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Effects of storage conditions on Argan oil quality of Beni Snassen natural forest

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ABSTRACT

Argan oil from- Beni Snassen natural Argan forest (East of Morocco)- displays a good nutritional value related to the high quality of its unsaturated fatty acid. Traditional processes of Argan oil extraction contribute to this quality. Fatty acid analysed by gas chromatography and the measure of peroxide index show that Argan oil traditionally extracted doesn't resist to oxidation and it's storage doesn't exceed 3 months. The quality of Argan oil is related to seeds storage conditions. The study of lipid composition evolution of Argan seeds during 5 months and at different storage conditions show that Argan seeds stored at low temperature (4°C) and in the freezer (- 20°C) present a stability of fatty acid composition than Argan oil from seeds stored in textile bags and black polyethylene bags at ambient temperature.

Keywords: Argan oil, fatty acids, peroxide index, storage.

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INTRODUCTION

The Argan tree (*Argania spinosa*), belonging to the Sapotacées family, is the only one representing the Argania kind in North Africa. It is a relic and endemic tree of Morocco [2, 6]. The Argan tree covers a coastal strip on most of the Souss plain, especially the catchment areas of the High Atlas. It is also present in the mountains of Beni Snassen, where it was very little studied. The UNESCO triggered in1998 a protection program targeting this specy which was considered as an international cultural heritage for humanity.

The Argan tree is an interesting example of the fruit-bearing woody and multi-purpose species. Its fruits contain an oleaginous almond from which an oil of economic interest is extracted mainly in traditional ways, in spite of the recent introduction mechanized extraction processes.

Consequently, most Argan oils found on the market do not meet the quality standards. Indeed, the extraction of oil implies several operations, which often proceed under uncontrolled conditions.

We underscore the existence of several scientific studies, related to the Argan oil of South-western Morocco such as works of Farines & *al*. [9, 10], Maurin [13] Mourin & *al*.[14], Charrouf & *al*. [7] and Rahmani [17] and others. However, no research has been devoted to the Argan oil of North-eastern Morocco so far.

Other works show a great sensitivity of Argan oil to oxidation [11]. This finding constitutes a major problem of storage. Hence the interest and purpose of this study targeting mainly the development of Argan oil quality through the study of the effects of storage conditions on the quality of the Argan oil extracted in a craft manner and that of seeds before the extraction.

MATERIALS AND METHODS

Vegetable equipment

The study considers traditional Argan oil extraction as well as Argan fruit almonds.

Artisanal oil

It was obtained by the artisanal extraction [8, 15] starting from almonds of the fruits collected in summer (2005) in the Argan natural forest of Jbel Tikermine (Beni Snassen) in the region of Chuihia- Berkane (North-eastern Morocco).

Fruits

The fruits were collected in the same area during the month of August 2005. This period corresponds to the maturation and the fall of fruit. After harvest, the fruits are exposed to the sun. The pulp, thus dried, is separated from the core. The almond is obtained after crushing.

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Treatment of storage

The Argan oil, extracted in an artisanal way, is stored for 5 months (as from August) in plastic bottles at ambient temperature (artisanal storage). The almonds, are separated in five batches and stored under various conditions for five months (as from August): free air at ambient temperature in textile bags at ambient temperature and black polyethylene bags at ambient temperature with cold storage at 4°C and the freezer at -20°C. The extraction and fatty acids of each batch are analyzed for each month, for 5 months, to follow the evolution of the fatty acids corresponding to each treatment.

Measurement of the peroxide index

The measurement of the peroxide index was carried out on Argan oil extracted by the artisanal way every month for 8 months according to AFNOR method [1].Three repetitions were performed.

Extraction and lipid analysis

The extraction of the lipids was made from almonds fixed in boiling water using a mixture (chloroform/methanol) according to the Blight and Dyer method [3]. Before analysis, by gas chromatography, the oil extracted in the artisanal way and the almond lipids are saponified, and their fatty acids are made volatile by methylation [4]. The methyl esters are quantified using an internal standard: héptadecanoïque acid for each treatment. The extractions and the analysis were repeated 3 times. The evolution of the composition in fatty acids of artisanal oil and almonds lipids is thus followed according to the time and according to the various conditions of storage.

