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Abstract—In Algeria, some fruit trees produce fruits in free nature. Such trees are Celtis australis, Crataegus azarolus, Crataegus monogyna and Zizyphus lotus. In spite of their appreciable consumption, their nutritional value remains unknown. The objective of this study is the determination of sugars in the pulp and almond of the above fruits. The biochemical analysis shows that these fruits present interesting contents of soluble sugars which confers significant caloric intakes to them. As well as significant fibres which give them therapeutic and industrial benefits? The analysis of the almonds shows that it contains considerable contents of sugars which enable them to be an energetic food.

Keywords—Celtis australis, Crataegus azarolus, Crataegus monogyna, Zizyphus lotus, Fibres, Soluble sugars.

I. INTRODUCTION

In the world and in Algeria, certain fruit trees grow in a spontaneous state and adapt to multiple ground and climate. Certain species produce fruits such as:

Celtis australis, a vigorous tree which grow in the wild state in Algeria [1]. It is especially localized in the east of the country, known under the name “n’chem, tegza, meiss” [2]. It is also found in the Mediterranean region [3]—[6], as well as in the north of Mexico [7]. The fruits called micocoulas, are about the size of a large black purple pea (10 to 12 mm diameter). The pulp is reddish, dry and thin of insipid savour [6]. These fruits are rich in fibres, proteins and minerals [5].

Crataegus azarolus, the hawthorn shrub with a height of 5 to 10 m [8]. It resists the dryness and the cold [9]. In Algeria, it is especially localized in the tell algero-constantinois region, and known under the name of "zaaoura" [10].

The fruit called the azerole, is a small fruit in the apple shape, from 1 to 3 centimeters diameter. When it matures, its skin color changes from white cream to yellow. Its flesh is delicately fruity [11,12]. It is rich in sugars, minerals and vitamin C [13].

Crataegus monogyna, a dense shrub [14]. It is found in all Europe, the Occidental Asia and in north Africa [15].

Elaeagnus angustifolia, a vigorous shrub, it is remarkable by its great resistance to the dryness [1]. The fruits are ovoid drupes of 1 cm length, of yellow color [1]-[11]. It is a spontaneous plant, which grow in the Mediterranean zone [16]. In Algeria, the tree is mainly localized in the high regions. It is rich in soluble and reducing sugars, fibres, minerals and vitamins [17]-[18].

Zizyphus lotus, the jujube tree is 2 to 3 m in height, with many ramifications [1]-[19]. Its fruits are round from 1 to 2 cm in diameter. At maturity, it has a brown skin, a very sweetened and farinaceous ochre flesh, wrapping a small seed with a diameter of 4 to 5 mm [20]-[21]. It is found in the south of Spain, Portugal, Greece and mainly in North Africa [19]. It is very common in North of Algeria. It is known under the name of "sedra", "nbeg", "azar". Fruits are rich in amino acids, sugars, phosphorus and ascorbic acid [4].

Although, these fruits are very appreciated by the Algerian population and in particular the children, their consumption remains seasonal and their nutritional values are unknown.

Up to date, the scientific work done on these species relates primarily to the study of their botanical characteristics. The biochemical characterization of the fruits is incomplete. The references which relate to the processing of the fruits are scarce. Hence, this work is aimed to study the glucidic fraction of these fruits.

II. MATERIAL AND METHODS

The vegetable material used in this work is composed of five fruits from five different areas in Algeria. Celtis australis, Crataegus azarolus, Crataegus monogyna, Elaeagnus angustifolia and Zizyphus lotus, coming respectively from the areas of Batna, Mila, Ain toutsa, Tazoult and Bounia. The harvest of these fruits was made during the year 2006, between September and December. Fruits were stored in a freezer at (-4°C) until analysis.

A. Moisture Content

The moisture content was determined by heating at 103 °C until stabilization of sample weight [22].

B. Total Sugars

The proportioning of total sugars was carried out by the method of Dubois in the presence of a standard range of glucose at 470 nm [23].
C. Reducing Sugars
The proportioning of reducing sugars, was carried out by the method of Fehling [24].

D. Sucrose
Sucrose content is obtained by the difference between the soluble sugar content and reducing sugars [25].

E. Energetic Contribution
The energetic contribution of the fruits at summer is calculated by multiplying the soluble sugar content for each fruit by the coefficient of Atwater which is: 3.6kcal [25].

F. Cellulose
Cellulose content at summer was determined by the method of Weende according to Iso-AFNOR (NF-v-03-040, 1977) [26].

G. Pectin
Pectin content at summer was carried out by the method of Lopes and Rao (2006) [27].

H. Chromatography
Soluble sugar profile at summer was evaluated by thin layer chromatography [28].

III. RESULTS AND DISCUSSION

A. Moisture Content

The fruits of *Crataegus azarolus* and *Crataegus monogyna* presented high moisture content similar to that of dry dates, which confirms the juicy state of these fruits and allows them to be classified as intermediate fruits between the moist fruits (80 to 90 %) and the dry fruits (20 to 40 %).

As for the other species *Celtis australis*, *Elaeagnus angustifolia* and *Zizyphus lotus*, they have average moisture contents and are regarded as dry fruits.

