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Research Article

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Effect of two Extraction Methods and Harvest Period and Performance there Statement of Fatty Oils of Figs Pear Seed

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ABSTRACT

The fatty acid composition and physico-chemical characteristics of the seeds lipid fraction of two Opuntia ficus indica (Issa and Moussa) varieties in southern Morocco from two solvent extraction methods and cold, were studied during the maturation period. Solvent extraction is more profitable (from 7.89 to 11.86%) than cold mechanical extraction (3.47 to 8.08%). Performance is optimal for the end of July 'Isa' and the end of October for 'Musa'. It turned out that the oil seeds of O. ficus indica is rich in unsaturated fatty acid (89.86%). Linoleic acid is the most dominant (64.13%), followed by oleic acid (25.73%), palmitic acid (14.6%) and stearic acid (10.63%). Linoleic acids are saturated and become oleic and stearic towards the end of the maturation period. The two methods of extraction, solvent and cold have different effects on oil yield but no remarkable difference was observed between the effects of the two methods on fatty acid composition of two cultivars Opuntia ficus indica oils.

Key words: *Opuntia ficus indica, lipid fraction seeds, extraction methods, maturation period, fatty acid.*

INTRODUCTION

In ancient times, it knows that the other therapeutic application of plants and the use of their juices, it's what made say without doubt that botanical evidence that God has created, in each country, the most necessary plants to humans and animals in the same country[3].

The various known properties of plants are related to the great source of complex chemical molecules they represent and operated by humans in the food, cosmetic, medicinal and pharmaceutical[4]. These molecules are stored in oils that are found in different parts of the plant: the fruit, leaves, pulp, roots and seeds.

The prickly pear is one of the plants that nothing is to throw. Whether it residues snowshoes or fruit, each part of the plant is an excellent fertilizer[3].

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Prickly pear seeds are 10-15% of the edible pulp and are usually discarded as waste after extraction of the pulp[17]. They are a relatively untapped source of the lipid fraction that is 7 to 15% by weight of the whole seed and is characterized by a high degree of unsaturation wherein the linoleic acid is the main fatty acid in the order of 56, 1 to 77% [14,19,20]. This acid is said to be essential because it can not be synthesized by the body and must be supplied in the diet. In addition, oleic acid, unsaturated fatty acid, has an effect particularly interesting in the regulation of cholesterol and other cosmetic virtues, medicinal and pharmaceutical[7,8].

The unsaturated oil of prickly pear seeds depends on the quantity and quality of several factors. The harvest period or maturation and geographic region are among the determinants[7].

The composition of the seed oil has been studied[12,13,18,19] while the operating Technology of this oil is still limited[5,10].

In this study, we compared the effect of two extraction of oils of prickly pear seeds methods (Musa and Issa) Aït Baamrane Performance and studied the influence of each method on the physicochemical characteristics and the fatty acid composition of the oil in question, depending on the date of collection.

MATERIALS AND METHODS

Seeds were collected from fruits of *Opuntia ficus indica* (L.) Mill. two varieties harvested in the region of Ait Baamrane in 2009. Issa variety, early, was harvested every ten days from early July to late August. The variety Moussa, late, was picked every ten days from September to October. The fruits were harvested in the cooperative Tighmarte region of Ait Baamrane, whose main activity is the extraction and upgrading of the cactus. The fruits were picked and placed in plastic crates. For each variety, fruit, carefully selected, were collected every ten days for their maturation period.

Fruit selection is based on the fruit weight which is not the same for both varieties. For variety Aissa, weighing between 90 and 100 g, while the weight of the Musa variety varies from 95 to 120 g. Next, the fruits are washed in running water and dried in air and protected from light. The fruits were then peeled and the grains are separated from the pulp using a cooking manual grinder, the grains thus separated and washed with water were dried in an oven in the dark at 35 °C.

These operations were carried out in three repetitions. For a total of 75 kg collected on the same date and divided into 3 quantities of 25 kg each, we completed the grinding of dried fruit. Thus the grain stage, we obtained for the three amounts, on average 500 g.

