BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS)
ISSN(P):2348-0521; ISSN(E):2454-4728
Vol. 3, Issue 8, Aug 2015, 1-14

PHYSICO-CHEMICAL AND NUTRITIONAL CHARACTERIZATION OF *ARBUTUS UNEDO* L. FROM THE REGION OF TIARET (ALGERIA)

DOUKANI KOULA & MIMOUN HADJER

Laboratory of Agrobiotechnology and Nutrition in Semi Arids Zones, Faculty of Nature and Life Sciences, University of Ibn Khaldoun, Zaaroura Tiaret, Algeria

ABSTRACT

In Algeria, wild berries Arbutus unedo L, known as "lendj" remain unexploited and little studies have been devoted to it. The presented work aims to study the physicochemical and nutritional characteristics of this fruit, The Arbtus unedo L. fruits are acidic (pH = 3.4 ± 0.005), rich in dietary fiber (18.63% ± 0.212) and polyphenols (21.13 mg GAE / g ± 0.03) and are an important source of vitamin C (527.21 mg / 100g) and malic acid (282.3 mg / 100g), but low in fat (0.68 ± 0.127%) and pectin (0.084% ± 0.002.

KEYWORDS: *Arbutus unedo L.*, Nutritional Value, Physicochemical Properties

INTRODUCTION

Fruits are important for human health because they contain vitamins, enzymes, minerals and natural sugars **(Akintunde et al., 2004).** They are an important source of vitamin C which is needed in the human diet to activate the antibodies that prevent and fight against diseases (such as scurvy in infants) (**Akintunde et al., 2004 and Iwe et al., 2003).** However, as arbutus fruits are seasonal and cannot be stored for long periods in their natural form **(Zakari et al., 2009).**

Indeed, Arbutus unedo L., a wild fruit known as "Lendj", is a shrub with persistent leaf which belongs to the Ericaceae family and grows in Mediterranean regions. It is located mainly in North Africa, primarily in Northern Algerian “Tell” **(IUCN, 2005).**

This shrub has long been used in traditional medicine in all Mediterranean countries, as infusions and decoctions of all parts of the plant: leaves, fruit, peels and roots. They are used to treat gastrointestinal and urological disorders, cardiovascular diseases such as hypertension and diabetes **(Oliveira et al., 2011).**

The fruits of Arbutus unedo L. are rich in sugars, vitamins, organic acids and phenolic compounds. They are used to produce jam, jelly and alcoholic beverages, but they are rarely eaten as fresh fruit **(Ayaz et al., 2000, Ruiz-Rodríguez et al., 2011 and Soufleros et al., 2005).** The Arbutus fruit is a little known from nutritional viewpoint. Nevertheless, there are few studies on its chemical composition; from Turkey, Algeria, Croatia, Portugal and Italy **(Alarcão-E-Silva et al., 2001; Ayaz et al., 2000; Barros and al., 2010; Celikel et al., 2008; Özcan & Haciseferoğullari, 2007; Pawlowska et al., 2006).** Indeed, Benamara and Allane **(2010)** conducted a study on the antioxidant activity of wild fruits among others *Arbutus* from Algeria.

In Algeria, very few studies have been devoted to the study this fruit; for this reason, we sought to collect data on their different physicochemical and nutritional characteristics

MATERIALS AND METHODS

Plant Material

The ripened fruit of *Arbutus unedo* L. (Figure 1) was collected from Guezoul forest locally know " Oued el Lendj", which is located on the western of the city of Tiaret (in the southern of Algeria) in November 2013. Indeed, harvesting was at an altitude of about 1040 m. These fruits are washed, wiped, sorted, and stored frozen at – 4 °C for analysis purposes.

