoicing. They are crushed and turned into a paste for soup preparation. These seeds contain high amounts of oil and therefore are used for vegetable oil extraction. Studies have shown that cucurbit seed oil contains a high level of monounsaturated fatty acids (Oleic acid), polyunsaturated fatty acids (linoleic acid), phytosterols, and antioxidants. These characteristics make the seed oil a remarkable therapeutic potential for human health (Libra *et al*., 2022; Lemus-Mondaca *et al*., 2019; Diaz *et al*., 2004).Besides their high oil content, cucurbits seeds contain proteins, carbohydrates, and mineral elements (Loukou *et al.,* 2007; Gbogouri *et al*., 2011; Salifou *et al*., 2016). This present study was conducted to assess the physicochemical parameters of *Cucumis melo* and *Cucumeropsis mannii* cultivated in Korhogo located in northern Côte d'Ivoire. This study will shed light on the nutritive value of the seed and therefore help intensify the cultivation of these Cucurbitaceae and therefore which in turn will help increase the productivity, consumption, and sale of these seeds especially in rural areas where agriculture is the main occupation for women. This increase would not only help improve their income but also generate more job and thus alleviate poverty.

MATERIALS AND METHODS

Biological material

The biological material used in this study was the seed kernel of *Cucumis melo* L and *Cucumeropsis mannii* Naudin.

Methods

Sample preparation
Collection of the melon's fruits

Melon fruits (*Cucumis melo* and *Cucumeropsis mannii* Naudin) were collected from a farm located in Korhogo in the northern part of Côte d'Ivoire.

Obtaining seeds kernels

After the collection of the melon, the fruit was treated as mentioned by (Libra *et al*., 2022). Briefly, the fruits were cut horizontally and heaped for 6 to 7 days to allow the separation of the seeds from the flesh. The collected freed seeds were washed with plenty of water to remove dirt and immature seeds. The matured seeds were then collected and sun-dried for three days. The seeds were shelled and then winnowed to separate the kernels from the coats. The kernels were oven-dried at 45°C for 48 hours, ground into flour with a kitchen grinder (Moulinex, France), and stored in hermetic bags at 4°C until use.

Proximate analysis

Crude fat was determined following the AOAC (2005) method. Fat from the kernels flour was exhaustively extracted with anhydrous hexane using a soxhlet apparatus. Nitrogen was determined by the Kjeldahl method (AOAC, 2005), and the crude protein content of the kernels was calculated by multiplying the nitrogen content by 6.25. Ashcontent was determined by measurement of residues left after combustion in a furnace at 550ºC for 8 h (AOAC, 2005).

Anti-nutritional factors analysis
Extraction of phenolic compounds

Phenolic compounds were extracted according to the method described by Mallek-Ayadi (2019). An aliquot of 2 mL of *n*-Hexane and 4 mL of a solution of methanol/water (60:40) were homogenized with 4 g of kernels flour sample. After vigorous mixing, the suspension was centrifuged at 1490 x g for 3 min. The extraction was performed twice, and the hydro-alcoholic phases were pooled together. The hydro-alcoholic fraction was washed with 4 mL of *n*-Hexane to eliminate the residue of oil, concentrated, and dried à 35°C using a rotary evaporator.

Total phenol

The total phenolic compounds of the kernels were determined using Folin Ciocalteu reagent according to Yoo et *al*. (2004) method. An aliquot of 2.5 mL of 1/10 Folin Ciocalteu reagent was added to 5 mL of the extract. The mixture was stirred and kept for 3 min in the dark. Then 1.5 mL of 20 % Na_2CO_3 was added. The mixture was then shaken and incubated at room temperature in the dark for 30 min. The absorbance was measured at 517 nm using a spectrophotometer (Shimadzu, Japan). Gallic acid was used as a standard and the results were expressed as mg Gallic acid equivalents per 100 g of extract (mg GAE/100 g extract).

Phytic acid

Phytic acid was determined according to the method describes by Zebib *et al.* (2015). This method consists of adding 0.25 g of flour of yam to 12.5 mL of hydrochloric acid 3%. The whole was placed for 45 min in a water bath at 30 ˚C then centrifuged at 4000 rpm for 10 min. 4 ml of FeCl3-6H2O was mixed with 10 ml of the supernatant solution and the formed ferric-phytate precipitate was analyzed for phosphorus phytate by measuring the absorbance at 822 nm using a spectrophotometer.