The oil was extracted from 500 g of seeds of each sample corresponding to a period of harvest. Two extraction methods have been used:

- Solvent Extraction: The seeds were crushed in a grain mill. The oil was extracted in a soxhlet for 7 hours with hexane. After removing the solvent in a rotary evaporator, the oil recovered was weighed and stored at -20 ° C.
- Extraction by cold pressing: screw press IBG Monforts Oekotec was used. The recovered oil was decanted, weighed and then stored at -20 ° C.

Acid values, saponification, peroxides and iodine were defined according to the AFNOR NF T60-204 standard NF T60-206, NF T60-220 and T60-203 AFNOR NF, 1981) in ISO 3961.

The profile of the oils of fatty acids was determined by gas chromatography; fatty acids are saponified with a methanolic KOH solution and then esterified with a solution of BF3 in excess methanol. The fatty acid esters were then extracted by hexane and analyzed by gas chromatography (Varian CP3800). The column used is fused silica column capill ary 100 m long and 0.2 μ m internal diameter. The device has the injector type Varian 1177 and a FID detector. The temperature is maintained at 50 ° C for 2 minutes to be then increased by 5 ° C / min to 180 ° C (ISO 5509, 1978 (F), AFNOR, 1995). The standard used for the identification is C4-C24 FAME mix (Sigma-Aldrich. Supelco).

RESULTS AND DISCUSSION

Oil yields seeds of *Opuntia ficus indica* from extraction by cold pressing are considerably lower than those obtained by solvent extraction (Table 1).

The seeds of two Prickly Pear varieties (*Opuntia ficus indica*) in the region of Ait Baamrane in southern Morocco, harvested at different maturation periods, gave the best yield of oil by solvent extraction (7.89 - 11.86%) than by cold mechanical extraction (3.47 to 8.08%). The yield is optimal to late July for 'Issa' and late October for 'Musa'.

The yield of oil from the seeds of *Opuntia ficus indica* was approximately 13.6% [19]. Other deferred seed oil contents were first reported by source of prickly 6.96% in Turkey[7], 9.88% in Germany in Berlin[15], 10.43% in Egypt[13], 10.90% in Tunisia in the Sfax region[15], 10.43% in Egypt[13], 10.90% in Tunisia in the Sfax region[8] and 11.75% in the Tunis region[12]. This study reveals oil content of around 11.86%. These differences may be related to geographic or genetic conditions because the oil content of the crop varies among cultivars, soil and climatic conditions of the region[6].

The different physicochemical indices of oil *Opuntia ficus indica* are shown in Table 2. The oil extracted from the seeds of both cultivars, from the two types of extraction, presented a very low acid value, which proves the purity and stability of these oils. The peroxide value is of the order of 1.43 for oil *Opuntia ficus indica*, from cold pressure extraction, and 1.84 for the following solvent extraction. These peroxides index values are less than 10 meq O2 / kg oil which characterize most conventional oils[9]. Indeed, lower peroxide index values 10 mEq O2 / kg oil are generally regarded as indicating an acceptable level of oxidation[16,23].

Table 1: The percentage of oil obtained after Solvent Extraction and Extraction by cold pressing (harvested in 2009)

Cultivar	Date de récolte	Cold pressing	Solvent
'Issa'	10/07	7.33 ± 0.03	10.80 ± 0.04
	20/07	8.08 ± 0.02	11.86 ± 0.02
	30/07	6.86 ± 0.04	11.14 ± 0.03
	10/08	5.826 ± 0.05	10.24 ± 0.05
	20/08	5.86 ± 0.05	10.04 ± 0.06
	30/08	5.33 ± 0.06	9.80 ± 0.07
'Moussa'	10/09	3.47 ± 0.07	7.95 ± 0.03
	20/09	4.85 ± 0.05	7.92 ± 0.03
	30/09	4.23 ± 0.06	7.89 ± 0.03
	10/10	5.90 ± 0.02	7.79 ± 0.04
	20/10	5.02 ± 0.04	9.04 ± 0.03
	30/10	5.54 ± 0.03	9.64 ± 0.02