Figure 1: *Arbutus unedo* L Fruit

Methods of Analysis

Water Content

The water content was determined by drying the samples at a temperature of 105 ° for 3 hours **(AOAC, 2000).**

Ash Content

The ash content was obtained by the calcination of the plant sample at 600 ° C for 5 hours **(AOAC, 2000).**

pH

Measuring the pH of the aqueous extract was carried out by means of a pH meter **(AOAC, 2002).**

Titratable Acidity

The titratable acidity was measured by titrating an aqueous solution of the sample with a solution of 0.1 N sodium hydroxide in the presence of phenol phthalein as color indicator **(AOAC, 2002).**

Soluble Solid Content

The soluble solids content was determined using an ABBE refractometer **(AOAC, 2000).**

Lipids

The lipids were extracted by petroleum ether using a Soxhlet extractor (GERHARD) **(AOAC, 1995).**

Crude Cellulose

The crude fiber content was determined after a successive treatment of the plant material with sulfuric acid and potassium hydroxide according to the method of Weende using an extractor (FIBREEC Heat extractor-1010) **(AOAC, 2000).**

Total Sugars

The total sugar content was determined by the phenol sulphuric dosage. The optical density was read at 490 nm **(Dubois *et al.*, 1956).**

Reducing Sugars

The determination of reducing sugars was carried out by using DNSA (dinitrosalicylic acid), the optical density was read at 540 nm **(Miller, 1972).**

Total Polyphenols

Polyphenols were extracted with methanol and dosed by the Folin-Ciocalteu at 760 nm according to **Singleton and Rossi (1965).**

Pectin

Pectin was deretmined as calcium pectate by the method of **Multon (1991)** after extraction with hot water and then saponification with NaOH and $CaCl_2$ precipitation in acidic medium.

Vitamin C

Vitamin C was extracted three times with phosphoric acid - acetic acid (3% and 8% H_3PO_3 HOAc). After centrifugation at 15,000 rpm for 10 minutes, the supernatant was added to 50 ml with distilled water (solution A). To determine the level of vitamin C, DL-Dithiothreiol (DTT) was used as the reducing agent 2 hours before its transmission through a filter of 0,45 mm in diameter and its injection into the HPLC. The analysis was performed at room temperature. The mobile phase was composed of 0.01% sulfuric acid (pH = 2.5-2.6) with a flow rate of 1 ml / min. Vitamin C was detected at 245 nm and quantified by comparison of the retention time of the chromatographic peak with the standard prepared by ascorbic acid **(Pallauf et *al.*, 2008).**

Vitamin E

A portion of 0.4 g of the sample was taken and mixed with 1 ml of ethanol. After sonication for 10 min, the mixture was centrifuged at 2,000 rpm for 3 minutes. 0,15 ml of n-hexane were added and mixed with the resulting supernatant. After drying the mixture, the residue was dissolved in methanol and filtered through a filter of 0,45 m in diameter and injected into the HPLC. The analysis was performed at room temperature. The mobile phase was composed of three solvents: methanol (A), acetonitrile (B) and chloroform (C). The flow rate was 1mL/min with 47% A, 42% B and 11% C. Vitamin E was detected at 296 nm and quantified from a calibration curve obtained with α-tocopherol **(Pallauf *et al.*, 2008).**

Organic Acids

Twenty grams of the sample was ground in a mortar. 10 ml of water-methanol (75:25) ($^{v}/_{v}$) were added and the mixture was centrifuged at 3,500 rpm for 30 minutes. The supernatant was collected and filtered through filter paper (Whatman No. 2). The chromatographic separation was performed at 214 nm. The mobile phase is 0.1% (w / v) of phosphoric acid in distilled water at a flow rate of 0.8 ml / min. The identification of each compound was made by comparison of retention time of each chromatographic peak with those of standard products prepared from oxalic acid, malic, citric, succinic and quinic. Quantification was performed by comparing the retention time of each compound with the retention time of standard solutions of oxalic acid, malic, citric, quinic and succinic **(Ergönül and Nergiz, 2010).**

RESULTS AND DISCUSSIONS

Water Content

Water content of the fruit of *Arbutus unedo* L. was 63.33% ± 0.0282 (Table N°1). This value is in the range 46.82% -71.89 cited by **Ruiz-Rodríguez et *al* (2011)**, but still lower compared to that found by **Favier et *al.* (1993)** which is (68.2%). Indeed, **Barros et *al.* (2010)** and **Ozan and Haciseferoğullari (2007)** found poorer outcomes; (59.7% ± 2.67) and (53.72 ± 2.1%) respectively. By comparing the water content of our sample to the fruits of the blackthorn (*Prunus spinosa* L) and rose (*Rosa canina* L) which are 60.86 ± 1.69% and 48.68% ± 0.91 respectively (**Barros *et al.*, 2010),** we find that they are inferior. The variation

Table 1: Results of the Physicochemical Analysis of the *Arbutus unedo* L.