RESULTS

Effects of the method of extraction on the composition in fatty acids of Argan oil

The examination of table 1 shows that Argan oil resulting from the Beni Snassen Argan natural forest (Eastern Morocco) is rich with unsaturated fatty acids (more than 80%). Oleic acid (C18: 1) and linoleic acid (C18: 2) are the most important fatty acids, expressed as a percentage, which confers on this oil a good nutritional quality [5]. By comparing the results of the two methods of extraction, we notice that the Argan oil produced in an artisanal way is slightly less rich in unsaturated fatty acids (C18: 1 = 42.60% and C18: 2 =33,80%) than that extracted by Blight and Dyer method [3] (C18: 1 = 46.20% and C18: 2 = 36.10%).

Table 1: Composition in fatty acid (in percentage) of the oil extracted by the artisanal way and that extracted by BLIGH and DYER method

Fatty acid	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3	C20:0	C22:0	C24:0	C22:1	other
Artisanal extraction	_	15.2	7.1	42.6	33.8	0.6	0.2	0.1	0 .2	_	0.9
Extraction by BLIGH & DYER method	0.04	11	5.3	46.2	36.1	0.8	0.2	0.3	0.2	_	0.6

C14 :0 = Myristic acid, C16 :0 = Palmitic acid, C18 :0 = Stearic acid, C18:1:Oleic acid, C18:2= Linoleic acid, C20:0= Arachidic acid, C22:0= Behenic acid, C24:0= Lignoceric acid, C22:1= Erucic acid

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Effect of the storage of the Argan oil extracted by the artisanal way on its composition in fatty acid

The peroxide index of Argan oil samples extracted by the artisanal way was set with an aim of evaluating the effect of conservation time on oxidation of oil. The values of peroxide index (figure 1) remain stable during the first three months (0,70 meq O2/kg). From the fourth month, this index increases until it reaches 1,50meq O2 /kg. Then the index remains stable as from five months. The evolution of the peroxide index shows that Argan oil traditionally extracted starts to deteriorate as from the third month. This deterioration becomes more important as from the fifth month. This is confirmed by the results of table 2, which shows that the oil preserved for five months presents an important reduction in the percentage of the unsaturated fatty acids. It moves down from 42.60% just after the extraction to 26.70% after five months for C18: 1 and from 33.80% to 21.90% for C18: 2. Thus the average life of Argan oil extracted traditionally does not exceed three months.

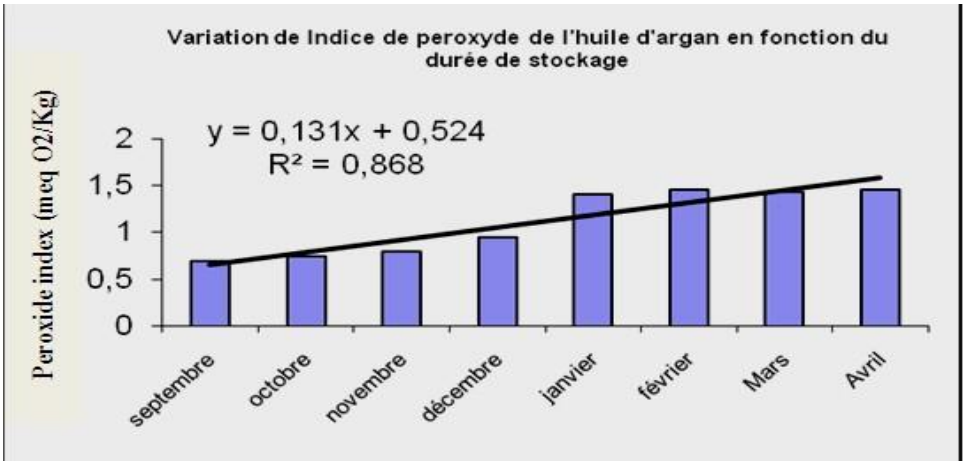

Figure 1: Variation of peroxide Index of argan oil according to the storage period.

Table 2: Percentage of the fatty acids in artisanal oil just after the extraction and after 5 months.