Results are expressed as mean ± standard deviation

Table 2 : Physico-chimical index of *Opuntia ficus indica* oil

Indices	Solvent		Cold pressing	
	Cultivar Issa	Cultivar Moussa	Cultivar Issa	Cultivar Moussa
Indice d'iode (g d'I2/100 g d'huile)	129.33 ± 4.67	119.03 ±4.77	113.77 ±2.65	108.47 ±2.65
Indice d'acidité	0. 011 ±0.006	0.0074 ±0.006	0.01 ±0.002	0. 007 ±0.002
Indice de saponification (mg de KOH/g d'huile)	196.38 ±0.001	196.38 ±0.001	209.47 ±26.18	209.33 ±25.89
Indice de peroxyde (meq O2/kg d'huile)	1.84 ±0.01	1.84 ±0.01	1.43 ±0.01	1.43 ±0.01
Indice de réfraction (20□)	1.46 ±0.001	1.46 ±0.001	1.46 ±0.001	1.46 ±0.001

Results are expressed as mean ± standard deviation

The saponification value, obtained from following solvent extraction oil, is 196.38, while that of celleissue extraction by cold pressure is of the order 209.47. These values are comparable to the saponification number of the usual oils (FAO, 1981), such as soybean (189-195), peanut (187-196) and cotton (189-198).

For tested, cultivars the refractive index is 1.46 for the oil from the two types of extraction. This value is comparable to values reported by Ennouri *et al.*,[8] and by Karleskind and Wolff[11].

The iodine value is in the range of 129.33-119.03 for oil extraction after solvent, and 113.77-108.47) for the following cold pressure extraction, reflecting the high level of unsaturated fatty acids of this oil. GPC chromatography, carried out on the oil samples OFI, from two types of extraction for both cultivars, indicates the existence of three prominent peaks (Table 3 and 4). This is linoleic acid (57.03-64.13%), oleic acid (15.73- 25.73%) and palmitic acid (10.97-14.6%). The first two fatty acids for an average of 89.86% of total fatty acids, indicating that this oil is highly unsaturated.

The amount of linoleic acid in the oil *O. ficus indica* is higher than in most commonly consumed oils such as corn, soybean and cotton seeds and is close to that of safflower oil[21]. In general, the level of unsaturation high seed oil of *O. ficus indica*, particularly the high level of linoleic acid in combination with low linolenic acid which affects the stability of the oil, said the seeds *O. ficus indica* may be an excellent source of oil potential.

The seed oil of *O. ficus indica* was found purely unsaturated (89.86%), this result is similar to those of other authors[12,19]. The difference in the percentage of fatty acids may be based on the degree of maturity of the fruit. In addition, Ennouri *et al.*[8] determined a palmitic acid content (9.32%) lower than our result (14.6%) and a high linoleic acid content (70.3%). These results are partly similar to those of Ramadan and Morsel[15] and Coskuner Tekin[7], Sawaya and Khan[19] and Mannoubi *et al.*[12]. The differences in the concentrations of oleic, linoleic and palmitic possibly depend on the degree of maturity of fruits and geographical and temporal factors.

Based on the variation of the percentages of seed oil fatty acids of *Opuntia ficus indica* of both cultivars from the two types of extraction throughout the period of maturation, we found that linoleic acids was converted to oleic and stearic acids. Ripening said top 63.62% for linoleic acid, 6.13% for stearic acid and 15.14% for oleic acid, while the end of maturation was registered a decrease in the percentage of linoleic acid (57.03%) and an increase of the stearic acid (8.84%), and oleic acid (20.32%) (Table 3, Issa cultivar). In parallel, a palmitic acid decreased slightly during the period of maturation, and other amino acids remained nearly constant during this period. These results are in agreement with those of Coskuner and Tekin[7].

Methods of extraction do not have a pronounced effect on the fatty acid composition of oils extracted or their percentages. GPC chromatography, carried out on the oil samples OFI, from two types of solvent extraction and cold for two cultivars revealed that these samples have the same types of fatty acids and that the percentage of they have undergone a similar pattern with a slight variation for the two types of extraction (Table 2 and 3).