Parameters	Results
Water content (%)	63,33 ± 0,0282[a]
Ashs (%)	0,68 ± 0,0141[a]
pH	3,475 ± 0,0057[a]
Tritratable Acidity (%)	2,144 ± 0,0773[a]
Lipids (%)	0,68 ± 0,1272[b]
Fibers (%)	18,63 ± 0,2121[b]
Total sugars (g/100 g)	9,68 ± 0,1331[a]
Reducing sugars (g/100g)	7,27 ± 0,2192[a]
Soluble Solids (%)	32,84 ± 0,5941[a]
Pectin (%)	0,084 ± 0,0021[b]
Polyphenols (mg GAE / g extract)	21,13 ± 0,0304[b]
Vitamin C (mg/100g)	527,21
Vitamin E (mg/100g)	3,06
Malic Acid (mg/100g)	282,3
Citric Acidic (mg/100g)	8,56
Oxalic Acid (mg/100g)	60,65
Quinic Acid (mg/100g)	Traces
Succinic acid (mg/100g)	Traces

a: 4 repetitions b: 3 repetitions

in water content due to different environmental conditions such as water availability, geographical distribution and exposure to sun and wind can contribute to the desiccation of the fruit (**Ruiz-Rodríguez *et al*., 2011)**

Ash

The analytical result of the content of ash fruit of *Arbutus unedo* L. is 0.68% ± 0.0141. Our result is slightly higher than that found by **Gonzalez et al (2011)** is 0.56 ± 0.15% but still lower compared to those found by **Barros *et al* (2010), Ruiz-Rodríguez *et al* (2011) and Ozan and Haciseferoğullari (2007)** which are respectively (1.71 ± 0.09%) (0.86%) and (2.82% ± 0.124). The ash content of the fruit of *Arbutus unedo* L. is lower compared to the fruit of blackthorn "*Prunus spinosa* L" and rosehips "*Rosa canina* L" which are of the order of (6.65% ± 2.03) and (3.47 ± 0.20%) respectively **(Barros et al., 2010).** The variation in ash content can be explained by the geographical origin of the samples, including climatic conditions and soil characteristics of soil, plant age, the period of the vegetative cycle, or even genetic factors.

Ph

The pH of the fruit of *Arbutus unedo* L. studied was 3.47 ± 0.0057 (Table N°. 1). This value is virtually identical to those found by **Ruiz Rodriguez (2011) and González *et al* (2011)** are (3.47 ± 0.12) and (3.50) respectively. Indeed,

Serçe et *al*. (2010) and Ozan and Haciseferoğullari (2007) gave pH values of 5.57 ± 0.07 and 4.6 ± 0.10 respectively for the same fruit. The differences depend on many factors including the climate and ripeness of the fruit.

Titratable Acidity

The studied fruit of *Arbutus unedo* L. has an acidity of 2.14% ± 0.0773; This value is much higher than the results found by **Serçe et *al.* (2010), and Ozan and Haciseferoğullari (2007) and Seker and Toplu (2010)** which are (0.67% ± 0.17), (0.4% ± 0.10) and (0.4%) respectively. However, our result is much higher than that reported by **Celikel et *al*. (2008)** who found values of 0.80 to 1.59%. The significant difference in acidity may be due to climatic conditions and the process of fruit ripening.

