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Characterisation of some nutritional constituents of melon (*Cucumis melo* hybrid AF-522) seeds

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Abstract

Seeds from a melon hybrid AF-522 largely cultivated in the northeast region of Brazil were analysed for their proximate composition. The seeds contained high percentages of lipids (30.8%) and proteins (14.9%). Hexane-extracted oil had acid, peroxide, iodine and saponification values of 2.06, 4.96, 111.8 and 210.6, respectively. Gas chromatographic analysis of the oil revealed the presence of 24 fatty acids varying from C_6 to C_{24} with the exception of C_{11}, C_{19}, C_{21} and C_{23}. The concentrations of individual fatty acids varied from trace quantities to about 64%. Linoleic, oleic, palmitic and stearic acids were the principal fatty acids contributing to 64.1, 19.4, 9.5 and 4.9%, respectively, of the total fatty acids which had a relatively high percentage (84.4%) of unsaturated fatty acids. Seed proteins were rich in arginine, aspartic and glutamic acids while limiting amino acids were methionine and lysine.

Keywords: Seeds; Oil; Melon; *Cucumis melo* hybrid AF-522; Fatty acid; Amino acid

1. Introduction

The melon fruit belongs to the family of *Cucurbitaceae* and is cultivated in all the tropical regions of the world. The pulp of the fruit is very refreshing and sweet in taste with a pleasant aroma, the intensity of which varies depending upon the variety. The fruit contains large quantities of seeds which are reported to possess medicinal properties (Bellakhdar, Claisse, Fleurentin & Younus, 1991; Lal & Lata, 1980; Quisumbing, 1951; Woo, Lee, Shin, Kang & Chi, 1981). In spite of being a rich source of oil and protein, the seeds are normally treated as waste products. The kernels are sometimes used in sweetmeats and in toppings as a substitute for almonds and pistachios in India (The Wealth of India, 1950).

Some reports are available on the composition of seeds or seed kernels of melons (*Cucumis melo*) from different geographical regions such as India (Kaur, Mann, Hura & Bajaj, 1988; Madaan & Lal, 1984; Teotia & Ramakrishna, 1984), Egypt (Rashwan, El-Syiad & Seleim, 1993) and Turkey (Tekin & Velioglu, 1993). Rashwan et al. (1993) reported lipid and protein contents (on dry weight basis) of approximately 37 and 54%, respectively, for seed kernels of sweet melon varieties of *Cucumis melo*. However, Teotia and Ramakrishna (1984) reported oil content to vary from 40 to 47% and protein from 23 to 36% in the seeds of melon grown in India. Kaur et al. (1988) found 35.68% oil and 23.8% protein in melon seeds. Rashwan et al. (1993) and Kaur et al. (1988) also published data on the amino acid composition of the proteins from melon seeds grown in Egypt and India, respectively.

The fatty acid and lipid composition of the oil obtained from *Cucumis melo* seeds grown in Egypt (El-Magoli, Morad & El-Fara, 1979), India (Hemavatahy, 1992) and Vietnam (Imbs & Pham, 1995) have been published. It is a well-known fact that the fatty acid composition of seed oils depends on the climatic conditions and cultivar of the fruit (Brignoli, Kinsella & Weihrauch, 1976). Brazil is producing various important melon cultivars such as Honey Dew, Pele de Sapo, Orange Flesh, Contaloupe and a recently developed hybrid, AF-522, commercially classified as yellow type melon. The fruits of the hybrid AF-522 developed for its resistance against *Fusarium* weigh, on an average, about 1.5 kg and possess pulp of about 12°Brix. However, no

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report is available on the nutritional constituents of the seeds obtained from the fruits of this hybrid. The present work was therefore undertaken with an objective to analyse the proximate and amino acid composition of the seed kernels and fatty acid composition of the seed oil obtained from the melon hybrid AF-522.

