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CHARACTERISTICS AND COMPOSITION OF MELON SEED OIL

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Abstract: Dried melon seeds (*Citrullus colocynthis* L.) of the family Cucurbitaceae were investigated for nutritional quality and the oil seed characteristics. These melon seeds, on a dry weight basis, consisted of 52.3% of testa and 47.7% of kernel. The moisture content in melon seeds was 54.5% and the mineral constituents were also determined. The oil content of seeds was very high, ranging from 22.1-53.5%, due to the presence of the hulls, 22% from the seeds and 53% of the kernel, and also the crude protein content was so high as the 21.8% of the seeds. Standard procedures were applied to determine the fatty acids composition of the seed oil. The fatty acid profiles of the seed oil showed an unsaturated fatty acid content of 77.4% and the high content of 63.2% of PUFA. The predominant fatty acid was linoleic (18:2) acid in 62.2%. The presence of other fatty acids ranged in 10-14% for oleic (18:1), stearic (18:0) and palmitic (16:0) acids, respectively. Furthermore, the physical and chemical characteristics of the seed oil was also determined, as iodine, acid, saponification, peroxide values and specific gravity.

Key words: melon seed oil, fatty acids.

Introduction

The fatty acid profile of edible oils plays an important role in their stability and nutritional value. Monounsaturates (18:1) and polyunsaturates (18:2) fatty acids have been found to be effective replacements for saturates as part of cholesterol-lowering diets (Mattson, F.H., and S.M. Grundy, 1985). However, it is also known that the oils with substantial amounts of unsaturation, particularly 18:2 fatty acids, are susceptible to oxidation and may produce products that contribute to arteriosclerosis and carcinogenesis. Some studies with experimental animals indicate that excessive amounts of linoleic acid promote carcinogenesis (Kubow, S., 1990).

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Watermelon seed oil, rich in linoleic acid (~64.5%), is used for frying and cooking in some African and Middle Eastern American countries owning to its unique flavor (Akoh, C.C, and C.V. Nwosu, 1992). Much research has been published on the oxidative stability of vegetable or fruit oils, but a little has been reported on the stability of melon seed oil. The modification of melon seed oil fatty acid composition by incorporation of oleic acid (18:1) has been explored (Charment, O. Moussata, and C.C. Akoh, 1997). The modified melon seed oil was produced with the better balance of monounsaturate (18:1) and essential fatty acids (18:2), and also improved the seed oil oxidative stability and nutritional value (Charment, O. Moussata, and C.C. Akoh, 1998).

The watermelon, (*Citrullus colocynthis* L.) family Cucurbitaceae is the most popular fruit in Serbia, with a traditional name ″lubenica″. Unfortunately, according to the literature data there is not any information of domestic sample, about medicinal values of the seeds or seed oil applied for cooking and frying or as useful product with good nutritional value. Thus, the seed oil composition of the domestic watermelon was evaluated in the current study, which had not been previously investigated. These data may help in the selection of melon seed oil for future commercial production in human diet.

Material and Methods

Melon seeds. Fresh seeds of watermelon (*Citrullus colocynthis* L.) of the Cucurbitaceae family, mainly imported in Serbia, were purchased from the local market in Belgrade, with the identity authenticated by the Department of Horticulture, Faculty of Agriculture, University of Belgrade. A voucher specimen was deposited in the herbarium of this institution. The seeds were taken from ripened fresh samples**.** Moisture was determined directly on the seeds by oven drying at 105^{o}C for 6 hours. The yield of the dry seeds from the sample was determined. The ripened seeds and dry seeds were then ground in some blender, separately, and placed in vacuum oven at 60^{o}C for 6 hours and finally stored in exiccator until analysed. Proximate analyses were performed in triplicate in accordance with the AOAC procedures (AOAC, 1975). The ash was determined by heating overnight at 500^{o}C and the protein content of the kernels and seeds by standard Kjeldahl (total %N) procedure.