Lipids

We found that the amount of lipids in fruit of *Arbutus unedo* L. is 0.68% ± 0.1272 (Table N^{o} 1). This value is in agreement with those found by **Ruiz Rodriguez *et al* (2011)** who showed that the values are between 0.229 and 0.779%. In addition, **Barros *et al* (2010) and Ozan and Hacireferogullari (2007)** recorded lipids content of 1.37% ± 0.40 and 2.1 ± 0.10% respectively for the same fruit. While **Favier & *al*. (1993)** found a lower value which is (0.4%). By comparing the estimated lipid content in the fruit of *Arbutus unedo* L. with other wild fruits as common Eglantier (*Rosa canina* L) and Blackthorn (*Prunus spinosa* L), we notice that our result is higher compared to the result of Eglantier (0.65% ± 0.04) and significantly lower compared to Blackthorn (6.65% ± 2.03) (**Barros & *al.*, 2010).** Multiple parameters influencing lipid levels such as particle size, moisture, nature of the solvent and the extraction method used.

Fiber

The result of the determination of dietary fiber of *Arbutus unedo* L. is 18.63% ± 0.2121. This value is within the range quoted by **Ruiz Rodriguez *et al* (2011)** who showed that values ranging from 10.04 to 22.27%. Indeed, **Ozan and Haciseferoğullari (2007)** estimated a low dietary fiber for the same fruit which is 6.4% ± 1.10. According to **Ramlu and Rao (2003),** geographic location, soil conditions, the genetic, agronomic and climatic conditions of culture can also affect the fiber content of the fruit.

Total Sugars

The fruit of *Arbutus unedo* L. contains a concentration of 9.68 g / 100 g ± 0.1331 of total sugars. This value is lower compared to the results found by **Favier & *al*. (1993) and Ruiz Rodriguez & *al.* (2011)** showed that the values of (20g/100g) and (14.11 g/100g) respectively. This difference may be due to the variety, geographical origin and storage conditions. Many authors including **Munier (1973), and Nixon and Carpenter (1978) and Sawaya & *al*. (1983)** agree that sugars vary depending on the climate and stage of maturation. According **to Harlt (2011),** the sugar content of the fruit is a complex that is strongly influenced by the environment. **Dorais & *al.* (2001)** found in their research that the post-harvest factors including solar radiation, temperature, duration of exposure to the sun, the availability of water, the mineral content of the soil, irrigation and fertilization can affect the level of sugars in the fruit. In addition, other factors were added by **Kader (1986)** that the date of harvest handling techniques and storage conditions of fruit can also change the profile of fruit sugar. Results by different authors depend partly on the method used in the assay.

Reducing Sugars

The reducing sugar content of the studied fruit is 7.27 g / 100 g ± 0.2192 (Table N^{o} 1). This value is much lower compared to the founded results by **González & *al.* (2011) and Orak & *al.* (2011)** which reported values of 15.66 g / 100 g and 9.97 ± 1.20 g/100g ± 0.53 respectively. Several parameters influence the reducing sugar content ; different climatic conditions, stage of maturity and physiological state of the fruit during the analysis. According to **Ayaz *et al* (2000),** fructose and glucose are the major reducing sugars in the fruit of *Arbutus unedo* L. with proportions of 27.8% ± 0.32 and 21.5 ± 0.18% respectively

Soluble Solids

The total soluble solids content of fruit is 32.34% ± 0.5941. This value is slightly higher than the range quoted by **Celikel & *al.* (2008)** which is from 21.4 to 30%. Moreover, **Seker and Toplu (2010), Mùller & *al.* (2010) and Serçe & *al.* (2010)** reported lower values for the same fruit that are (16%) (8.1%) (11.9 %) respectively. By comparing the soluble solids in the fruit of *Arbutus unedo* L. with other wild fruits such as *Arbutus andrachanae* L., blackberries and raspberries, we find that the fruit of *Arbutus unedo* L. has a soluble solids content higher than that of *Arbutus andrachnae* (14%), blackberries (9.5%) and raspberries (6.2%) **(Seker and Toplu, 2010)**. Different parameters that can affect the rate of soluble solids are: climate, soil type and the process of fruit ripening **(Mùller & *al*, 2010).**