Tannins

Tannins Tannins are proportioned by the method of Trease and Evans (1978). 1 mL of methanolic extract was treated with 5 mL reagent of Folin-Dennis in basic medium. The content of tannins was given using a curve standard built starting from a range of concentration of gallic acid.

Mineral analysis

Minerals were analyzed by the method reported by Oshodi (1992). The ash obtained from 1g of sample was dissolved in 10% HCl, filtered, and made up to standard volume with deionized water. The flame photometry method reported by AOAC (2005) was used to determine the sodium and potassium contents of the sample. Calcium, Fe, Mg, Zn, Cu, and Mn were determined using Atomic Absorption Spectrophotometer (AAS). Phosphorus was estimated calorimetrically (UV-visible spectrophotometer, Model DR 2800/United States).

STATISTICAL ANALYSIS

All experiments were performed in triplicate and the results were expressed as the mean values and standard deviation. One-way analysis of variance (ANOVA) was used to determine significant differences among means and Tukey's test was used to perform multiple comparisons among means using Statistica software (version 7.1). The significance level was defined as $p < 0.05$.

RESULTS AND DISCUSSION

Proximate composition

The proximate composition of the kernels of *Cucumis melo* and *Cucumeropsis mannii* seeds is shown in table 1. The results show that *Cucumis melo* and *Cucumeropsis mannii* seed kernels contained 95.56 ± 0.54% and 96.14 ± 0.02% of dry matter content respectively. No statistical difference ($p > 0.05$) was observed between the both species. This similarity of values may attribute to the dehydration process during seed drying. The protein contents of the kernels and of were 31.93 ± 0.01% and 45.36 ± 0.15% for *Cucumis melo* and *Cucumeropsis mannii* respectively. Protein content is statistically ($p < 0.05$) higher in *Cucumeropsis mannii* than *Cucumis melo*. These values were found to be higher than 36.31 ± 2.17% and 29.55 ± 0.03% obtained by Loukou (2007) for *Cucumeropsis mannii* and *Cucumis melo* respectively but closer to values (34.64-41.18%) reported by Achu (2005) for *Cucumeropsis mannii* collected from high savanna region of Cameroon. The protein contents of the both *Cucurbitaceae* varieties studied were above 30% indicating that they are rich sources of proteins. Therefore, they may be able to provide enough proteins for the nutritionally vulnerable, especially children, pregnant and lactating mothers, as well as old people who need adequate proteins in their diet for proper growth, maintenance and repair of worn out tissues (Williams, 2005). It also suggests that the *Cucurbitaceae* varieties studied are capable of providing enough proteins that could be added to staples that are poor in proteins and/or some of the amino acids. The total fiber and ash content were 4.62 ± 0.76% and 1.58 ± 0.01% for *Cucumis melo* respectively, 4.03 ± 0.88% and 2.15 ± 0.01% for *Cucumeropsis mannii* respectively. The total fiber and ash contents of both species are comparable to those of several previous studies, which indeed showed that seeds of edible cucurbits are generally low in fiber and ash (Acar *et al.,* 2012; Oyeleke *et al.*, 2012).

Table 1. Proximate composition of *Cucumis melo* and *Cucumeropsis mannii* seed kernel flours

Parameters (%)	*C. melo*	*C. mannii*
Dry matter	95.56 ± 0.54^b	96.14 ± 0.02^a
Proteins	31.93 ± 0.01^b	45.36 ± 0.15^a
Total fiber	4.62 ± 0.76^a	4.03 ± 0.88^a
Ash	1.58 ± 0.01^b	2.15 ± 0.01^a

Values are Means ± SD (standard deviation) of three determinations. In the same row, mean values followed by the same letter (superscript) are not significantly different (P < 0.05).