Fatty acid	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3	C20:0	C22:0	C24:0	C22:1	other
Just after extraction	_	15.2	7.1	42.6	33.8	0.6	0.2	0.1	0 .2	_	0.9
after five months of extraction	_	30.4	20.2	26.7	21.9	0.1	0.1	0.08	0.2	_	0.6

C14 :0 = Myristic acid, C16 :0 = Palmitic acid, C18 :0 = Stearic acid, C18:1:Oleic acid, C18:2= Linoleic acid, C20:0= Arachidic acid, C22:0= Behenic acid, C24:0= Lignoceric acid, C22:1= Erucic acid

Influence of the techniques of seeds storage on the composition in fatty acids of almonds

The seeds almonds stored in free air at ambient temperature (figure 2) present, according to time, a reduction in the percentage of their unsaturated fatty-acids (C18: 1 and C18: 2) and an increase in that of the saturated fatty acids (C16: 0 and C18: 0). Concerning seeds stored in textile bags at ambient temperature (figure 3), the almonds show an

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increase in the percentage of the saturated fatty acids. However, linoleic acid (C18: 2) remains stable whatever the period of storage.

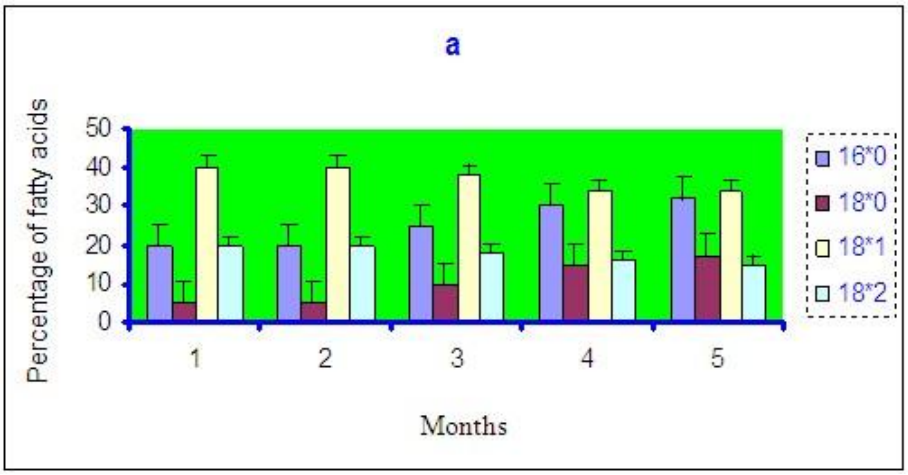

Figure 2: Variation of the composition in fatty acids of almonds of argan seeds stored in free air at ambient temperature

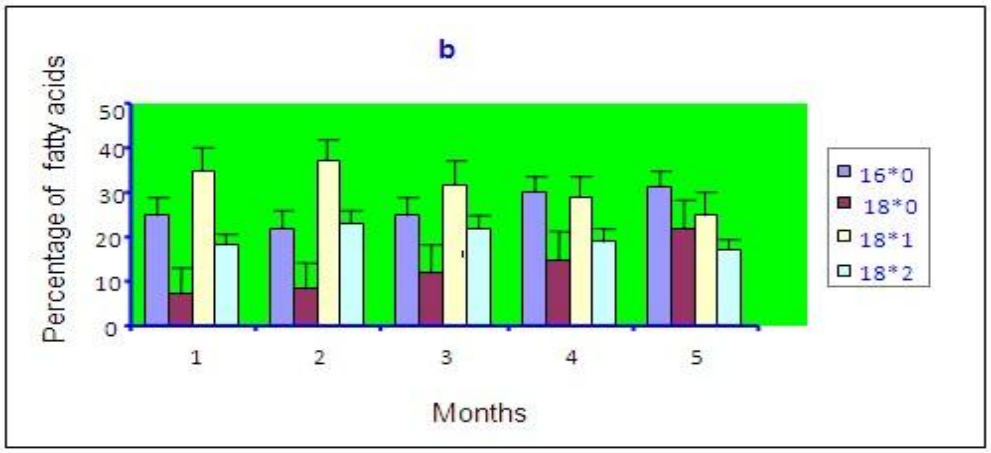

Figure 3: Variation of the composition in fatty acids of almonds of argan seeds stored in textile bags at ambient temperature

