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Some physical and chemical properties of bitter melon (*Momordica charantia* L.) seed and fatty acid composition of seed oil*

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Abstract

Edible part and leaves of bitter melon (*Momordica charantia* L.) are used as food or medicine to control some diseases because of its antioxidant, antibacterial, anticancer, anti-hepatotoxic, antiviral, antiulcerogenic and larvicidal effects. Although fruits have considerable amount of seeds, they have not received much attention. In this study, some physical and chemical properties of the seed and also fatty acid composition of seed oil were determined. Oil content of the sample was determined by soxhlet apparatus as 26.10% in dried sample. Fatty acid composition was analyzed by GC-MS and seven fatty acids were identified and their ratios were determined in this seed oil. The main fatty acid was determined as *α*-eleostearic (45.60%). The other fatty acids were palmitic (3.69%), stearic (28.00%), oleic (12.45%), linoleic (8.90%), arachidic (0.71%) and gadoleic acids (0.65%).

Keywords: *Momordica charantia*, Bitter melon, Seed oil

Kudret narı (*Momordica charantia* L.) tohumunun bazı fiziksel ve kimyasal özellikleri ile tohum yağının yağ asitleri bileşimi

Özet

Kudret narının meyvesi ve yaprakları antioksidan, antibakteriyel, anti-kanser, anti-hepatotoksik, antiviral, antiülserojenik ve larvisid etkileri dolayısıyla bazı hastalıkların kontrolü için gıda veya ilaç olarak kullanılabilmektedir. Kudret narı önemli oranda çekirdek içermesine rağmen genel olarak değerlendirilmemektedir. Bu çalışmada, kudret narı tohumunun bazı fiziksel ve kimyasal özelliklerinin yanında tohum yağının yağ asidi bileşimi belirlenmiştir. Kudret narı tohumunun yağ içeriği

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soxhelet cihazı ile tespit edilmiş olup, kurumadde üzerinden %26.10 olarak tespit edilmiştir. Elde edilen tohum yağının yağ asidi bileşimi GC-MS ile analiz edilmiş ve örnekte yedi farklı yağ asidi bulunduğu saptanmıştır. Örnekte en fazla bulunan yağ asidi *α*-eleostearik asit (%45.60) olarak tespit edilmiştir. Örnekte bulunan diğer yağ asitleri palmitik (%3.69), stearik (%28.00), oleik (%12.45), linoleik (%8.90), araşidik (%0.71) ve gadoleik (%0.65) asit olmuştur.

Anahtar kelimeler: *Momordica charantia*, Kudret narı, Tohum yağı

1. Introduction

Bitter melon (*Momordica charantia* L.) is a vegetable that belongs to Cucurbitaceae family. It is grown mainly in tropic and subtropic regions of the world (Li et al., 2007) and called as bitter melon or bitter gourd because of its bitter taste (Tuan et al., 2011). It is known also as balsam pear, karela (Maiti et al., 2008), bitter cucumber and African cucumber (Behera et al., 2010).

Bitter taste of the fruit comes from momordicosides K and L, and momordicines I and II glycosides (Lucas et al., 2010). Its fruit and leaves were used to control or treate catarrh, flux, cough, diabetes, stomachache, toothache, liver diseases, hypertension and also some types of cancer diseases as medicinal purposes (Yuwai et al., 1991; Raman and Lau, 1996; Grover and Yadav, 2004; Kubola and Siriamornpun, 2008; Wu and Ng 2008; Krishnaiah et al., 2011; Lin et al., 2011). Because of these medicinal properties, bitter melon could be called as food drug (Padmavathi et al., 2009). There are some researches on chemical composition of its fruit. Lipid, protein and ash content of the fruit were determined as 93.20%, 0.76%, 18.2% and 8.12%, respectively (on dry matter base). Additionally, copper, iron, magnesium, zinc and calcium contents of the fruit were found to be 3.54 mg 100 g^{-1}, 5.97 mg 100 g^{-1}, 119.92 mg 100 g^{-1}, 3.53 mg 100 g^{-1} and 137.69 mg kg^{-1}, respectively (Yuwai et al., 1991). Total phenolic content of four different varieties of bitter melon were analyzed with respect to drying process. Phenolic content of the samples were ranged between 4.64 and 8.94 mg chlorogenic acid equivalent g^{-1} on dry weight base (Maiti et al., 2008).