Pectin

We recorded a low pectin content which is 0.084% ± 0.0021. This value is significantly lower than that found by **Ruiz Rodriguez & *al.* (2011)** for the same fruitwhich is 2.95%. By comparing the pectin in the fruit of *Arbutus unedo* L. with other fruits, blackberries and raspberries, we note that our result is very low compared to blackberries and raspberries that are of the order of 0.72% and 0.6% respectively **(Hodgson and Kerr, 1991)**. This difference may be due to growing conditions and maturity. Thus, we can say that the results depend partly on the method used (dosage). Studies on guava (*Psidium gwajava* L.) showed that the content of pectic substances varies with the stage of growth, the season and the cultivar. In passing from the green fruit to mature fruit, the pectin content increases. This phenomenon is attributed to the action of polygalacturonases which act together with other enzymes such as pectin methylesterases **(Marcellin & *al.*, 1990).** The pectin content decreases with fruit ripening; however, this decline seems not affect the texture **(Myhara & *al.*, 2000).**

Polyphenols

The assay of total polyphenols gives us an overall estimate of the amount of different classes of phenolic compounds contained in the extract of the fruit of *Arbutus unedo* L. **(Pawlowska & *al.*, 2006).** The average value of the concentration of polyphenols our fruit is 21.13 ± 0.0304 mg GAE / g extract. Our result is significantly higher than those found by **Alarcão-e-Silva et al (2001), Tavares & *al.* (2010) and Orak & *al.* (2011)** which recorded values of (15.5 mg GAE / g), (18 mg GAE / g) and (14.29 mg GAE / g) respectively. By cons, **Barros & *al.* (2010),, Serçe & *al.* (2010) and Ruiz Rodriguez & *al.* (2011)** reported higher levels of polyphenols for the same fruit that are the order of (126.83 mg GAE / g of extract), (37.36 mg GAE / g of extract) and (1656 mg GAE / 100 g of extract) respectively. By comparing the polyphenols content of *Arbutus unedo* L. with other wild fruits, blackthorn (*Prunus spinosa* L) and *Eglantier* (Roasa canina L) ; we notice that these latters are higher in phenolic compounds which are 83.40 mg GAE / g and 143.17 mg GAE / g, respectively. In contrast, mulberry (*Rubus adenotrichus*) have a lower polyphenol content which is 6 mg GAE / g **(Barros & *al.*, 2010 and Gancel & *al.*, 2011).** Recent studies have shown that extrinsic factors (such as geographic and climatic factors), genetic factors, ans also the degree of maturation of the plant and storage time have a strong influence on the content of polyphenols **(Aganga, 2001, and Fiorucci, 2006). Patthamakaporn & *al.* (2007)** showed that the variation in polyphenol content could be due to cold storage conditions of fruit and on the other hand, they found that the content of polyphenols fruits of *Elaeagnus* decreases with the degree of maturation. Polyphenols are known for their antioxidant and biological virtues. They contribute to the prevention of degenerative diseases and cardiovascular diseases **(Scalbert & *al*., 2002, Henk & *al*., 2003 and Manach & *al*., 2004).** Polyphenols are able to scavenge free radicals generated continuously by the body **(Morelle, 2003 and Djeridane & *al*., 2006)**. They are involved in the prevention of cancer diseases **(Rice-Evans & *al*., 1995).**