2. Materials and methods

2.1. Fruits

Melon (*Cucumis melo* hybrid AF-522) fruits were obtained from the farm of an exporting agency MAISA (Mosorro Agro-Industrial S/A) located at Mosorro city in the state of "Rio Grande do Norte" in Brazil. The seeds were removed, cleaned and washed of any adhering residue and dried at 50°C for 24 h. Dried seeds were triturated in a mill and screened through a mesh of 0.5 mm dia. The triturated seeds were packed in polyethylene bags and stored in a refrigerator.

2.2. Proximate analysis of seeds

Moisture, protein, lipid, ash and crude fibre contents were determined following the standard Association of Official Analytical Chemists (AOAC, 1990) methods. Total carbohydrate content was calculated from the difference. Ten different samples were analysed in duplicate.

2.3. Physical and physicochemical properties of oil

The oil was extracted from dried powdered melon seeds in a Soxhlet extractor using hexane as a solvent. The solvent-extracted meal was stored at 4°C for later amino acid determination. Specific gravity and refractive index were determined at room temperature (28°C) by using a specific gravity bottle and refractometer, respectively. For determination of acid, peroxide, iodine and saponification values, standard (AOAC, 1990) methods were used. Three different samples of oil were analysed in duplicate.

2.4. Fatty acid composition of seed oil

Fatty acids were transformed to their methyl esters (FAME) following the method of Hartman and Lago (1973) and were determined by using a gas chromatograph HP 5890 Series II (Hewlett–Packard) equipped with a flame ionisation detector. 1.5 μl of the FAME sample was injected and GC separation was carried out on a HP-INNOwax capillary column (Hewlett–Packard; 30 m length, 0.25 mm i.d. and 0.25 μm film thickness). The carrier gas (helium) head pressure was maintained at 11.5 psi and the column flow rate was 1 ml/min. The oven temperature was held initially at 120°C for 1 min, increased from 120°C at 8°C/min to 210°C and then maintained at 210°C for 45 min. The temperatures of the injection port and of detector were 250 and 280°C, respectively. FAME were positively identified by matching their retention time data and mass spectra with those of the authentic standards obtained from various firms (Sigma; Nu-Chek-Prep, USA) which were run also under identical analytical conditions using a high resolution GC–MS system (GCQ of Finnigan Mat).

2.5. Amino acid composition

The solvent-extracted seed meal was used for the determination of amino acids in an amino acid analyser (Hewlett–Packard Amino Quant Series II, HP 1090). A finely powdered sample (100 mg) was taken in an ampoule and hydrolysis was carried out using 5 ml of 6 N HCl containing 0.05% marcaptoethanol at 105°C for 24 h. Filtered hydrolyzate was dried in a vacuum desiccator and redissolved in 0.1 N HCl containing sarcosine and norvaline as internal standards. One microliter of the solution was injected directly in an amino acid analyser with reverse phase column using sodium acetate buffer (a) 20 mM, pH 7.2, containing 0.018% triethylamine and 0.3% tetrahydrofuran and (b) 100 mM, pH 7.2 containing 40% acetonitrile and 40% methanol, both HPLC grades.

Double pre-derivatization of the amino acids was achieved by reacting with orthophthalide (OPA) except for proline which was derivatized with 9-fluorenilmethyl chloroformate (FMOC). The carrier gas was maintained at a flow rate of 0.45 ml/min in a gradient of buffer a for buffer b. The amino acids standard were obtained from Hewlett–Packard.

3. Results and discussion

The proximate analysis of whole dried seed powder of the melon hybrid AF-522 is presented in Table 1. The seeds contained 30.83% oil and 14.91% proteins. The presence of seed coat in the whole seed powder contributed to the high fibre (19%) content. Comparing

Table 1
Proximate composition (%w/w; average value ± standard deviation) of melon seeds

Moisture	Lipid	Protein	Ash	Fibre	Carbohydrates
7.78 ± 0.96	30.83 ± 2.10	14.91 ± 0.45	4.20 ± 0.44	19.00 ± 0.45	22.94 ± 1.27

with the results obtained by Teotia and Ramakrishna (1984) and Kaur et al. (1988), the oil content of the seeds of melon hybrid AF-522 was lower while the protein value approximated to the values reported by them.