This fruit has considerable amount of seeds. Its seeds are used for breeding of this plant. These seeds contain considerable amount of oil and oil content was about more than 25%. Some researchers have conducted to determine the content of seed and also fatty acid composition of its oil. Ali et

al. (2008), carried a study to determine chemical composition and the fatty acid composition of the three different cultivars of bitter melon seed oil. Moisture, oil, ash, protein and total carbohydrate contents of the seeds ranged from 7.62 to 8.20%, from 33.93 to 36.21%, from 2.25 to 2.73%, from 18.23 to 21.36% and from 32.51 to 35.52%, respectively. Some mineral contents of the seeds also determined. Calcium, copper, iron, zinc and phosphorus contents of the seeds ranged between 383.45-440.96 mg kg^{-1}, 2.85-3.52 mg kg^{-1}, 41.10-45.03 mg kg^{-1}, 12.41-13.47 mg kg^{-1} and 134.65-142.39 mg kg^{-1}, respectively. The main fatty acid of the oil was determined as *α*-eleostearic acid and its amount ranged between 50.36-53.22% in these cultivars. This fatty acid was followed by stearic, oleic and linoleic acids and ranged between 20.21-24.20%, 15.26-16.01% and 4.81-6.98%, respectively.

Although bitter melon is not native to Turkey, the fruits are generally used in folk medicine. Recently, it has been grown in the western and south parts of Turkey. According to the encountered literature, there are no study on oil content and fatty acid composition of the bitter melon seed in Turkey. Fruit and seed compositions of plants depend on cultivars, climatic condition, soil type and cultural practices. The aim of the present study was to determine the some physical and chemical composition of the fruit seed and also fatty acid composition of the seed oil.

2. Material and Methods

Fruits were collected from bitter melon plants (*Momordica charantia* L.) grown in Batı Akdeniz Agricultural Research Institute, Aksu-Antalya. Fruit were picked at commercial harvest maturity (18 July 2011), when its colour turned from green to yellow-orange. After harvesting, seeds were separated from the fruit, then red parts on the scene of the seed were removed (Figure 1).

Figure 1. Bitter melon seeds

Average fruit weight was measured on fresh fruits. And, seed content was determined as a percentage of dry seed content of fresh fruit. Dry matter content of this seed was analyzed by drying the seeds at 102°C. One thousand seeds weight were defined by using these dried samples. Total ash content of the sample was determined at 550°C using ash furnace (Anonymous, 1983). Oil content of the sample was determined with soxhelet extractor (Gerhardt, Soxtherm 2000 automatic) by using petroleum ether (AOAC, 2005). Refractive index value of the seed oil was determined at 25°C by using digital refractometer (Krüss DR6000-T, Germany).

The fatty acid composition of the seed oil was determined by gas chromatography (Agilent 5975C) coupled to mass spectrometry (Agilent 5975C) using capillary column (HP Innowax Capillary; 60.0 m x 0.25 mm x 0.25 µm). Fatty acid methyl esters of the oil was prepared by using Garces and Mancha (1993) method and injected into the GC-MS. Helium was used as carrier gas at 1 mL minute^{-1} flow rate. The samples injection volume was adjusted as 1 µl and injected at split mode (50:1). Injection block of the instrument was maintained at 250°C. The oven temperature was programmed as follows; started from 150°C and raised 200°C with an increment of 10°C minute^{-1}, held at 200°C for 5 minutes, then increased to 250°C with an increment 5°C minute^{-1}, held at 250°C for 10 minutes (totally 30 minutes). MS spectra were monitored between 35-500 amu and the ionization mode used was electronic impact at 70 eV. The identification of the components was performed by WILEY, NIST and FLAVOR libraries. Fatty acids peaks also were identified by comparison with authentic fatty acid standards. And the results were calculated according to peak response area and given as percentage (%). All results were reported as mean±standard deviation (SD).

3. Results and Discussion

Some physical and chemical properties such as fruit weight, seed ratio, one thousand seeds weight, dry matter content, oil and ash content of bitter melon seeds were given in Table 1.

Average fresh fruit weight was determined as 84.89 g, and seed content of this fruit was 5.11% (dry seed). One thousand seed weight was determined as 183.20 g on dried seeds. Total dry matter, oil and ash contents of the sample were determined as 65.19%, 26.12%, 2.56%, respectively. Some studies have been carried out on the physical and

chemical properties of the bitter melon seed. Fruit weight of this plant were affected from difference in nutria environments and found between 85.43-201.33 g by Raja and Shanthi (2009).