Vitamin C

The vitamin C content of *Arbutus unedo* L. was 527.21 mg/100 g. This content was calculated from the chromatographic peak of vitamin C (see figure 3) by referring to the standard peak of ascorbic acid. This value is slightly lower than that found by **Alarcão-e-Silva *et al* (2001)** which is 542 mg / 100g for the same fruit. Moreover, the obtained result is much higher than those found by **Ruiz – Rodriguez *et al* (2011), Barros et al (2010) and Pallauf *et al* (2008)** which are (182 mg/100 g), (15.07 ± 0.77 mg/100g) and (5.05 ± 0.14 mg / 100g) respectively. By comparing our value to those found in other wild fruits, there is only the fruit of *Arbutus unedo* L. which has a high content of vitamin C in relation to the fruit of blackthorn (*Prunus spinosa* L) (15.69 ± 0.53 mg/100g) and common wild rose (*Rosa canina*) (68.04 ± 1.11 mg/100g) **(Barros & *al*., 2010).** Different levels of vitamins in fruits can be explained by the difference in varieties, genetic factors and environmental conditions. In addition, the collection period and their fruit maturation level, different post-harvest treatments are important factors for the observed differences. And that these variations can be attributed to the geographical origin (**Munzuroglu & *al*., 2003).** Indeed, we can say that the fruit of *Arbutus unedo* L. is a good source of vitamin C which also means natural antioxidants, and thus a functional food or an ingredient for functional foods. Vitamin C neutralizes free radicals and regenerates the antioxidant potential of vitamin E after its reaction with free radicals. It helps to strengthen the capillaries (the smallest blood vessels) and cell walls, and plays a role in the formation of collagen, a protein found in connective tissue. Hence, it activates healing and maintains healthy ligaments, tendons and gums. It promotes the production of hemoglobin in red blood cells and facilitates the absorption of iron from food **(Pacaud & Six, 2004).**

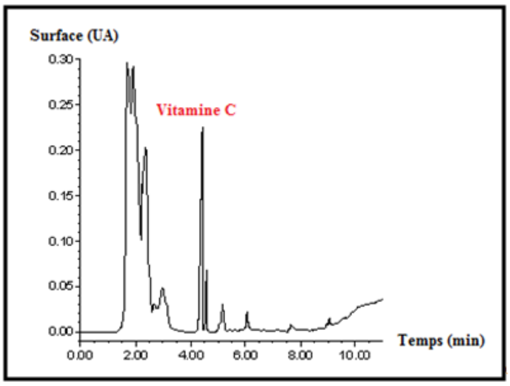

Figure 2: Chromatographic Peak of Vitamin C in *Arbutus unedo* L at 245 Nm

Vitamin E

The determined amount of vitamin E from the chromatographic peak in our fruit was 3.06 mg / 100g (see figure 4). This value is much higher than that found by **Pallauf et *al* (2008)** (0.0237 ± 0.001 mg/100g) but remains well below that recorded by **Barros et (2010)** (23.46 ± 0.26 mg/100g). By comparing the vitamin E content of strawberry fruit to other wild fruits, we note that our result is much lower than the fruits of blackthorn (*Prunus spinosa* L) and common rosehips (*Rosa canina*) which contain levels of vitamin E (9.25 mg/100 g) and (8.33 mg/100 g) respectively. Unlike recorded vitamin E may be due to a number of factors, including varieties, the method used for its determination, the natural variation in fruit, the use of fertilizers, agro-climatic conditions, the effect of solar radiation and geographic origin. In addition, certain conditions such as post-harvest transport time, storage time, may also affect the amount of vitamin E **(Assuncao and Mercadant, 2003, Boudries *et al.*, 2007, Chun & *al*., 2006, Javanmardi and Kubota, 2006 and Wall, 2006).**