Anti-nutritional factors composition

Anti-nutritional factors are substances or chemical compositions found in fruits, seeds, cereals and legumes that reduce the nutrient utilization and/or food intake. Therefore, it is important to have knowledge of their level in food because they can adversely affect human health. Results presented in Table 3 showed that the seed kernels of *Cucumeropsis mannii* contained statistically (p < 0.05) higher amount of the total polyphenolics and tannins but similar amount of phytate with the seed kernels of *Cucumis melo*. The total polyphenolics content of the seed kernels of *Cucumis melo* and *Cucumeropsis mannii* were found to be 6.55 ± 0.50 mg GAE/100 g and 9.14 ± 0.16 mg GAE/100 g respectively. These values were lower than that stated for *Cucumis melo* L seeds oil (22.63 mg GAE /100 g) (Mallek-Ayadi *et al*., 2019). Indeed, the higher amount of total polyphenols ensures the stability of oilseed oils by protecting them against oxidation. They are not only responsible for the color of the seed kernels but also play a role in the resistance of the seeds against bacterial attacks (Dixon & Paiva, 1995; Paiva, 2000). Tannins are phenolic compounds formed in the fruits, seeds, leaves and bark of plants (Timotheo and Lauer 2018). In fruits,they imports an astringent taste that affects palatability, reduce food intake and consequently body growth. Also, tannins are known to inhibit the activities of digestive enzymes and nutritional effects of tannin are mainly related to their interaction with protein. Tannin protein complexes are insoluble and the protein digestibility is decreased thus leading to a reduction in the bioavailability of essential amino acids (Raes *et al.,* 2014; Lampart-Szczapa *et al.,* 2003; Carnovale *et al*., 1991).One of its properties is that they can precipitate proteins and affect their digestibility, thus leading to a reduction in the bioavailability of essential amino acids (Raes *et al.,* 2014; Lampart-Szczapa *et al.,* 2003). The tannins content of seed kernels of *Cucumis melo* was1.22 ± 0.39 % while that of seed kernels of *Cucumeropsis mannii*was 2.16 ± 0.75 %. Results showed that seed kernelsof the both cucurbits species are very rich in tannins and therefore strategies to reduce them to safe level should be implemented. Indeed, tannins levels in the range of 5 to 9% have been reported to reduce fiber digestibility due to inhibition of the rumen bacterial activity thus leading to reduce feed intake and mortality (Nawab *et al*., 2020). These authors recommended soaking these unconventional feeds for 24h before their use in feed formulation. Phytate content of seed kernels of *Cucumis melo* (3.74 ± 0.56 %) was closer to value obtained with seed kernels of *Cucumeropsis mannii* (3.71 ± 0.46 %). The values of this study were higher than value (2.48 mg/100g) reported by Ogunbusola and its collaborators (2012) for *Cucumeropsis mannii* seed flours. However, the value obtained in *Cucumis melo*seed kernels was lower to that reported by Ijarotimi *et al*. (2022). Phytates or phytic acids are naturally present in the plant kingdom. Due to its negatively-charged structure, they chelate bivalent cationic mineral elements such as Ca^{2+}, Mg^{2+} and Fe^{2+} thus making them metabolically unavailable to the human and animal organism. Therefore, the low phytate content obtained from seed kernels of *Cucumis melo*and *Cucumeropsis mannii* suggests them to be good source of food to man and its animal especially in the feeds formulation Bello *et al*. (2008).Therefore feed formulated with unconventional feedstuffs should be supplemented with enzymes to improve the bioavailability of nutrients (Fang *et al*., 2022; Samtiya *et al.,* 2020; Chan *et al*., 2007). Moreover, processing techniques such soaking and fermentation which are cost effective and efficient to improve the nutritional value could be implemented to reduce the phytate content the seed of *Cucumeropsis mannii* and *Cucumis melo* (Duodu *et al*., 2018).

Table 2. Anti-nutritional factors composition of *Cucumis melo* and *Cucumeropsis mannii* seed kernel flours

Parameters (%)	*C. melo*	*C. mannii*
Total phenols (mg GAE/100g)	6.55 ± 0.50^b	9.14 ± 0.16^a
Tannins	1.22 ± 0.39^b	2.16 ± 0.75^a
Phytates	3.74 ± 0.56^a	3.71 ± 0.46^a

Values are Means ± SD (standard deviation) of three determinations. In the same row, mean values followed by the same letter (superscript) are not significantly different (P < 0.05).