Table 1. Some physical and chemical properties of the bitter melon fruit and seeds (mean±SD)

Fruit and seeds characteristics	Value
Fruit weight (g)	84.89±8.87
Seed content (%)	5.11±0.23
1000 seeds weight (g)	183.20±6.56
Dry matter content (%)	65.19±1.65
Total oil content (%)	26.12±0.95
Total ash content (%)	2.56±0.10

Mulani et al. (2007) measured the fruit weight as 68.66-84.80 g for bitter melon fruits grown under different fertilizers. Effects on bitter melon characteristics of fertigation levels have been studied in India. Fruits weight ranged from 247.00 to 278.00 g with respect to fertigation level (Meenakshi et al., 2007). While our findings for fruit weight were similar with Mulani et al. (2007) results, they were lower than Raja and Shanthi (2009) and Meenakshi et al. (2007) findings. Oil and ash contents of the fruit seeds were found to be 33.93-36.21%, 2.25-2.73%, respectively by Ali et al. (2008). Ash content showed similarity with this literature values. On the other hand, oil content was lower than Ali et al. (2008) findings. Horax et al. (2010) found the oil content of the seed was 18.1% for mature fruit and 36.51% for ripe fruit. The physical and chemical properties of fruits and vegetables could be changed with respect to cultivar, agricultural practices, ecology and harvesting time etc.

Edible oil quality is determined by analyzing the fatty acid composition. Seven different fatty acids were identified and quantified by gas chromatography-mass spectrometry in the bitter melon seed oil (Table 2). Among the identified fatty acids; *α*-eleostearic acid, which is a conjugated linolenic acid (C18:3; 9*t*, 11*c*, 13*c*), is major fatty acid. Conjugated linolenic acids refer to a group of linolenic acid derivatives with positional and geometric isomers (Khan, 2007). Conjugated linolenic acids have a stronger antitumor effect than conjugated linoleic acid (C18:2) on human tumor cells (Tsuzuki et al., 2004). This fatty acid is followed by oleic, linoleic and gadoleic acids as unsaturated fatty acids.

Table 2. Fatty acid compositions of the bitter melon seed oil (mean±SD)

Fatty acids	%
Palmitic acid (C16:0)	3.69±0.10
Stearic acid (C18:0)	28.00±0.21
Oleic acid (C18:1)	12.45±0.13
Linoleic acid (C18:2)	8.90±0.07
α-eleostearic acid (C18:3)	45.60±0.16
Arachidic acid (C20:0)	0.71±0.04
Gadoleic acid (C20:1)	0.65±0.08
Totals Saturated	32.40±0.27
Unsaturated	67.60±0.27
Saturated/Unsaturated	0.48±0.01

The amount of unsaturated fatty acids was 67.60% of the total oil. Stearic acid was the most abundant fatty acid as saturated fatty acid in the sample. The other determined and quantified saturated fatty acids were palmitic and arachidic acids in the oil. The total amount of saturated fatty acids ratio was calculated as 32.40% for the bitter melon seed oil. The ratio of the saturated to unsaturated fatty acids was calculated as 0.48 in the sample.

Nyam et al. (2009) analyzed the fatty acid composition of bitter melon seed oil to evaluate the oil quality. They also found *α*-eleostearic acid as major unsaturated fatty acid (61.5%) and stearic acid as unsaturated fatty acid (32.4%) in the seed oil. Another study was conducted in Bangladesh by Ali et al. (2008). They analyzed the fatty acid composition of three different bitter melon seed oils. They identified and quantified palmitic (3.20-5.29%), stearic (20.21-24.20%), oleic (15.26-16.01%), linoleic (4.81-6.98%) and *α*-eleostearic acid (50.36-53.22%) in these samples. Findings of these studies have differences from our results. These differences could be sourced from differences in cultivar, growing region and applied cultural practices.

4. Conclusion

Bitter melon could be grown in Mediterranean region of Turkey. This plant fruits has some functional properties, especially on health. This plant seed oil had seven different fatty acids. And, the saturated/unsaturated fatty acid ratio was 0.48. The oil is very rich in conjugated linolenic acid (*α*-elestearic acid), which is protective against some cancer types. Therefore,

bitter melon seed oil is very valuable in terms of health purposes. The seeds, remaining after processing the fruits into different products, can be subjected to oil extraction. This is important for making additional profit from the plants.

References

Ali, M.A., Sayeed, MA., Reza, M.S., Yeasmin, M.S., & Khan, A.M. (2008). Characteristics of seeds from different varieties of Linn. cultivated in Bangladesh. *Czech Journal of Food Sciences*, 26(4): 275-283.

Anonymous (1983). Gıda Maddeleri Muayene ve Analiz Yöntemleri. T.C. Orman ve Köyişleri Bakanlığı, Gıda İşleri Genel Müdürlüğü, Genel Yayın No: 65, Ankara.

Arora, A., & Chaudhary, S. (2012). Potential source of α-eleostearic acid of *Momordica charantia* seed oil of arid zone plants of Rajasthan, India. *International Journal of Basic and Applied Sciences*, 2 (2): 59-62.

Behera, T.K., Behera, S., Bharathi, L.K., John, K.J., Simon, P.W., & Staub, J.E. (2010). Bitter gourd: Botany, horticulture, breedings, pp: 101-141. In: Janick, J., (ed.), Horticultural Reviews, Volume 37, Wiley Blackwell, USA.

