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Evaluation of the nutritional and anti-nutritional factors composition of the seed coats of two species of Cucurbitaceae (*Cucumis melo* L. and *Cucumeropsis mannii* Naudin) for their possible use in animal feed formulation

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Abstract
Seed coats wastes produced during processing of Cucurbitaceae seed for human diet could be used in animal feed, and their value relies on their nutritional content. High dry mater (86.60 ± 0.54-87.26 ± 0.30%), carbohydrate (23.32 ± 0.36-25.19 ± 0.78%), protein (10.06 ± 0.01-18.81 ± 0.01%), lipid (14.51 ± 0.28-18.86 ± 0.86%), fibers (51.48 ± 0.24-60.87 ± 1.51%) and glutamic acid (5.65 ± 0.00-6.44 ± 0.00) were found in the seed coat of *cucumis melo* and *Cucumeropsis mannii*. Moreover, the high level of total phenolic content (150.30–207.36 mg GAE/100 g) may reveal important antioxidant properties of the seed coat. Levels of macro-elements such as Phosphorus (326.66 ± 15.27-400.00 ± 10.00 mg/100g), potassium (1931.44 ± 2.64-2206.00 ± 2.64 mg/100g), calcium (2941.00 ± 1.00-3596.00 ± 0.57mg/100g) and magnesium (54.50 ± 1.00-329.33 ± 0.57 mg/100g), and also micro-elements such as Iron (8.35 ± 0.00-9.50 ± 0.00 mg/100g), copper (4.54 ± 0.00-5.14 ± 0.00 mg/100g), manganese (5.71 ± 0.00-5.87 ± 0.00 mg/100g), sodium (14.21 ± 0.00-17.93 ± 0.00 mg/100g) and zinc (19.11 ± 0.00-24.57 ± 0.00 mg/100g) displayed the potential of the seed coats as mineral source. The presence of anti-nutrient like tannins (43.63 ± 0.48-57.73 ± 0.97%) and phytate (15.51 ± 0.51%) may be reduced to safe level through fermentation, autoclaving and soaking before feeds formulation. This study displayed the variability in the nutritional and anti-nutritional factors contents of the seed coats obtained from the *cucumis melo* and *Cucumeropsis mannii*.
Vegetable waste, when properly managed, could provide a source of feed for animal thus reducing feeding cost and in this regards seed coat of Cucurbitaceae seed might be an alternative.

Keywords: Seed coats, cucurbitaceae, composition, anti-nutritional factors, feed

Introduction
Cucurbitaceae is an important family comprising one of the most genetically diverse plant food groups. They are annual herbaceous plants widely cultivated in the word (Schippers, 2004) [1]. Nowadays, sixty-five cucurbit species are known in West Africa among which twelve are cultivated (Zoro Bi *et al*. 2003) [2]. In Côte d'Ivoire, five domesticated species have been described: *Cucumeropsis mannii*, *Cucumis melo*, *Citrullus lanatus*, *Cucurbita pepo* and *Lagenaria siceraria* (Djè Bi *et al.*, 2011; Zoro Bi *et al*. 2003) [3, 2]. Cucurbit species are grown for their seeds which play a fundamental role in the development of civilizations by supplying food, natural products, and traditional medicines. Mature seeds of *Cucumeropsis manii* and *Cucumis melo* are ovate with pointed ends, flat or slightly curved when viewed from the edge. The seed coat is the outer covering of every mature seed. The seed coat allows the preservation of the integrity of the seed parts, the protection of the embryo against mechanical injuries and attacks of pests and diseases, as well as the regulation of gaseous exchanges between embryo and the external environment. The coat also contributes to seed morphology (Dübbern de Souza & Marcos-Filho, 2001) [4]. Its structure and composition differs among species and varieties (Moïse *et al.*, 2005) [5]**.** The seeds are removed from the flesh usually fruits by cutting horizontally and heaped for 6 to 7 days so that the seeds can be freed from the flesh. The free seeds were washed with plenty of water to remove dirt and matured seeds were collected and