Mineral composition

Table 4 reports the macro-elements (P, K, Ca, Mg, and Na) and micro-elements (Fe, Cu, Mn and Zn) analyzed in the kernels, and it could be noticed that the levels of these minerals varied significantly in the seeds of the two varieties. Elevated levels of macro-elements such as calcium (Ca) and potassium (K), as well as micro-elements such as sodium (Na) and zinc (Zn) were found in the almonds of the two varieties. As compared to seed kernel of *Cucumis melo* (Ca: 2549 ± 2.00 mg/100 g; K: 1879 ± 1.00mg/100 g), *Cucumeropsis mannii* seed kernels contained lower amount (2942.00 ± 2.00 mg/100 g) of calcium but higher amount of potassium (K) (1891 ± 1.00mg/100 g).

Table 3. Minerals composition of flours of the seed kernels of *Cucumis melo* and *Cucumeropsis mannii*

Parameters (mg/100g)	*C. melo*	*C. mannii*
Macroelements		
Phosphorus	620.00 ± 1.00^b	656.66 ± 5.77^a
Potassium	1879.00 ± 1.00^b	1891.00 ± 1.00^a
Calcium	2549.00 ± 2.00^a	2492.00 ± 2.00^b
Magnesium	373.00 ± 1.00^a	370.50 ± 0.57^b
Sodium	12.50 ± 0.00^b	18.36 ± 0.00^a
Microelements		
Iron	9.03 ± 0.00^a	8.39 ± 0.00^b
Cupper	4.47 ± 0.00^b	4.87 ± 0.00^a
Manganese	3.9 ± 0.00^b	8.69 ± 0.00^a
Zinc	19.11 ± 0.00^a	15.02 ± 0.00^b

Values are Means ± SD (standard deviation) of three determinations. In the same row, mean values followed by the same letter (superscript) are not significantly different (P < 0.05).

The calcium values obtained in this study were greater than the value reported by Gbogouri and collaborators (2011) for the seeds of *Cucumis melo* (1426.00 ± 50.10 mg /100 g) whereas the values for potassium (K) were in close agreement with the results reported by Karaye *et al*. (2021). Moreover, the seed kernels of *Cucumeropsis mannii* was richer in phosphorus (P) (656.66 ± 5.77 mg/100 g) and sodium (Na) (18.36 ± 0.00 mg/100 g) but contained lowest magnesium (Mg) (370.33 ± 0.57 mg/100 g) when compared to the seed kernel of *Cucumis melo* (P: 620 ± 1.00 mg/100 g; Mg: 373 ± 1.00 mg/100 g; Na: 12.50 ± 1.00 mg/100 g). As far as the micro-elements are concerned, higher value of zinc (Zn: 19.11 ± 0.00 mg/100 g) and lower value of zinc (Zn: 19.11 ± 0.00 mg/100 g) were observed in the seed kernels of *Cucumis melo* than in the seed kernels of *Cucumeropsis mannii* (Zn: 15.02 ± 0.00 mg/100 g). Micro-element like iron (Fe), manganese (Mn) and cupper (Cu) were also found at various levels in seed kernels of the two varieties, and *Cucumis melo* tended to possess more of these elements than *Cucumeropsis mannii* variety. Results reported in this study for the macro and micro-elements did not agree with the results reported by Steiner-Asiedu *et al*. (2014) and Mgbemena *et al.* (2019). Indeed, low levels were found for the seed kernels of *Cucumis melo* and *Cucumeropsis mannii* and the seed kernels of *Irvingia gabonensis* and *Irvingia wombolu*. This study revealed that the *Cucumis melo* and *Cucumeropsis mannii* seed kernels could be considered as good sources of macro and micro-elements and could therefore be suggested for infant food formulation.

Conclusion

This study revealed that the seed kernels of *Cucumis melo* and *Cucumeropsis mannii* are rich in protein and can therefore be considered as potential sources of protein. The study also revealed that the seed kernels contain fiber and mineral elements with an appreciation level. They also contain anti-nutrients like total polyphenols, tannins and phytates. Thus, this study provided useful data on *Cucumis melo* and *Cucumeropsis mannii* seed kernels suggesting their incorporation in food formulation.

REFERENCES

Acar R., Özcan M., Kanbur G. and Dursun N.,"Some Physico-Chemical Properties of Edible and Forage Watermelon Seeds",*Iran Journal of Chemistry and Chemical Engineering,* 31(4) 41-47.December 2012.