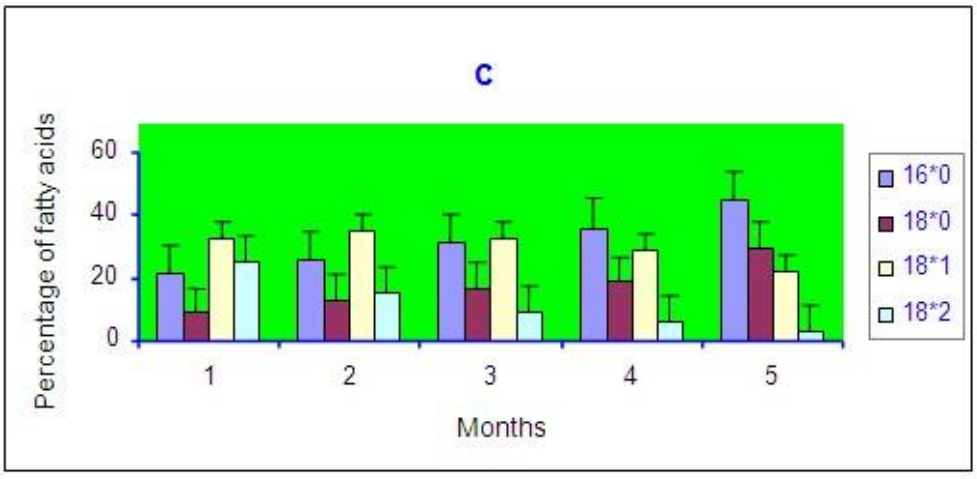

Figure 4: Variation of the composition in fatty acids of almonds of argan seeds stored in black polyethyene bags at ambient temperature

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The almonds resulting from seeds stored in black polyethylene bags (figure 4) present the greatest variations according to the time of storage. Indeed, the saturated fatty acids increase enormously as expressed in percentage. Palmitic acid (C16: 0) reached 20% after 1 month of storage and 45% after 5 months and the stearic acid (C18: 0) increase from 8% after 1 month to 30% after 5 months. Parallel to this increase, percentage of C18: 2 witness an important reduction according to the duration of storage. It falls down from 26% after 1 month to 4% after 5 months.

When the seeds are stored in cold storage (4°C) (figure 5) and in the freezer (- 20°C) (figure 6), the percentage of the fatty acids remains stable or varies very slightly whatever the duration of storage.

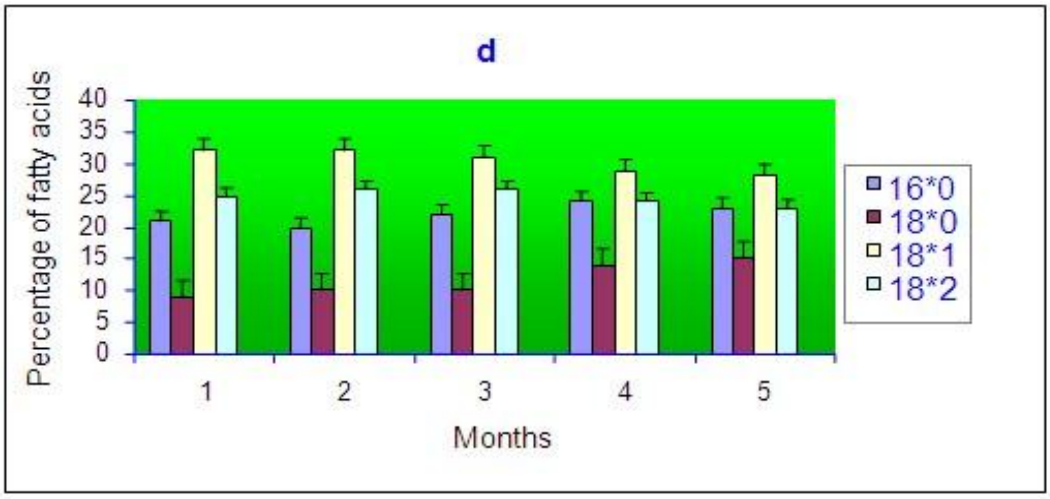

Figure 5: Variation of the composition in fatty acids of almonds of argan seeds stored in cold storage (4°C).