then sun-dried for three days (Libra *et al*., 2022) [6]. Before consumption, the seeds are roasted and shelled to free the seed coat from the kernel. Kernels were then ground and utilizing as ingredient in "Pistachio soup" while seed coats were wasted. Several studies have shown that the kernels of seeds of *Cucumeropsis manii* and *Cucumis melo* are an excellent source of vegetable oil with significant health-promoting properties due to their unsaturated fatty acid profile and high content of dietary protein (Okwundu *et al*., 2021; Rabadán *et al*., 2020; Foku *et al.*, 2009; Nyam *et al*., 2009; Loukou *et al*., 2007) [7, 8, 9, 10, 11]. However, there is limited information in the chemical composition of seed coats of *Cucumeropsis manii* and *Cucumis melo.*

Knowledge of the nutritional composition will lay ground for the appropriate use of this waste mostly as animal feed. Indeed, to reduce the feed cost, many farmers usually use unconventional feedstuffs in their feed formulations. Therefore, this research was carried out to examine the nutrient and anti-nutrient compositions of the seed coats of *Cucumis melo* L and *Cucumeropsis manii* with the view of their inclusion in animal feed formulation

The aim of this study is to evaluate the proximate composition, amino acids profile, anti-nutritional factors and mineral content of *Cucumis melo* L and *Cucumeropsis manii* seed coats so as to provide information on its nutritional values for animal feed.

Material and methods

Biological material

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

Methods

Sample preparation

Collection of the melons fruits

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

Obtaining shelled seeds and seed coats

After collection of the melon, 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 seed. The matured seeds were then collected and sun-dried for three days. The seeds were shelled and then winnowed to separate the shelled seeds from the coats. The seed coats were oven-dried at 45°C for 72 hours, grounded into powder 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) [12] method. Fat from the seed coat powder was exhaustively extracted with anhydrous hexane using a soxhlet apparatus.

Crude fiber was determined according to the gravimetric method described by Van Soeest (1963) [13].

Nitrogen was determined by the Kjeldahl method (AOAC, 2005) [12], and the crude protein content of the seed coat was calculated by multiplying the nitrogen content by 6.25.

Ash content was determined by measurement of residues left after combustion in a furnace at 550ºC for 8 hours (AOAC, 2005) [12].

Total carbohydrate content was obtained by difference based on this equation: 100 - (Moisture content + Crude protein content + Crude fats content+ Ash content).

Energy (calories) was calculated after multiplying the mean values of protein, lipid and carbohydrate by their respective Atwater factors of 4, 9 and 4 (Udosen, 1995) [14].

Extraction of phenolic compounds

The extraction of phenolic compounds was conducted according to the method described by Mallek-Ayadi (2019) [15]**.** An aliquot of 2 mL of *n*-Hexane and 4mL of a solution of methanol/water (60:40) were homogenized with 4 g of seed coat 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 seed coast were determined using Folin Ciocalteu reagent according to Yoo *et al*. (2004) [16] 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).

HPLC analysis of phenolic composition

To identify and quantify the phenolic compounds of the seed coat, commercial standards (Sigma-Aldrich, USA) were used. To an aliquot (50 mL) of the previously prepared phenolic extract, distilled water was added to get a final volume of 100 mL.

Stock solutions of the various standards was prepared at a concentration of 1 mg/mL and stored in methanol. An intermediate solution containing each of the standards was prepared in methanol for the calibration curve. A stock solution of cinnamic acid, used as internal standard (1 mg/mL), was also prepared and stored in methanol. All the standard stock solutions were filtered through 0.45 µm membrane filter and stored at -20 °C.

For the HPLC analysis, an aliquot of 100 µl of cinnamic acid (1 mg/mL) (internal standard) was added to 100 µl of seed coats oil extract. Samples were passed through a 0.45 µm membrane filter before injection.

For the quantitative evaluation of the phenolic compounds of the seed coat, a High Performance Liquid Chromatography (HPLC) analysis was performed. To an aliquot of 100 µl of the seed coat extract, 100 µl of the internal standard (cinnamic acid) was added. Before any injection, all the samples prepared were filtered using a 0.45 µm membrane filter.

