Evaluation of physicochemical property and fatty acid composition of *Opuntia elatior* seed oil

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Abstract

Seed oil extracted from *Opuntia elatior* was analyzed for its physicochemical properties such as acid value, iodine value, saponification value, unsaponifiable matter and fatty acid composition. The assessment of fatty acid composition using gas liquid chromatography shows the presence of 15.65% saturated fatty acids and 84.35% unsaturated fatty acids. Linoleic acid was the dominating fatty acid followed by oleic and palmitic acids respectively. The oil analysis showed that the Iodine value, Acid value, Saponification value and Unsaponifiable matter were 110.95, 1.64, 191.85 and 2.65 respectively. *Opuntia elatior* appears to be a good potential source of seed oil for industrial utilization.

Keywords: seed oil; fatty acids; physicochemical characteristics.

Introduction

Opuntia elatior is a member of the Cactaceae family. The fruit is an oval, elongated berry, consisting of a thick pericarp with a number of clefts of small prickles, dark reddish in colour, with a luscious sweet pulp intermixed with many small hard seeds. The ripe fruits of *Opuntia* sp. are 30-220 g in weight contain pulp (39-67 %), seeds (10-15 %) and peel (31-51 %). Many authors have studied the traditional uses of *Opuntia* sp. (Kirtikar and Basu, 1999; The Wealth of India, 2001; Duke and Vasquez, 1994; Galt and Galt, 1978; Barbera *et al.*, 1992). Major studies have been done on the phytoconstituents of *Opuntia* sp. (Retamal *et al.*, 1987; Rodriguez-Felix and Cantwell, 1988; Batista *et al.*, 2003). Kossori *et al.* (1998) reported mineral composition of *O. ficus-indica* seeds along with protein content. Nassar (2008) studied amino acids composition of prickly pear seed flour and its protein concentrate. Other authors have studied the nutritional significance of *Opuntia* sp. (Stintzing *et al*., 2001; Piga, 2004; Stintzing and Carle, 2005; Feugang *et al.*, 2006). A remarkable number of studies have been reported on ethnopharmacological actions of *Opuntia* sp. such as Analgesic and Anti-inflammatory (Park *et al.*, 2001; Loro *et al.*, 1999), anticancer (Sreekanth *et al.*, 2007), antidiabetic (Domínguez-López, 1995; Cicero *et al.*, 2004; Frati *et al.*, 1989a, 1989b, 1990a, 1991; Roman-Romas *et al.*, 1991, 1995; Ibanez-Camacho *et al.*, 1979, 1983; Frati *et al.*, 1988, 1990b; Trejo-González *et al.*, 1996; Gonzalez *et al.*, 1996), Anti-hyperlipidemic & Hyper-cholesterolemic (Fernandez *et al.*, 1992; Frati, 1992; Gurbachan and Felker, 1998; Galati *et al.*, 2003; Jones *et al.*, 2000), Antioxidant (Tesoriere *et al.*, 2002, 2003, 2004, 2005a, 2005b; Stintzing *et al.*, 2005; Zourgui *et al.*, 2008), Antiulcer (Galati *et al.*, 2001, 2002a), antiviral (Ahmad *et al.*, 1996; Mtambo *et al.*, 1999), Diuretics (Galati *et al.*, 2002b), Immunomodulatory (Schepetkin *et al.*, 2008), improving platelet function (Wolfram *et al.*, 2003), Neuroprotective (Jungsook Cho *et al.*, 2003; Jung-Hoon Kima *et al.*, 2006), and Antispermatogenic (Gupta *et al.*, 2002). Prickly pear seeds were first characterized (Sawaya *et al*., 1983) and showed that the seeds of *Opuntia ficus-indica* are rich in minerals and sulphur amino acids. A reserve protein from the seeds has been isolated and characterized (Uchoa *et al*., 1998).

The prickly pear seed oil composition and its chemical characteristics were investigated (Sawaya and Khan, 1982; Salvo *et al*., 2002). Monitoring of seed composition of prickly pear fruits during maturation period

(Coskuner & Tekin, 2003). However, studies on the physicochemical characteristics and fatty acid composition of seed oil of *O. elatior* are up to now unknown.