B. Total Sugars

The interesting contents presented by the fruits of *Elaeagnus angustifolia* (17.02 %) and of *Celtis australis* (16.71 %) are rather close to those of grape (16.5 %) and cherry (15 %) given by Régal [29]. While the fruit of *Crataegus monogyna* (11.45 %), *Zizyphus lotus* (10.55 %) and *Crataegus azarolus* (9.86 %) contain average contents which are close to apricot (10 %) given by Régal [29]. The variation of the sugar contents could be due to several factors such as differences in variety, age of the plant, load of the trees and environmental factors. According to the obtained results, these fruits could constitute a considerable source of soluble sugars.

D. Sucrose
Sucrose content of the fruits of *Celtis australis* (2.8 %) is identical to that of apple red Joly variety (2.8 %) given by Levaillez [30]. Whereas the fruits of *Crataegus azarolus* and *Zizyphus lotus* present contents in the interval of (6 to 9 %) given by Apfelbaum and Roman [31]. As for the fruits of *Crataegus monogyna* and *Elaeagnus angustifolia*, their sucrose content is close to that of apple varieties, sweet Auvergne (3.8 %) given by Levaillez [30].
The fruit of *Zizyphus lotus* has a cellulose content close to the interval (5.24-7.81%) reported by Li [32].

**G Pectin**

T*e* content of *pectin* present in the fruit of *Crataegus azarolus* is similar to cherry (0.44). In addition, the high content of the other species (*Elaeagnus angustifolia*), *Crataegus monogyna* and *Zizyphus lotus* exceeds those found in *t*he best sources of pectin, *e*ach as *cassia* (1.2%), *q*uite (0.6 to 0.7), including the interval of 0.57-0.79% found by Li [32], and similar with that for *orange* and even less than that of dry peas (4.02%) given by Ba'e [33].

From these results, one can say that *t*he fruit is an *i*deal pectin. *T*his means that it is possible to produce jams from these fruits or to exploit these pectins after extraction order to increase the gelling capacity of certain fruits whose gelliting capacity is weak.

**Chromatography**

The fruit of *Crataegus azarolus* contains cellulose and *Celtis australis* provides energetic contributions which are comparable to the energy value of apple (54 Kcal) or cherry (68 Kc·l). In addition, the fruits of *Crataegus azarolus*, *Crataegus monogyna* and *Zizyphus lotus* provide moderate caloric intake which makes them suitable at the same level as raspberries (38 Kc·l).

**F. Cellulose**

The fruit of *Crataegus australis* contains cellulose at 4.40%. For the fruit of *Zizyphus lotus*, the cellulose content is close to the interval (5.24-7.81%) reported by Li [32].

**E. Energetic Contribution**

**Table 1**

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Energetic contribution</th>
<th>Kcal</th>
<th>KJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elaeagnus a. angustifolia</td>
<td>63.03</td>
<td>263.46</td>
<td></td>
</tr>
<tr>
<td>Celtis australis</td>
<td>60.15</td>
<td>251.42</td>
<td></td>
</tr>
<tr>
<td>Crataegus m. monogyna</td>
<td>40.14</td>
<td>167.78</td>
<td></td>
</tr>
<tr>
<td>Zizyphus lotus</td>
<td>37.98</td>
<td>158.75</td>
<td></td>
</tr>
<tr>
<td>Crataegus az. robus</td>
<td>35.49</td>
<td>148.34</td>
<td></td>
</tr>
</tbody>
</table>

*Fig. 4 sucrose of the fruits of *Crataegus australis*, *Crataegus azarolus*, *Zizyphus lotus* (g/100 g of matter dried)*

*Fig. 5 cellulose of the fruits of *Celtis australis*, *Crataegus azarolus*, *Zizyphus lotus* (g/100 g of matte dried)*

*Fig. 6 pectin of the fruits of *Celtis australis*, *Crataegus azarolus* and *Zizyphus lotus* (g/100 g of matte dried)*
quince, blackcurrant, raspberry where the majority of sugars are glucose and fructose whereas the sudden sucrose has hydrolysis under the effect of invertase during maturity.

The sugar composition of the fruits of *Zizyphus lotus* and *Crataegus monogyna* is close to that of sins; mango, prickly pear, whose its carbohydrate is divided into a majority of sucrose, while glucose and fructose are in small quantities. According to the results, these fruits contain simple sugars, directly assimilable.

IV. CONCLUSION

At the end of our research on the study of the carbohydrate fraction of the fruits of *Celtis australis*, *Crataegus azarolus*, *Crataegus monogyna*, *Elaeagnus angustifolia* and *Zizyphus lotus*, we conclude that:

The high content in water of the fruits is due to the high contents recorded mainly by the fruits of *Crataegus azarolus* of *Crataegus monogyna*. This allows their transformation into juice.

As for the modest contents found in the fruits of *Elaeagnus angustifolia*, *Celtis australis* and *Zizyphus lotus*, they allow a better conservation during their storage.

The significant contents of soluble carbohydrate presented by the fruit of *Elaeagnus angustifolia*, *Celtis australis*, *Zizyphus lotus* and *crataegus azarolus* confer an appreciable caloric intake to them.

The interesting pectin content of the fruits, in particular the fruit of *Crataegus azarolus* and *Crataegus monogyna*, combined with the high cellulose contents confer therapeutic virtues and hypcholesterolémiantes to them.

The high content in pectin of these fruits will widen and diversify their use as fruits and allow their application in cosmetic and food industries.

The qualitative analysis of these fruits shows that they are composed mainly of simple sugars: glucose, fructose and sucrose with different proportions.

REFERENCES