The HPLC (Shimadzu Corporation, Japan) system unit used in this study was equipped with a binary pump (LC-6A) coupled to a UV-VIS detector (SPD-6A). Phenolic compounds were separated on ICSep-ICE ORH-801 column of 25 cm length at a temperature set at 30 °C. The mobile phase consisted of 50 mM $NaH_4H_2PO_4$ at pH 2.6 (eluent A), a solution of acetonitrile / $NaH_4H_2PO_4$ (0:20, v/v) (eluent B) and 200 mM acid O-phosphoric at pH 1.5 (eluent C). The operating time was 70 min with a flow rate of 1 mg/min. Phenolic compounds in methanolic extract of the seed coat of

Cucumeropsis mannii and *Cucumis melo* samples were identified through comparison of their retention times and UV-visible spectra with those obtained by injection of the standard solution under the same conditions. The peak area was used for quantitation purposes, using external calibration with standards.

Amino acids content

The amino acids content in the samples was determined by HPLC using an analytical HPLC system unit (Shimadzu Corporation, Japon) in conjunction with a column heating device set at 35°C with the aid of an oven Meta Therm TM (Interchrom, France) and a 40 cm x 5 µm ions exclusion column ICSep ICE ORH-801 (Interchom, France). The system was also coupled to a pump (Shimadzu LC-6A Liquid Chromatograph), an UV detector (Shimadzu SPD-6A UV Spectrophotometric Detector), and an integrator (Shimadzu Chromatopac CR 6A). Elution was carried out isocratically with sulphuric acid (0.04 N) at a solvent flow rate of 0.6 ml/min and detection was performed at a wave length of 210 nm. The chromatograms obtained indicate amino acids peaks corresponding to the magnitude of their respective concentrations. Quantification was performed by comparing the peak area of each amino acid in the sample to the area of the corresponding amino acid standard.

Mineral analysis

Minerals were analyzed by the method reported by Oshodi (1992) [17]. The ash obtained from 1g of sample was dissolved in 10% HCl, filtered and made up to standard volume with deionized water. Flame photometry method reported by AOAC (2005) [12] was used to determine sodium and potassium contents of the sample. Calcium, Fe, Mg, Zn, Cu, and Mn were determined using Atomic Absorption Spectrophotometer (AAS). Phosphorus was estimated colorimetrically (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 seed coat of *Cucumis melo* and *Cucumeropsis mannii* is shown in table 1. No statistical difference ($p > 0.05$) was observed in the dry matter content of the seed coat of *Cucumis melo* (86.60 ± 0.54%) and that of *Cucumeropsis mannii* (87.26 ± 12.74%). Seed coat of *Cucumis melo* was richer in carbohydrates (13.38 ± 0.36%) than the seed coat of *Cucumeropsis mannii* (8.49 ± 0.78%). Moreover, these values were higher than those reported by Steiner-Asiedu (2014) [18] for *Cucumis melo* (3.11 ± 0.74%) and *Cucumeropsis mannii* (7.65± 0.25%) kernel flours. The protein (10.06 ± 0.01%) and lipid (14.51 ± 0.28%) contents of the seed coat of *Cucumis melo* were statistically ($p < 0.05$) lower than the protein (18.81 ± 0.01%) and lipid (18.66 ± 0.86%) contents of the seed coat of *Cucumeropsis mannii*. The seed coat of the two Cucurbitaceae contained less protein and lipid than the seed kernel reported by Achu (2005) [19] and Steiner-Asiedu (2014) [18]. However, these contents were higher than the values reported for the tubers of some African yam bean (Konyeme *et al.*, 2020) [20] and cassava (Bayata, 2020) [21]. Therefore, the incorporation of the seed coat of *Cucumis melo* and *Cucumeropsis mannii* in animal feed could constitute an undeniable source of proteins and lipids. Ash and fiber contents of the seed coat of *Cucumis melo* and *Cucumeropsis mannii* were statistically different ($p < 0.05$). *Cucumis melo* seed coat contained less ash (1.35 ± 0.00%) but more fiber (60.87 ± 0.24%) than the seed coat of *Cucumeropsis mannii* which contained 2.36 ± 0.00% and 51.48 ± 1.51% of ash and fiber respectively. Similar results were reported by Loukou *et al.* (2007) [11] as regards to the ash content of these Cucurbitaceae. The energy value of the seed coat of *Cucumis melo* (467.57 ± 3.44 Kcal) was is significantly lower ($p < 0.05$) than that of *Cucumeropsis mannii* seed coat (484.90 ± 5.01 Kcal) meaning that *Cucumeropsis mannii* seed coat would generate higher energy upon consumption.