The majority of the products use the juice of the cactus pear, while the seeds are usually discarded. The ratio of low water requirement and high water-use efficiency supports the expansion of cactus production, as stated by the Food and Agriculture Organisation (Barbera *et al.*, 1995). Annual production of prickly pear can reach 50 tons/hectare under most favourable condition (Dominguez-Lopez, A., 1995). Therefore, *Opuntia* will be a significant fruit crop for revitalization in arid and semiarid areas. Seeds constitute about 10-15% of the edible pulp and are usually discarded as waste after extraction of the pulp. Oil from the seeds of *O. ficus-indica* constitutes 8-12% of whole seed weight and is characterised by a high degree of linoleic acid (Sawaya & Khan, 1982; Pimienta-Barrios, 1994; Stintzing *et al*., 2000). Moreover, no data about the seed is yet available. In the present study, we analysed the seeds to obtain information about the physicochemical characteristics of seed and fatty acid composition of seed oil in *O. elatior* which will serve as a basis for further detailed chemical investigation and nutritional evaluation. The results will be important as an economic utility of cactus pear as a new source of seed oil. Being an organic natural plant *O. elatior* appears to be a good potential source of seed oil for industrial utilization.

Materials and methods

Sampling

O. elatior is declared as a noxious weed in semi-arid regions of Saurashtra (Gujarat) India. Fresh mature fruits were collected from the hedges of the plant in any field during the month of August, 2012. The specimen collected was identified with the help of Flora of the Indian Desert (Bhandari, 1995). After separating, the seeds were washed with distilled water several times and air-dried at ambient temperature.

Extraction and analysis of oil

O. elatior seeds were powdered without removing the testa and then extracted completely with petroleum ether (40-60 ºC) in a Soxhlet apparatus for 6 - 8 hours. The thimble is taken out dried and the contents are finely ground in a mortar. The material is again transferred to the thimble and extraction is continued for one hour. The resulting extract was filtered and the solvent was evaporated using rota evaporator leaving behind yellowish oil. It was analysed for its various physicochemical properties by AOCS standard methods (Link., 1973).

Gas liquid chromatography (GLC) analysis of fatty acid methyl ester

The fatty acid analysis was carried out as per Bureau of Indian Standards (548, part III) testing procedures using a NUCON-GLC chromatograph with a flame ionization detector (FID). The column used was 30M x 0.53 mm I.D. 5.0 µm DB-1 Type MXT-1 capillary column. Sample injection was done at 60 ˚C and the temperature programming was set for 2 ˚C rise per minute till a maximum of 280 ˚C. The total run time was 40 min. Each fatty acid was identified by comparing its retention time with that of a Sigma-Aldrich standard fatty acids mixture.

Results and discussion

The major objective of the present work was to study the physicochemical properties of the seed oil and fatty acid composition of *O. elatior*, as presented in Table 1. Seed oil content in *O. elatior* was 13.6 %. According to the results obtained by Coskuner and Tekin (2003) in a study of *O. ficus-indica*, because the palmitic acid content is closer to ours (12 versus 12.18 %), but the content of linoleic acid is lower (52 versus 65.81 %). The observed difference is possibly due to the degree of maturity of the fruit; however, some authors have also suggested that there was an increase in saturated fatty acid content towards the end of fruit maturation. Linoleic acid is the major component (65.81 %), followed by oleic (16.88 %) and palmitic acids (12.18 %). Stearic and Eicosadienoc acids were detected in *O. elatior* seed oil in low amounts 3.47 % and 1.66 %, respectively.

The saponification value was 191.85, which indicates amount of saturated fatty acids in the oil, and the iodine value was 110.95. Acid value and unsaponifiable matter were 1.64 and 2.65 respectively. The ratio of saturated to unsaturated fatty acid was 15.65:84.35 %.

Table 1. Physicochemical characteristics and fatty acid composition of *Opuntia elatior* (Mill.) Willd. seed oil.

Characteristics	Results
Acid value	1.64
Iodine value	110.95
Saponification value	191.85
Unsaponifiable matter	2.65
Fatty acid	
C16:0 - Palmitic acid	12.18 %
C18:0 - Stearic acid	3.47 %
C18:1n9c - Oleic acid	16.88 %
C18:2n6c - Linoleic acid	65.81 %
C20:2 - Eicosadienoic acid	1.66 %

Conclusions

The oil analysis show that the iodine value and saponification value in *Opuntia elatior* was higher than *O. ficus-indica*. The Palmitic acid concentration in *O. elatior* was 12.18% while in *O. ficus-indica* it was 9.32%. Eicosadienoic acid (EDA) was found to be present only in *O. elatior*, and was not reported from *O. ficus-indica*. Thus the results obtained prove the presence of an essential Omega-6 fatty acid (EDA) which improves the economic utility of cactus pear as a potential source of seed oil.

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