Table 3: **Rate (%) of the principal fatty acids by solvent pressing method of *Opuntia ficus indica* oil of both cultivars Issa and Moussa**

Varieties	Harvest period	C_6	C_{14}	C_{16}	$C_{16.1}$	$C_{17.1}$	C_{18}	$C_{18.1n\ 9C}$	$C_{18.2n\ ;-t}$	$C_{18.2n\ ;-C}$	C_{20}	$C_{20.1}$	$C_{20.3n.6}$	$C_{18.3n3}$	C_{21}	$C_{22\ .1n9}$	$C_{22\ .6n.3}$	C_{24}
Issa	10/07	0.03 ±0.02	0.1 ±0.1	12.77 ±0.6	0.39 ±0.06	0.05 ±0.02	6.13 ±0.07	15.14 ±0.16	0.28 ±0.08	63.62 ±0.09	0.37 ±0.05	0.3 ±0.06	0.06 ±0.02	0.02 ±0.01	0.06 ±0.03	0.03 ±0.02	0	0.06 ±0.03
	20/07	Nd	0	12.68 ±0.3	0	0	7.9 ±0.2	15.20 ±0.4	Nd	62.72 ±0.14	0.58 ±0.13	0	0.01 ±0.01	0.39 ±0.03	0.02 ±0.02	0.06 ±0.03	0.09 ±0.03	0.01 ±0.01
	30/07	0	0	14.19 ±0.12	0.01 ±0.01	0	4.33 ±0.14	16.52 ±0.06	0.12 ±0.02	58.93 ±0.10	Nd	0.36 ±0.12	0.19 ±0.04	0.30 ±0.20	Nd	0.23 ±0.03	0.14 ±0.02	3.91 ±0.07
	10/08	0	0.01 ±0.01	11.12 ±0.05	0.02 ±0	0.87 ±0.05	7.46 ±0.04	15.15 ±0.03	1.45 ±0.06	61.34 ±1.07	0	0.37 ±0.03	0.01 ±0.01	0.37 ±0.02	0.02 ±0.02	0.06 ±0.02	1.17 ±0.03	0.07 ±0.03
	20/08	0	0.14 ±0.03	11.65 ±0.07	Nd	0.02 ±0.01	6.38 ±0.05	16.81 ±0.09	0.07 ±0.04	61.81 ±0.11	0.01 ±0.01	0.50 ±0.30	0.23 ±0.03	0.38 ±0.05	0.02 ±0.02	0.05 ±0.03	0.01 ±0.01	0.12 ±0.03
	30/08	0	0.02 ±0.01	10.97 ±0.07	0.01 ±0.01	0.23 ±0.03	8.84 ±0.07	20.32 ±0.03	0.38 ±0.62	57.03 ±0.08	0	0.51 ±0.09	0.26 ±0.07	0.02 ±0.02	0.01 ±0.01	0.23 ±0.02	0.72 ±0.06	0.06 ±0.02
Moussa	10/09	0.15 ±0.05	Nd	12.87 ±0.12	0.32 ±0.08	0.02 ±0.02	4.27 ±0.07	21.43 ±0.13	0.32 ±0.05	58.6 ±1.5	0.26 ±0.04	0.44 ±0.05	0.33 ±0.04	0.32 ±0.10	0.01 ±0.01	0.35 ±0.07	0.51 ±0.05	0.10 ±0.02
	20/09	0.02 ±0.01	0	12.08 ±0.10	0.68 ±0.04	0.02 ±0.02	9.98 ±0.04	15.60 ±0.38	1.42 ±0.21	58.39 ±0.41	0.23 ±0.08	0.43 ±0.07	0.27 ±0.06	0.27 ±0.03	0.03 ±0.02	0.02 ±0.02	0.41 ±0.04	0.02 ±0.01
	30/09	0.10 ±0.03	0.02 ±0.02	12.27 ±0.36	0.04 ±0.03	0.03 ±0.03	4.48 ±0.18	18.69 ±0.36	0.06 ±0.03	61.87 ±0.15	0.28 ±0.06	0.45 ±0.12	0.33 ±0.09	0.32 ±0.08	0.06 ±0.05	0.30 ±0.08	0.24 ±0.05	0.06 ±0.05
	10/10	0.41 ±0.08	0.02 ±0.02	11.80 ±0.33	0.11 ±0.04	0.09 ±0.06	4.10 ±1.20	20.35 ±0.40	0.08 0.03	60.15 ±0.14	0.27 ±0.03	0.45 ±0.08	0.30 ±0.03	0.40 ±0.20	0.07 ±0.04	0.25 ±0.07	0.27 ±0.08	0.07 ±0.04
	20/10	0.03 ±0.02	0.02 ±0.01	12.83 ±0.98	0.02 ±0.02	0.11 ±0.03	3.97 ±0.05	17.36 ±2.30	1.84 ±0.18	59.00 ±2.40	Nd	0.41 ±0.02	0.2 ±0.1	0.36 ±0.11	0.04 ±0.03	0.17 ±0.07	0 0.05	0.04 ±0.03
	30/10	0.21 ±0.08	0.03 ±0.02	11.59 ±0.32	0.06 ±0.05	0.18 ±0.10	4.24 ±0.42	18.89 ±0.25	2.07 ±0.01	57.83 ±0.21	0.23 ±0.05	0.14 ±0.06	0.22 ±0.06	0.26 ±0.08	0.04 ±0.03	0.22 ±0.07	0.14 ±0.05	0.05 ±0.04