Free amino acids composition

The results from the HPLC analysis are presented in Table 2. The major amino acids identified in the seed coat were glutamic acid and proline. Statistically higher value of glutamic acid ($p < 0.05$) was obtained with the seed coat derived from *Cucumis melo* variety (6.44 ± 0.00 g/100 g) than with that derived from *Cucumeropsis mannii* (5.65 ± 0.00 g/100 g). However, these values were lower than the one indicated by Hassan *et al.* (2009) for the seed of *Cucurbita pepo* L (13.10 g/100 g). The amino acid proline was not detected in the seed coat of *Cucumeropsis mannii* but its content in the seed coat of *Cucumis melo* was about 5.14± 0.00 g/100 g. This value was higher than the proline content (2.18 g/100 g) found in the seed of *Cucurbita pepo* L (Hassan *et al.*, 2009) [22]. Others amino acids such as serine and valine were also found in the seed coat of the two varieties but at very low levels. The seed coat of *Cucumis melo* variety contained more of these amino acids ($1.95\ 10^{-2}$ ± 0.00 and $9.75\ 10^{-2}$ ± 0.00 g/ 100 g) than the seed coat of the *Cucumeropsis mannii* variety ($8.56\ 10^{-3}$ ± 0.00 and $8.83\ 10^{-4}$ ± 0.00 g/100 g). Moreover, arginine ($1.78\ 10^{-2}$ ± 0.00 g/100 g) and methionine ($8.82\ 10^{-4}$ ± 0.00 g/100 g) were only found, at very low levels, in the seed coat of the *Cucumeropsis mannii* variety.

Anti-nutritional factors composition

Anti-nutritional factors, when present in animal feed or water, can reduce the availability of one or more nutrients. Therefore, it is important to have knowledge of their level in feed because they can adversely affect the health of the animal. Results presented in Table 3 showed that the seed coats of *Cucumis melo* variety contained statistically ($p < 0.05$) higher amount of the total phenolic compounds, tannins but lower amount of phytate than the seed coats of the *Cucumeropsis mannii* variety. The total polyphenolics content of the seed coats of *Cucumis melo* and *Cucumeropsis mannii* were found to be 207.36 ± 0.96 mg GAE/100 g and 150.30 ± 0.44 mg GAE/100 g. These values were higher than that stated for *Cucumis melo* L seeds oil (22.63 mg GAE /100 g) (Mallek-Ayadi *et al.*, 2019) [15]. 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 coat but also play a role in the resistance of the seeds against bacterial attacks (Dixon & Paiva, 1995; Paiva, 2000) [23, 24]. The tannins content of the

seed coats of *Cucumis melo* variety was 57.73 ± 0.97% while that of the seed coats of *Cucumeropsis mannii* variety was 43.63 ± 0.48%. Results showed that the seed coats of *Cucumis melo* and *Cucumeropsis mannii* 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) [25]. These authors recommended soaking these unconventional feeds for 24h before their use in feed formulation. Phytate content of the seed coat of *Cucumis melo* (15.51 ± 0.51%) was lower than that of the seed coat of *Cucumeropsis mannii* (26.67 ± 0.37%). The values of this study were higher than value (2.48 mg/100g) reported by Ogunbusola and its collaborators (2012) [26] for *Cucumeropsis mannii* seed flours. However, the value obtained in *Cucumis melo* seed coat was closer to that reported by Ijarotimi *et al*. (2022) [27]. Phytate has the ability to 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 feed formulated with unconventional feedstuffs should be supplemented with enzymes to improve the bioavailability of nutrients (Fang *et al*., 2022) [28]. 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) [29].