Achu, BM, Fokou, E, Tchiégang, C, Fotso, M. and Tchouanguep, FM,"Nutritive value of some cucurbitaceae oilseeds from different regions in Cameroon",*African journal of Biotechnology*, 4(11). 1329-1334. 2005.

AOAC. Official Method of Analysis, eighteenth edition. Association of Official Analytical Chemists, 18th edition, Washington DC, USA.2005.

Carnovale, E., Marletta, L., Marconi, E. and Brosio, E.,"Nutritional and hydration properties in cowpea", In Ng NQ, Monti LM (Eds.), Cowpea genetic resources, International Institute of Agriculture (IITA), Ibadan, 111-118. 1991.

Chan, SS., Ferguson, EL., Bailey, K., Fahmida, U., Harper, TBand Gibson, RS, "The concentrations of iron, calcium, zinc and phytate in cereals and legumes habitually consumed by infants living in East Lombok, Indonesia", *Journal of Food Composition and Analysis*, 20(7). 609–617.November 2007.

Dixon, RA and Paiva, NL. Stress-induced phenylpropanoid metabolism. Plant Cell, 7(7). 1085-1097.July 1995.

Djè Bi IR, Koffi KK, Baudoin J-P, Zoro Bi IA,"Effet de la saison de culture et de la densité des plants sur les adventices et la production de la cucurbite oléagineuse *Citrullus Lanatus* (Thunberg) Matsum & Nakai (Cucurbitaceae)",*Sciences & Nature*, 1(1), 85-93. Août 2011.

Duodu, CP, Adjei-Boateng, D., Edziyie RE, Agbo NW, Owusu-Boateng G., Larsen B K and Skov PV,"Processing techniques of selected oilseed by-products of potential use in animal feed: Effects on proximate nutrient composition, amino acid profile and antinutrients", *Animal Nutrition*, 4(4). 442-451.December 2018.

Fang, C., Yu, Q., He, J., Fang, R. and Wu S, "Phytase Supplementation of four non-conventional ingredients instead of Corn enhances phosphorus utilization in yellow-feathered broilers", *Animals*, 12(16), 2096: 2-10.August 2022.

Gbogouri, GA, Brou, K., Linder, M., Tehrany, EA, Gnakri, D. and Zoro-Bi, IA, "Comparative study of physicochemical and thermal properties of the seeds oils of three cucurbit species", *International Journal of Biological and Chemical Sciences*, 5(3), 1165-1171.June 2011.

Ijarotimi, OS, Wumi-Adefaye, OA, Oluwajuyitan, TD, Oloniyo, OR, "Processed white melon seed flour: Chemical composition, antioxidant, angiotensin-1-converting and carbohydrate-hydrolyzing enzymes inhibitory properties", *Applied Food research*, 2(1), 1-9.June 2022.

Karaye, LA, Hayatu, M, Mustapha, Y, Sani, LA,"Nutritional an ant-nutritional properties of the seeds of six selected Nigerian cucurbit germplasm", *Journal of plant Development*, 8, 139-150.December 2021.

Lampart-Szczapa, E., Siger, A., Trojanowska, K., Nogala-Kalucka, M., Malecka, M., and Pacholek, B, "Chemical composition and antibacterial activities of lupin seeds extracts", *Food/Nahrung*, 47(5), 286–290.October 2003.

Libra, MA, Diby NA, Assoi, S, Dué, AE and Kouamé LP,"Characterization Characterization of Oils Extracted from Shelled Seeds and Seed Coats of Two Species of Cucurbitaceae Cultivated in Korhogo, North of Côte d'Ivoire" *International Journal of Food and Nutritional Sciences,* 11(5), 7-16.July 2022.

Loukou, AL, Gnakri, D., Djè Y., Kippré, AV, Malice, M., Baudoin, J-P and Zoro Bi, IA,"Macronutrient composition of three cucurbit species cultivated for seed consumption in Côte d'Ivoire", *African Journal of Biotechnology*, 6 (5), 529-533.March 2007.

Mallek-Ayadi, S., Bahloul, N., and Kechaou, N., "*Cucumis melo* L. seeds as a promising source of oil rich in biologically active substances: compositional characteristics, phenolic compounds and thermal properties", *GRASAS Y ACETTES*, 70 (1), 1-10. March2019.