Table 2 presents the data on some physical and physico-chemical properties of seed oil extracted with hexane. The oil had a specific gravity of 0.90 and a refractive index 1.482. Freshly extracted oil possessed acid and peroxide values of 2.06 and 4.96, respectively. The saponification value of the seed oil in our study was found to be higher (211) than 193, while iodine value (112) was lower than the values (126 and 128) reported in The Wealth of India (1950) and by Ramakrishna et al. (1970).

3.1. Fatty acid composition of seed oil

The fatty acid composition of the seed oil is presented in Table 3. The oil contained all the fatty acids from C_6 to C_{24} with the exception of C_{11}, C_{19}, C_{21} and C_{23} fatty acids. The oil contained fatty acids with carbon atoms 6, 7, 8, 9, 10, 12 and 22 in trace quantities when the concentration of each of these acids was less than 0.01% of total fatty acids. Other fatty acids, such as C_{14}, C_{15}, C_{17}, $C_{17:1}$, were also present in concentrations less than 0.1%. Saturated fatty acids constituted nearly 15.2% of the total fatty acids; among there hexadecanoic acid (C_{16}) was the dominant fatty acid with approximately 9.52% followed by octadecanoic acid (4.89% of the total fatty acids).

Unsaturated fatty acids composed nearly 84.4% of total fatty acids. Mono-unsaturated and poly-unsaturated fatty acids contributed 20.2 and 64.3% of the total fatty acids, respectively. Among the mono-unsaturated fatty acids, octadecenoic acid ($C_{18:1}$) was the principal (19.4%) acid, followed by fatty acids $C_{22:1}$, $C_{16:1}$, $C_{20:1}$ and $C_{17:1}$, with concentrations of 0.42, 0.17, 0.11 and 0.03%, respectively. Octadecadienoic ($C_{18:2}$) and octadecenoic ($C_{18:1}$) acids were the dominant fatty acids in the AF-522 seed oil. Hemavatahy (1992) and Imbs and Long (1995) also found octadecadienoic (52.1 and 65.5%, respectively) as the principal fatty acid followed by octadecenoic (31.9 and 15.8%, respectively) acid. El-Magoli et al. (1979) also reported octadecadienoic acid (46.6%) as the principal fatty acid in the seed oil of King bahtin variety but tetradecanoic (34.0%) and hexadecanoic (27.4%) acids in the seed oil of Malti bahtin variety cultivated in Egypt. In general, in melon hybrid AF-522 seed oil, C_{18} fatty acids constituted 88.6% of the total fatty acids. However, the odd chain fatty acids, independent of their saturation or unsaturation, represented only a small fraction (0.5%) of the total fatty acids. Comparing the fatty acid composition of the seed oil of melon hybrid AF-522 with the seed oils of melon from different locations and varieties, it could be observed that only 5–8 fatty acids had been earlier reported in the seed oils of the melons grown in other geographical regions (El-Magoli et al., 1978; Hemavatahy, 1992; Imb and Long, 1995), while 25 fatty acids were identified in the AF-522 seed oil. In addition, a wide variation had been observed in the quantitative composition of the fatty acids in oils from melon of different varieties and locations.

Table 2
Some physical and physico-chemical properties of melon (hybrid AF-522) seed oil

Characteristic	Value (average ± SD)
Specific gravity	0.9000 ± 0.0018
Refractive index	1.4820 ± 0.0120
Acid value	2.06 ± 0.15
Peroxide value	4.96 ± 0.10
Iodine value	112 ± 1.82
Saponification value	210.62 ± 0.53

3.2. Amino acid composition of seed proteins

The data on amino acid composition of melon seed proteins are presented in Table 4. Like other oil seed proteins, melon seed protein is also rich in aspartic and glutamic acids. Jacks, Hensarling and Vatsue (1972) observed the abundance of these amino acids in the seed meal proteins of several *cucurbits*. It could be observed