Phenolic compounds

The phenolic contents of the seed coats of *Cucumis melo* and *Cucumeropsis mannii* are presented in table 4. Tannin H_2O, tannin-OH, gallic acid, caffeic acid, catechin and hydroquinone were found at different levels in the seed coat of the two varieties. Among these compounds, hydroquinone level was the highest, and seed coats of *Cucumis melo* contained more hydroquinone (1885 ± 0.10 mg/100 g) than that of *Cucumeropsis mannii* (1095.33 ± 0.57 mg/100 g) ($p < 0.05$). Moreover, seed coats of *C. melo* was also richer in gallic acid (35.44 ± 0.00 mg/100 g) than the seed coats of *Cucumeropsis mannii* (21.80 ± 0.00 mg/100 g). However, in the seed coat of *Cucumeropsis mannii*, the levels of catechin (199 ± 0.00 mg/100 g) and caffeic acid (54.50 ± 0.00 mg/100 g) were found respectively 30 and 20 times higher than the levels found in the seed coat of *Cucumis melo*. In this study, the levels of all the phenolic compounds evaluated were higher than values reported by Mallek-Ayadi *et al*. (2019) [15].

Mineral composition

Table 5 reports the macro-elements (P, K, Ca, and Mg) and micro-elements (Fe, Cu, Mn, Na, and Zn) analyzed in the seed coats, and it could be noticed that the levels of these minerals varied significantly in the seed coats 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 seed coat of the two varieties. As compared to seed coat of *Cucumis melo* (Ca: 3596.00 ± 0.57 mg/100 g; K: 1931.44 ± 2.64 mg/100 g), *Cucumeropsis mannii* seed coat contained lower amount (2942.00 ± 2.00 mg/100 g) of calcium but higher amount of potassium (K) (2206.00 ± 2.64 mg/100 g). The calcium values obtained in this study were greater than the value reported by Gbogouri and collaborators (2011) [30] for the seeds of *Cucumis melo* (1426.00 ± 50.10 mg /100 g) whereas the values for K were in close agreement with the results reported by Karaye *et al*. (2021) [31]. Moreover, the seed coat of *Cucumeropsis mannii* was richer in phosphorus (P) (400.00 ± 10.00 mg/100 g) but contained 6 folds less magnesium (Mg) (54.50 ± 1.00 mg/100 g) when compared to the seed coats of *Cucumis melo* (P: 326.66 ± 15.27 mg/100 g; Mg: 329.33 ± 0.57 mg/100 g). As far as the micro-elements are concerned, higher value of sodium (Na: 17.93 ± 0.00 mg/100 g) and lower value of zinc (Zn: 19.11 ± 0.00 mg/100 g) were observed in the seed coat of *Cucumeropsis mannii* than in the seed coat of *Cucumis melo* (Na: 14.21 ± 0.00 mg/100 g; Zn: 24.57 ± 0.00 mg/100 g). Micro-element like Fe, Mn and Cu were also found at various levels in the seed coats 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) [18] and Mgbemena *et al*. (2019) [32]. Indeed, low levels were found for the seed kernel of *Cucumis melo* and *Cucumeropsis mannii* and the seed coats of *Irvingia gabonensis* and *Irvingia wombolu*. This study revealed that the *Cucumis melo* and *Cucumeropsis mannii* seed coats could be considered as good sources of macro and micro-elements and could therefore be suggested for animal feed formulation.