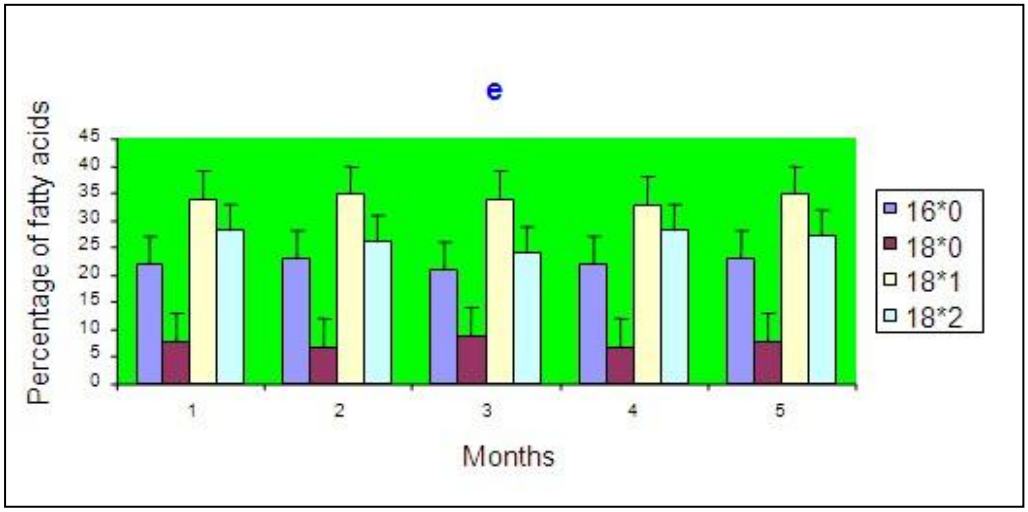

Figure 6: Variation of the composition in fatty acids of almonds of argan seeds stored in the freezer (- 20°C).

DISCUSSION

From harvest to the production of oil, the fruits, seeds, almonds and Argan oil undergo various operations carried out under uncontrolled traditional conditions. Among these critical operations, we can mention the conditions of storage of oil and seeds. The

results obtained in this research paper show that Argan oil resulting from Beni Snassen forest is rich with unsaturated fatty acids (more than 80%). Oleic acid (C18: 1) and linoleic acid (C18: 2) are the most important fatty acids expressed as a percentage; what confers on this oil a good nutritional quality [5].

The Argan oil produced traditionally is slightly less rich in unsaturated fatty acids than that extracted by Blight and Dyer method [3]. This could be related to the bad conditions of craft oil extraction (addition of water, hygiene, storage of almonds before the extraction). The same remarks were made in the works of Hammadi [11] which showed that the Argan oil extracted in an artisanal way badly preserves dietetic qualities than that extracted by the power press.

The evolution of the peroxide index according to time shows that Argan oil artisanally extracted starts to deteriorate as from the third month. This deterioration becomes more important as from the fifth month. The increase in the peroxide index is due to the oxidation of the unsaturated fatty acids leading to their oxidative rancidity (self-oxidation and photo oxidation) [17].

The composition in fatty acids of artisanal oil preserved for five months presents an important reduction in the percentage of the unsaturated fatty-acids (C18: 1 and C18: 2). Thus the average life of Argan oil artisanally extracted does not exceed three months. Its fast oxidation is probably due to the bad conditions of extraction and conservation. Indeed the artisanal process of extraction, incorporating important quantities of water, modifies the composition of oil by impoverishing it in particular of polyphenols, which are antioxidant agents relatively polar and hydrophilic. The water traces, unseparated of oil, also support the process of accelerated rancidity of oil, and that is related to its wealth of unsaturated fatty acids [17].

Increase in the quantity of the saturated fatty acids (C16: 0 and C18: 0) in almonds seeds stored in the open air, in textile bags or black polyethylene bags at ambient temperature show the deterioration of the quality of almonds and consequently that of the oil extracted from this one. Indeed, oxidation is the major cause of the degradation of oils and fats [16]. The degradation of the unsaturated fatty acids is underlined in the case of seeds stored in black polyethylene bags and that could be due to the physiological activity of almonds since they are under conditions of moisture and exposed to ambient temperatures that may reach 35°C. These conditions are favorable to the thermal reactions responsible for the degradation of the unsaturated fatty acids and production of energy. They can also be a precursor to the synthesis of new molecules, which causes the acidification of the oils extracted from the almonds [12].

The stability of the unsaturated fatty acids of almonds resulting from cold stored seeds or frozen ones is allotted to the inhibition of the biochemical reactions in particular the activity of the lipoxygenase [12].

CONCLUSION

Argan oil is rich in unsaturated fatty acids in particular in oleic acid and linoleic acid which confers to it a good nutritional quality. However, the artisanal extraction of oil and its

storage for periods higher than three months involve a deterioration of its quality appearing by a reduction of its content of unsaturated fatty acids. The storage of Argan seeds at cold conditions allows a better conservation of their contents of saturated and unsaturated fatty acids and consequently we obtain oil with a very good nutritional quality.

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