Garces, R. & Mancha, M. (1993). One step lipid extraction and fatty acids methyl esters preperation from tree plant tissues. *Analitical Biochemistry*, 211: 139-143.

Grover, J.K., & Yadav, S.P. (2004). Pharmacological actions and potential uses of *Momordica charantia*: A Review. *Journal of Ethnopharmacology*, 93: 123-132.

Horax, R., Hettiarachchy, N., Kannan, A., & Chen, P. (2010). Proximate composition and amino acid and mineral contents of *Momordica charantia* L. Pericarp and seeds at different maturity stage. *Food Chemistry*, 122: 1111-1115.

Khan, S.A. (2007). Bitter Gourd (*Momordica charantia*): A potential mechanism in anti-carcinogenesis of colon. *World Journal of Gastroenterology*, 13 (11): 1761-1762.

Krishnaiah, D., Sarbatly, R., & Nithyanandam, R. (2011). A review of the antioxidant potential of medicinal plant species. *Food and Bioproducts Processing*, 89: 217-233.

Kubola, J., & Siriamornpun, S. (2008). Phenolic contents and antioxidant activities of bitter gourd (*momordica charantia* l.) leaf, stem and fruit fraction extracts *in vitro*. *Food Chemistry*, 110: 881-890.

Li, Q.Y., Liang, H., Chen, H.B., Wang, B., & Zhao, Y.Y. (2007). A new Cucurbitane triterpenoid from *Momordica charantia*. *Chinese Chemical Letters*, 18: 843-845.

Lin, K.W., Yang, S.C., & Lin, C.N. (2011). Antioxidant constituents from the stems, and fruits of *Momordica charantia*. *Food Chemistry*, 127: 609-614.

Lucas, E.A., Dumancas, G.G., Smith, B.J., Clarke, S.L., & Arjmandi, B.H. (2010). Health benefits of bitter melon (*Momordica charantia*). pp: 525-549. In:

Watson, R.R., Preedy, V.R. (eds.), Bioactive Foods in Promoting Health: Fruit and Vegetables. Academic Press, UK.

Maiti, R.K., Devi, M.U., Padmavathi, V., Rani, T.S., & Pinero, J.H. (2008). Biochemistry and food value of bitter gourd (*Momordica charantia*). *International Journal of Agriculture, Environmentand Biotechnology*, 1(4): 236-244.

Meenakshi, N., Vadivel, E., & Kavitha, M. (2007). Response of bitter gourd (*momordica charantia* l.) on fruit yield and quality traits as influenced by fertigation levels. *Asian Journal of Horticulture*, 2 (2): 126-130.

Mulani, T.G., Musmade, A.M., Kadu, P.P., & Mangave, K.K. (2007). Effect of organic manures and biofertilizers on growth, yield and quality of bitter gourd (*Momordica charantia* L.) cv. Phule Green Gold. *Journal of Soils and Crops*, 17 (2): 258-261.

Nyam, K.L., Tan, J.P., Lai, O.M., Long, K., & Che Man, Y.B. (2009). Physicochemical properties and bioactive compounds of selected seed oils. *LWT-Food Science and Technology*, 42: 1396-1403.

Padmavathi, V., Maiti, R.K., & Rani, T.S. (2009). Therapeutics and food value of bitter gourd. *International Journal of Agricture, Environment and Biotechnology*, 2(3): 310-314.

Raja, M., & Shanthi, A. (2009). Stability studies in bitter gourd (*Momordica charantia* L.) under different nutrio environments. *Asian Journal of Horticulture*, 4 (1): 108-111.

Raman, A., & Lau, C. (1996). Anti-diabetic properties and phytochemistry of *Momordica charantia* L. (Cucurbitaceae). *Phytomedicine*, 2(4): 349-362.

Tsuzuki, T., Tokuyama, Y., Igarashi, M., & Miyazawa, T. (2004). Tumor growth suppression by α-eleostearic acid, a linolenic acid isomer with a conjugated triene system, via lipid peroxidation. *Carcinogenesis*, 25 (8): 1417-1425.

Tuan, P.A., Kim, J.K., Park, N., Lee, S.Y., & Park, S.U. (2011). Carotenoid content and expression of phytoene desaturase genes in bitter melon (*Momordica charantia*). *Food Chemistry*, 126: 1686-1692.

Wu, S.J., & Ng, L.T. (2008). Antioxidant and free radical scavenging activities of wild bitter melon (*Momordica charantia* Linn. var. *abbreviata* Ser.) in Taiwan. *LWT-Food Science and Technology*, 41: 323-330.

Yuwai K.E., Rao K.S., Kaluwin C., Jones G.P. & Rivett D.E. (1991). Chemical composition of *Momordica charantia* L. fruits. Journal of Agricultural and Food Chemistry, 39: 1762–1763.