Conclusion

For increasing the utilization of dietary nutrients from waste, reducing environmental contamination and decreasing animal feeding cost, the optimum use of unconventional feedstuffs present big potential. This current study revealed that the seed coats of *Cucumis melo* and *Cucumeropsis mannii* are potential sources of protein, fiber, lipid, carbohydrate and mineral elements. They are also rich in glutamic acid and contain also some anti-nutrients like tannins and phytates. The high nutrient content of of *Cucumis melo* and *Cucumeropsis mannii* could justice the need of their incorporation in animal feed formulation while keeping in mind the necessity to reduce the anti-nutrient content. Research studies involving the incorporation of these non-conventional feedstuffs in feed formulation should be conducted to ascertain their benefits in the productive performance of the experimental animal**.**

Table 1: Proximate composition of seed coat of *Cucumis melo* and *Cucumeropsis mannii*

Parameters (%)	*Cucumis melo*	*Cucumeropsis mannii*
Dry matter	86.60 ± 0.54[a]	87.26 ± 0.30[a]
C:arbohydrates	13.38 ± 0.36[a]	8.49 ± 0.78[b]
Proteins	10.06 ± 0.01[a]	18.81 ± 0.01[b]
Lipids	14.51 ± 0.28[a]	18.86 ± 0.86[b]
Fibers	60.87 ± 0.24[a]	51.48 ± 1.51[b]
Ash	1.35 ± 0.00[a]	2.36 ± 0.00[b]
Energy (Kcal)	467.83 ± 3.44[a]	484.6 ± 5.01[b]

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

Table 2: Free amino acids content of seed coat of *Cucumis melo* and *Cucumeropsis mannii*

Amino acids (g/100 g)	*Cucumis melo*	*Cucumeropsis mannii*
Serine	$1.95\ 10^{-2} \pm 0.00$	$8.56\ 10^{-3} \pm 0.00$
Valine	$9.75\ 10^{-2} \pm 0.00$	$8.83\ 10^{-4} \pm 0.00$
Glutamic acid	6.44 ± 0.00^{a}	5.65 ± 0.00^{b}
Proline	5.14± 0.00	ND
Arginine	ND	$1.78\ 10^{-2} \pm 0.00$
Methionine	ND	$8.82\ 10^{-4} \pm 0.00$

Means ± standard deviation of three determinations. In the same row, mean values followed by the same letter (superscript) are not significantly different ($p< 0.05$). ND: No detected.

Table 3: Anti nutritional factors composition of seed coat of *Cucumis melo* and *Cucumeropsis mannii*

Parameters (%)	*Cucumis melo*	*Cucumeropsis mannii*
Total phenols (mg GAE/100 g)	207.36 ± 0.96^{a}	150.30 ± 0.44^{b}
Tannins (%)	57.73 ± 0.97^{a}	43.63 ± 0.48^{b}
Phytates (%)	15.51 ± 0.51^{a}	26.67 ± 0.37^{b}

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

Table 4: Phenolic compounds composition of seed coat of *Cucumis melo* and *Cucumeropsis mannii*

Parameters (mg/100 g)	*Cucumis melo*	*Cucumeropsis mannii*
Tannin, H_2O	6.10 ± 0.00	3.80 ± 0.00
Tannin-OL	8.50 ± 0.00	4.50 ± 0.00
Gallic acid	35.44 ± 0.00	21.80 ± 0.00
Caffeic acid	2.70 ± 0.57	54.50 ± 0.00
Catechin	6.50 ± 0.00	199 ± 0.00
Hydroquinone	1885± 0.10	1095.33 ± 0.57

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

Table 5: Minerals composition of seed coat of *Cucumis melo* and *Cucumeropsis mannii*

Parameters (mg/100g)	*Cucumis melo*	*Cucumeropsis mannii*
Macro elements		
P	326.66 ± 15.27^{a}	400.00 ± 10.00^{b}
K	1931.44 ± 2.64^{a}	2206.00 ± 2.64^{b}
Ca	3596.00 ± 0.57^{a}	2941.00 ± 1.00^{b}
Mg	329.33 ± 0.57^{a}	54.50 ± 1.00^{b}
Micro elements		
Fe	9.50 ± 0.00^{a}	8.35 ± 0.00^{b}
Cu	5.14 ± 0.00^{a}	4.54 ± 0.00^{b}
Mn	5.87 ± 0.00^{a}	5.71 ± 0.00^{b}
Na	14.21 ± 0.00^{a}	17.93 ± 0.00^{b}
Zn	24.57 ± 0.00^{a}	19.11 ± 0.00^{b}

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

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