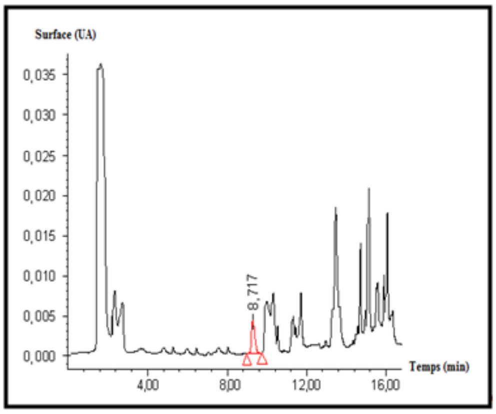

Figure 3: Chromatographic Peak of Vitamin E in *Arbutus unedo* L. at 296 Nm

Organic Acids

Different identified organic acids by HPLC were found in the fruit of *Arbutus unedo* L. are shown in figure 5. This figure shows that the malic acid is the predominant organic acid with a proportion of 282.3 mg/100g followed by oxalic acid and citric acid with proportions of 60.65 mg/100g and 8.56 mg/100g respectively. In fact, we recorded traces of succinic acid and quinic acid. **Ayaz & *al.* (2000)** reported high proportions of fumaric acid and malic acid in the fruit of *Arbutus unedo* L. var. *ellipsoidea* from Turkey which are (1.94 ± 0.07 mg / g), and (0.84 ± 0.06 mg / g). By cons, **Alarcão-E-Silva & *al.* (2001)** showed significant levels of quinic acid and malic acid are of the order of (7.35 ± 0.03 g/100g) and (5.99 ± 0, 03 g/100g) in the fruit of *Arbutus unedo* L. from Portugal. Malic acid is predominant in various fruits and other berries such as the fruit of *Rubus fruticosus* L and the fruit of *Vaccinium myrtillus* L have higher proportions (0.8 g/100g) **(Souci et *al.*, 2008).** In addition, **Ruiz - Rodriguez & *al*. (2011)** showed a total absence of citric acid and **Ayaz & *al*. (2000)** gave a minimum value which is 0.01 mg / g. Citric acid is a major acid in many fruits but absent in other berries such as *Vaccinium myrtillus* fruit and the fruit of *Rubus fructicosus* **(Rodriguez & *al*., 1992).** Concerning oxalic acid, **Ruiz-Rodriguez & *al*. (2011)** showed varying amounts of 0.05 to 0.15 g/100g ; *Arbutus unedo* L. contain a large proportion of oxalic acid with the exception of *Carambola* L. Averrhoa which has a content of 0.04 to 0.68 g/100 g. We recorded traces of succinic acid and quinic acid. Unlike **Ayaz & *al.* (2000)** showed that a high concentration of quinic acid (7.35 g/100g) in fruits of *Arbutus unedo* L. from Samsun (Turkey). Organic acids are generally intermediate metabolic process. They influence the growth of microorganisms and affect the quality of preservation. They are directly involved in the growth, maturation and senescence of fruit **(Al Farsi & *al*., 2005)**. These acids also affect the sensory properties of fruits **(Jadhav and Andew, 1977 and Siebert, 1999)**. The presence and composition of organic acids can be affected by various factors such as: the conditions of growth, maturity, season, geographical origin fertilization, soil type, storage conditions, the rate of exposure to sun and the harvest period **(Al Farsi *et al*., 2005 and Ahmed & *al.*, 1995).**

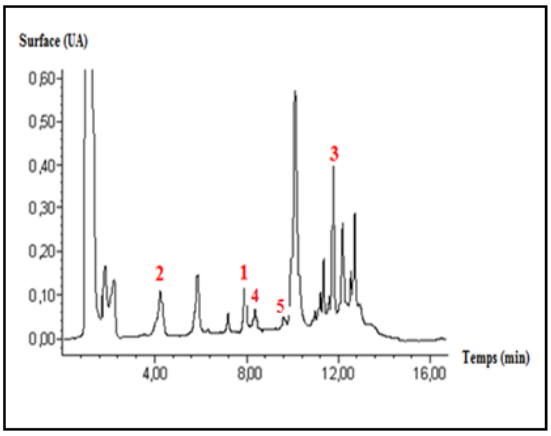

Figure 4: Chromatographic Peak of Organic Acids in the Fruit of *Arbutus unedo* L

1 - Citric acid, 2 - Oxalic acid, 3 - Malic acid, 4 - Quinic acid; 5 - Succinic Acid

CONCLUSIONS

This work focuses on the physicochemical and nutritional characterization of *Arbutus unedo* L. harvested in the region of Tiaret (Algeria).