Results are expressed as mean ± standard deviation
Nd : Not detected

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Table 4: Rate (%) of the principal fatty acids by cold pressing method of *Opuntia ficus indica* oil of two cultivars Issa et Moussa

Varieties	Harvest period	C_6	C_{14}	C_{16}	$C_{16.1}$	$C_{17.1}$	C_{18}	$C_{18.1n\ 9C}$	$C_{18.2n\ ;-t}$	$C_{18.2n\ ;-C}$	C_{20}	$C_{20.1}$	$C_{20.3n.6}$	$C_{18.3n3}$	C_{21}	$C_{22\ .1n9}$	$C_{22\ .6n.3}$	C_{24}
Issa	10/07	Nd	0.03 ±0.02	6.50 ±1.70	0.74 ±0.36	0.03 ±0.02	3.09 ±0.06	16.27 ±0.26	0.06 ±0.03	61.88 ±0.11	0.00	0.23 ±0.12	0.02 ±0.02	0.3 ±0.05	0.03 ±0.03	0.03 ±0.02	0.09 ±0.02	0.02 ±0.02
	20/07	Nd	0	11.77 ±0.14	0.06 ±0.04	0.03 ±0.03	10.53 ±0.75	14.80 ±0.26	Nd	61.27 ±0.70	0	0.46 ±0.08	0.02 ±0.02	0.47 ±0.23	0.02 ±0.02	0.07 ±0.05	0.02 ±0.02	0.03 ±0.03
	30/07	Nd	Nd	11.48 ±0.55	Nd	Nd	3.83 ±0.15	16.15 ±0.26	0.58 ±0.31	63.58 ±0.04	0.31 ±0.19	0.28 ±0.19	0.24 ±0.09	0.19 ±0.10	Nd	0.12 ±0.02	0.19 ±0.08	0.26 ±0.10
	10/08		0	11.55 ±0.24	0.66 ±0.07	Nd	3.94 ±0.24	15.75 ±0.28	Nd	59.13 ±0.18	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
	20/08	Nd	0.03 ±0.03	9.60 ±0.12	0.35 ±0.07	0.25 ±0.13	3.4 ±0.19	17.74 ±0.06	Nd	49.96 ±0.33	0.56 ±0.28	0.61 ±0.31	0.05 ±0.03	0.44 ±0.15	0.17 ±0.02	0.42 ±0.08	0.13 ±0.09	0.03 ±0.02
	30/08	Nd	2.10 ±0.17	10.29 ±0.17	0.11 ±0.03	0.13 ±0.07	4.39 ±0.10	25.73 ±0.35	0.36 ±0.09	56.00 ±0.13	0.26 ±0.07	0.32 ±0.15	0.23 ±0.09	0.26 ±0.08	0.03 ±0.03	0.02 ±0.02	0.54 ±0.17	0.06 ±0.05
Moussa	10/09	0.42 ±0.06	0.09 ±0.06	14.60 ±0.03	0.15 ±0.06	0.05 ±0.04	3.96 ±0.09	17.97 ±0.15	0.13 ±0.09	58.32 ±0.69	0.29 ±0.11	0.40 ±0.14	1.33 ±0.63	0.21 ±0.09	0.06 ±0.02	0.29 ±0.06	0.04 ±0.03	0.54 ±0.15
	20/09	**Nd**	0.02 ±0.02	12.59 ±0.62	0.02 ±0.02	0.01 ±0.01	4.37 ±0.54	16.23 ±0.41	0.24 ±0.07	64.13 ±0.12	0.27 ±0.09	0.14 ±0.06	0.27 ±0.04	0.28 ±0.09	0.04 ±0.03	0.29 ±0.13	0.64 ±0.19	0.07 ±0.04
	30/09	**Nd**	0	11.47 ±0.26	0.03 ±0.02	0.02 ±0.02	5.76 ±0.23	17.80 ±0.07	0.22 ±0.12	61.81 ±0.27	0.27 ±0.09	0.41 ±0.12	0.25 ±0.07	0.30 ±0.08	0.03 ±0.02	0.38 ±0.13	0.97 ±0.04	0.08 ±0.07