Table 3
Fatty acid composition of melon (hybrid AF-522) seed oil

Fatty acid	Value[a] (% total fatty acids)
Saturated fatty acids	15.2
Hexanoic acid ($C_{6:0}$)	Tr
Heptanoic acid ($C_{7:0}$)	Tr
Octanoic acid ($C_{8:0}$)	Tr
Nonanoic acid ($C_{9:0}$)	Tr
Decanoic acid ($C_{10:0}$)	Tr
Dodecanoic acid ($C_{12:0}$)	Tr
Tridecanoic acid ($C_{13:0}$)	0.36
Tetradecanoic acid ($C_{14:0}$)	0.04
Pentadecanoic acid ($C_{15:0}$)	0.03
Hexadecanoic acid ($C_{16:0}$)	9.52
Heptadecanoic acid ($C_{17:0}$)	0.07
Octadecanoic acid ($C_{18:0}$)	4.89
Eicosanoic acid ($C_{20:0}$)	0.18
Docosanoic acid ($C_{22:0}$)	Tr
Tetracosanoic acid ($C_{24:0}$)	0.12
Monounsaturated fatty acids	20.1
9-Hexadecenoic acid ($C_{16:1}$)	0.17
10-heptadecenoic acid ($C_{17:1}$)	0.03
9-octadecenoic acid ($C_{18:1}$)	19.42
11-eicosenoic acid ($C_{20:1}$)	0.11
13-docosenoic acid ($C_{22:1}$)	0.40
Polyunsaturated fatty acids	64.3
9,12-octadecadienoic acid ($C_{18:2}$)	64.13
9,12,15-octadecatrienoic acid ($C_{18:3}$)	0.20
11,14,17-eicosatrienoic acid ($C_{20:3}$)	Tr
5,8,11,14-eicosatetraenoic acid ($C_{20:4}$)	Tr

[a] Tr — Traces (concentration less than 0.01% of the total fatty acids).

Table 4
Amino acid composition (g/100 g protein) of melon (hybrid AF-522) seed proteins

Amino acid	Value (g/100 g protein)	FAO ref. Protein (FAO, 1981) (g/100 g of protein)	% of FAO (1981) protein
Essential			
Isoleucine	5.33 ± 0.23	3.00	167
Leucine	7.39 ± 0.05	6.50	113
Lysine	2.43 ± 0.07	5.50	51.1
Methionine	0.90 ± 0.10	2.20	37.3
Phenylalanine	5.14 ± 0.32	2.80	169
Threonine	3.60 ± 0.01	4.00	89.5
Valine	4.43 ± 0.04	5.00	88.7
Non-Essential			
Alanine	4.40 ± 0.02		
Arginine	12.18 ± 1.11		
Aspartic acid	9.07 ± 0.04		
Cystine	7.97 ± 0.52		
Glutamic acid	19.47 ± 0.32		
Glycine	4.44 ± 0.13		
Histidine	1.50 ± 0.01		
Proline	3.59 ± 0.46		
Serine	4.74 ± 0.06		
Tyrosine	3.24 ± 0.33		

that the hybrid AF-522 seed proteins also had high concentrations of aspartic and glutamic acids (9.07 and 19.47 g/100 g of proteins, respectively). Besides these two amino acids, arginine was also present in fairly high (12.18 g/100 g of proteins) concentration. Seed protein contained lower concentrations of essential amino acids, viz. methionine and lysine (0.90 and 2.43 g/100 g of proteins, respectively), which were the first and second limiting amino acids. The concentrations of the essential amino acids lysine, threonine, valine and methionine in the seed proteins of this hybrid were lower than those reported by Rashwan et al. (1993) for cantaloupe and sweet melon seed proteins but higher in leucine and isoleucine. Comparing the amino acid composition of the seed protein of *Cucumis melo* var. *aegyptiacus*, as reported by Lasztity, Abd El Samei and El Shafei (1986), the seed protein of the hybrid AF-522 had arginine, methionine, cystine, threonine and proline in higher concentrations and histidine, leucine, lysine, phenylalanine, tyrosine, valine, aspartic acid and glutamic acid in lower concentrations while amino acids alanine, serine and glycine contents were almost in equal amounts.

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