Mineral constituents. According to the standard procedure, the sample of the seeds was dry and ashed for the mineral determination. A Varian A 1475 atomic absorption spectrophotometer was employed to measure Mg, Fe, Zn, Cu, Ca and K in the seeds.

Extraction. The seeds were dried at room temperature, ripened and ground in an electric blender. The samples of seeds (100g) and kernels (100g) were extracted with petroleum ether (Merck, 40-60^{o}C) using a Soxhlet apparatus for 6 hr. The extract was desolventised *in vacuo* on a rotary evaporator at 35^{o}C, yielding lipid samples as the residue.

Physico-chemical characteristics of seed oil samples. The ordinary oil constants, e.g. acid value, iodine, saponification and peroxide values, specific gravity and the refractive index were estimated according to the AOCS method (Official Methods of Analysis of AOAC, 1995).

The fatty acids profiles were determined by GC. The methyl esters of the fatty acid were prepared by the method of Christie (C r i s t i e, W., 1973) and analysed by a Hewlett-Packard (Avondale, PA) 571017 gas chromatograph, fitted with a flame ionisation detector. A 152.4 cm x 0.317 cm glass column packed with 10% DEGS on Chromosorb VV HP 80/100 mesh was used for the analysis. Samples were run isothermally at 190^{o}C with injector and detector ports at 200^{o}C. Helium carrier gas flow was 30 mL/min. The peaks obtained, by injecting 20 µl of methyl esters, were identified by running a standard fatty acid mixture and comparing the R_f values.

Results and Discussion

Melon seeds are also used as thickeners in soup. The meal from melon seeds can be made into patties and served as a meat substitute (A k o b u n d u, E. et al., 1982). The present investigation was carried out to determine the physical and chemical characteristics of the seeds and the seeds oil of domestic watermelon. The similar results were reported by authors B a s i l K a m e l and H. D a w s o n, 1985.

The melon samples yielded 1.9% and 2.7% seeds on a dry basis. These melon seeds on a dry weight basis consisted of 52.3% of testa and 47.7% of kernel. The chemical composition of the seeds is shown in Table 1. The moisture content of the fresh ripened samples was 54.5% and total ash was 2.9%. The oil content of seeds was very high, ranging from 22.1-53.5%, due to the presence of the hulls. The crude protein content was also high i.e. 21.8% for seeds and especially 38.2% for the kernel.

T a b. 1. - Chemical composition of Melon Seeds*

Total protein of seeds	21.8
Total protein of kernels	38.2
Crude oil of seeds	22.1
Crude oil of kernels	53.5
Total ash	2.9
Moisture in %	54.5

*Percent basis on a dry weight

The analysis of the mineral constituents of the ash showed a significant concentration of calcium, phosphorus, magnesium and potassium. Copper, zinc

and iron ranged from 17 to 42 ppm, and the obtained results are presented in the following Table 2.

T a b. 2. - Mineral Constituents of Melon Seeds*

Iron	42
Calcium	1035
Zinc	39
Copper	17.8
Phosphorus	5200
Magnesium	2100
Potassium	7700

*Parts per million-mg/kg

The seed oil had an amber colour and a very characteristic nutty flavour. The oil was also stable at the room temperature. The physical and chemical characteristic of the seed oil are summarised in Table 3. The table 3 clearly shows that the iodine, peroxide and saponification values are especially high. The specific gravity and refractive index of the oil are also relatively high. The physical results from the oil indicated that these properties of the seed oil are similar to oils rich in linoleic acid.

T a b. 3. - Physical and Chemical Characteristics of Melon Seed Oil

Specific gravity 20^{o}C (kg/dm^{3})	0.914
Refractive index 20^{o}C	1.4733
Acid value (mgKOH/g)	1.00
Saponification value (mgKOH/g)	188
Iodine value (g/100g)	119
Peroxide value (mmolO_2/kg)	7.9
Unsaponifiable matter (%)	1.02
Ester number	187
Free fatty acid (% oleic acid)	0.52

T a b. 4. - Fatty Acid Content and Summary of its Important Parameters of Melon Seed Oil