Mgbemena, NM, Ilechukwu, I, Okwunodolu, UF, Chukwurah, OV, Lucky, BI, "Chemical composition, proximate and phytochemical analysis of *Irvingia gabonensis* and *Irvingia wombolu.* Ovidius", *University Annals of Chemistry*, 30(1), 65-69. June 2019.

Milind, P. and Satbir, K., "Is bottle gourd a natural guard?"*International Research Journal of Pharmacy* 2(6), 13-17.June 2011.

Nawab, A., Tang, S., Gao, W., Li, G., Xiao, M., An, L., Wu, J. and Liu, W., "Tannin supplementation in animal feeding; Mitigation strategies to overcome the toxic effects of tannins on animal health", *A review. Journal of Agricultural Science*, 12(4), 217-230. March 2020.

Ogunbusola, ME, Fagbemi, NT and Osundahunsi, F., "Chemical and functional properties of full fat and defatted white melo (Cucumeropsis mannii) seed flours", *Journal of Food Science and Engineering*, 2, 691-696.December 2012.

Oshodi, AA,"Proximate composition, nutritionally valuable mineral and functional properties of Adenopus breviflorus benth seed flour and protein concentrate", *Food chemistry*, 45(2), 79-83.September 1992.

Oyeleke, GO, Olagunju, EO,"Functional and Physicochemical Properties of Watermelon (Citrullus Lanatus) Seed and Seed-Oil", *Journal of Applied Chemistry*, 2 (2), 29-31.October 2012.

Paiva N.,"An introduction to the biosynthesis of chemical used in Plant-microbe communication", *Journal of Plant growth Regulation*, 19(2), 131-143.July 2000.

Raes, K., Knockaert, D., Struijs, K. and Van Camp, J.,"Role of processing on bioaccessibility of minerals: Influence of localization of minerals and antinutritional factors in the plant", *Trends in Food Science & Technology*, 37(1), 32–41.May 2014.

Salifou A., Alidou, C., Tchobo, PF, Barea B. and Soumanou, MM, "Agronmic evaluation and quality characteristics of three Cucurbitaceae varieties acclimated in Benin", *African Journal of Biotechnology*, 15(44) 2524-2529.November 2016.

Samtiya, M., Aluko, RE, and Dhewa T., "Plant food anti-nutritional factors and their reduction strategies: an overwiew", *Food Production, Processing and Nutrition*, 2(6) 14 p. March 2020.

Steiner-Asiedu, M, Nuro-Ameyaw, P., Agbemafle, I., Hammond, HS and Tano-Debrah, K.,"Nutrient composition and protein quality of flour species of the Curcubitaceae family". *Advance Journal of Food Science and Technology*, 6(7), 843-851.July 2014.

Timotheo, CA, and Lauer, CM, 'Toxicity of vegetable tannin extract from Acacia mearnsii in Saccharomyces cerevisiae", *International Journal of Environmental Science and Technology*, 15(3), 659–664.July 2018.

Trease, EG, Evans, WC "*Pharmacognosy*' 11th Edition, Balliere Tindall, London, 115-222. 1978

Williams, MH, *Nutrition for Health, Fitness and Sports*. 7th Edition, McGraw Hill, New York, 2005, 208-240.

Yoo, KM., Lee KW, Park, JB., Lee, HJ and Hwang, IK,"Variation in major antioxidants and activity of Yuzu (Citrus Junos Sieb ex Tanaka) during maturation and between cultivars", *Journal of Agriculture and Food Chemistry*, 52(19), 5907-5913.September 2004.

Zebib H., Geremew Bultosa G. Abera S. "Physico-Chemical Properties of Sesame (Sesamum indicum L.) Varieties Grown in Northern Area, Ethiopia". *Agricultural Sciences*, 6, 238-246. February 2015.

Zoro Bi, IA., Koffi, KK., Djè, Y., "Caractérisation botanique et agronomique de trois espèces de Cucurbites consommées en sauce en Afrique de l'Ouest : Citrullus sp., Cucumeropsis mannii Naudin et Lagenaria siceraria (Molina) Standl", *Biotechnologie, Agronomie, Société et Environnement,* 7 (3-4) 189-199.Octobre 2003.

****