	10/10	0.01 ±0.01	0	12.80 ±0.07	0.73 ±0.07	0.09 ±0.03	4.95 ±0.12	15.62 ±0.60	0.21 ±0.06	63.15 ±0.19	0.03 ±0.03	0.42 ±0.07	0.31 ±0.09	0.33 ±0.12	0.02 ±0.02	0.06 ±0.02	0.34 ±0.12	0.02 ±0.02
	20/10	0	0	11.76 ±0.17	0	0.03 ±0.02	10.63 ±0.08	14.77 ±0.07	Nd	61.40 ±0.07	0	0.43 ±0.05	0.25 ±0.07	0.26 ±0.11	0.03 ±0.02	0.26 ±0.04	0.01 ±0.01	0
	30/10	**Nd**	0	10.92 ±0.89	0.04 ±0.04	0.24 ±0.13	4.70 ±1.53	15.37 ±3.52	1.49 ±0.59	57.47 ±5.54	0.29 ±0.09	0.46 ±0.44	0.33 ±0.19	0.07 ±0.02	0.1 ±0.02	0.03 ±0.02	0.02 ±0.02	0.68 ±0.68
	06/11	0	0.04 ±0.03	12.84 ±0.28	0.63 ±0.12	0.15 ±0.07	6.84 ±0.23	12.64 ±0.16	1.71 ±0.34	52.60 ±0.24	Nd	0.63 ±0.25	0	0.03 ±0.03	0.02 ±0.02	0.04 ±0.03	0.04 ±0.04	0.02 ±0.01
	10/11	Nd	0.03 ±0.03	13.23 ±0.18	0	0.37 ±0.23	7.70 ±0.41	13.80 ±0.24	1.64 ±0.09	61.11 ±0.16	0.02 ±0.02	0.40 ±0.12	0.25 ±0.08	0.33 ±0.13	0.03 ±0.03	0.05 ±0.03	0.69 ±0.47	0.02 ±0.01

Les résultats sont exprimés en moyenne± écart type

Nd : Not detected

CONCLUSION

The use of the seeds for their oil content may not be economically viable, even if the oil appears to be a great source of excellent vegetable oil. But given the high value of linoleic acid and oleic and value of the iodine value, *Opuntia ficus indica* oil is classified as oleic / linoleic oils like olive oil. It has a clear rule on it because of its richness in linoleic acid.

In this work, we tried to quantify the oil content and fatty acid composition of the two varieties of *Opuntia ficus indica*. We found that oil yield is better by solvent extraction (7.89 to 11.86%) than by cold mechanical extraction (3.47 to 8.08%), it is optimal at the end of July 'Isa' and the end of October to Moussa '.

As for the oil composition, it turned out that this is purely unsaturated oil 89.86%. Linoleic acid is the predominant fatty acid, followed by oleic acid, and palmitic acid. Linoleic acid are saturated and are converted into oleic acid and stearic towards the end of the maturation period.

These results argue that the two methods of extraction, solvent and cold affect oil yield. By cons, they have no obvious influence on the fatty acid composition of oils of *Opuntia ficus indica* of both cultivars.

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