Fatty acid	%
16:0	12.42
16:1	t
18:0	10.2
18:1	14.2
18:2	62.2
18:3	1.02
PUFA[a]	63.22
Total saturated acids	22.6
Total unsaturated acids	77.4
Ratio unsaturated/saturated	3.42

t - trace; [a] -polyunsaturated fatty acids

Table 4 demonstrates that the linoleic acid (18:2) is the major fatty acid in the 62.2%, and melon seed oil appears to be an excellent source of the linoleic acid. The high linoleic acid value is similar to those found in other oils, such as sunflower seed oil, linseed and hempseed oils (Swern, D. 1979). Low molecular weight (C_{10}-C_{12}) and high molecular weight (C_{20}-C_{22}) fatty acids were not detected in the investigated seed oil. In contrast, oleic acid (18:1) accounted for 14.2%. The total unsaturated fatty acids level was 77.4%. The total saturated acids made up a moderate proportion in 22.6% of the total fatty acids content of the seed oil. The palmitic acid accounted for 12.42% and the stearic acid accounted for 10.2% of the total fatty acid content.

The fatty acid composition and characteristics of the melon seed oil obtained in our study were in general agreement with the results obtained in earlier studies, however, the levels of the linoleic acid reported ranged from 52-65%, compared to the 62.2% in the present study. The modification of the melon seed oil fatty acid by the addition of oleic acid (18:1) into seed oil provided better oxidative stability at the moderate temperature (Charment, O. Moussata, and C.C. Akoh, 1997).

Conclusion

The presented data suggest that melon seeds may constitute useful product with good nutritional value. The melon seeds contain a high content of crude protein and oil, e.g. 21% and 22% respectively. The melon kernels had especially high content: 38% of protein and 52% of oil. The seed oil contains linoleic acid, as a major fatty acid in 62%. The seeds could be extracted for oil and furthermore used for edible purposes, and the meal could be used as a meat substitute, and also for animal and poultry feed or protein production.

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KARAKTERISTIKE I SASTAV ULJA SEMENA LUBENICE

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Rezime

Ispitane su fizičko-hemijske karakteristike i odredjen je sastav osušenog semena i ulja semena domaće lubenice (*Citrullus colocynthis* L.) familije Cucurbitaceae. Prema dostupnoj literaturi, nema podataka o medicinskoj vrednosti semena, ali je poznato da se brašno koristi u kulinarstvu (kao zamena za meso), jer sadrži značajne količine proteina. Ulje semena lubenice se tradicionalno primenjuje u kulinarstvu za kuvanje i pečenje u zemljama Srednje Amerike i Afrike.

Hemijske karakteristike semena pokazuju visok sadržaj proteina 21,8%, posebno u jezgru 38,2%, kao i saržaj ulja i to 22,1% u semenu i 53,5% u jezgru. Ulje semena je karakteristične boje ćilibara, lešnik arome i stabilno je na sobnoj temperaturi. Standardnim AOCS metodama odredjene su fizičko-hemijske karakteristike ulja: specifična masa (0,914 kg/dm^3), indeks refrakcije (1,4733 na 20^{o}C), kiselinski broj (1,0mgKOH/g)), saponifikacioni broj (188 mgKOH/g), jodni broj (119 g/100g), peroksidni broj (7,9 mmolO_2/kg), slobodne masne kiseline (0,52 % naeleinsku kiselinu) i estarski broj (187). Gasnom

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hromatografijom odredjen je sastav masnih kiselina. Dokazan je relativno visok sadržaj nezasićenih masnih kiselina (77,4%), pri čemu je najviše prisutna linolna kiselina (62,2%). Visok sadržaj linolne kiseline je u saglasnosti sa dosadašnjim ispitivanjima ovog ulja na uzorcima lubenice iz Amerike i Afričke regije. Dokazan je umeren sadržaj zasićenih masnih kiselina, uglavnom palmitinske i stearinske kiseline. Stoga, može se preporučiti upotreba brašna semena, kao stočne hrane i ulja semena u kulinarstvu usled svoje specifične lešnik arome.

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