The obtained results of the physicochemical analyzes revealed a humidity of (63.3% ± 0.028) and an ash content of (0.68 ± 0.014%). *Arbutus* fruit are acids because their pH (3.47 ± 0.0057) and titratable acidity (2.14% ± 0.077). Indeed, the fruits of *Arbutus unedo* L. have considerable levels of total sugars and reducing sugars which are (9.68 ± 0.133 g/100g) and (7.27 ± 0.219 g/100g) respectively. In addition, they are rich in dietary fiber (18.63% ± 0.212) but low in pectin (0.084% ± 0.0021) and fat (0.68% ± 0.127). In addition, our fruit is an important source of vitamin C (527.21 mg/100g) and polyphenols (21.13 mg GAE / g ± 0.03) with a high malic acid (282.3 mg/100g) and oxalic acid (60.65 mg/100g).

The study of physicochemical composition of *Arbutus unedo* L., shows that this fruit has a high nutritional quality because it provides an important bioactive compounds in health protection namely polyphenols that are antioxidants**,** dietary fibers, vitamins and organic acids.

REFERENCES

1. **Aganga, A. A., Mosase, K.W. (2001).** Tannins content, nutritive value and dry matter digestibility of Lonchocarous capussa, Ziziphus mucropata, Sclerocarya birrea, Kirkia acuminata and Rhus lancea seeds. Animal Feed Science and Technology. 91:107-113.

2. **Ahmed, I.A., Ahmed, A.W.K., Robinson, R.K. (1995)**. Chemical composition of date varieties as inflenced by the stage of ripening. Food Chemistry. 54:305-309.

3. **Akintunde, B. O., Tunde Akintunde, T. Y. and Adejumo, A. O. (2004).** Development of a manual fruit juice extracto. NIFOL.22:178-182.

4. **Alarcão-e-Silva, M., Leitão, A.E.B., Azinheira, H.G., Leitão, M.C.A. (2001).**The Arbutus Berry: Studies on its color and chemical characteristics at two mature stages. J. Food Compos. Anal**.** 14:27-35.

5. **Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M., Shahidi F.(2005).**Compositional and sensory characteristics of three native sun –dried date (Phoenix dactylifera L) varieties grown in Oman. Journal of Agricultural and Food Chemistry.33: 7586 – 7591.

6. **AOAC. (1995).** Official Methods of Analysis. 16th Ed. Gaithersburg, MD.

7. **AOAC. (2000).** Official Method of Analysis. 17th Ed. Maryland. U.S.A

8. **AOAC. (2002)**. Official Methods of Analysis.17th Ed. Gaithersburg, USA.

9. **Assuncao, R., Mercadant, A.Z.(2003)**. Carotenoid and ascorbic acid from cashew apple (Anacardium occidentale L.): Variety and geographic effects. Food Chemistry.81:495 – 502.

10. **Ayaz, F.A.,Kucukislamoglu, M.,Reunanen, M. (2000)**.Sugar, non-volatile and phenolic acids composition of strawberry tree (Arbutus unedo L **.** var. ellipsoidea) Fruits. Journal of Food Composition and Analysis.13:171-177.

11. **Barros, L., Carvalho, A., Morais, J., Ferreira, I. (2010).** Strawberry-tree, blackthorn and rose fruits: Detailed characterization in nutrients and phytochemicals with antioxidant properties. Food Chemistry.120:247-254.

12. **Benamara,S., Allane, T.(2010).** Activités antioxydantes de quelques fruits communs et sauvages d'Algérie. Phytothérapie. 8 :171-175.

13. **Boudries, H., Kefalas, P., Hornero-Mendez, D . (2007).** Carotenoïd composition of Algerian date varieties (Phonenix datylifera) at different edible maturity stages. Food Chemistry . 101: 1372 – 1377.

14. **Celikel, G., Demirsoy, L., Demirsoy, H**. **(2008).** The strawberry tree (Arbutus unedo L.) selection in Turkey. Scientia Horticulturae . 118 : 115–119.

15. **Chun, J ., Lee,J ., Ye, L ., Exler, J ., Eitenmiller, R.R .(2006)**. Tocopherol and tocotrienol contents of raw and processed fruits and vegetables in the United States diet . Journal of Food Composition and Analysis.19: 196–204.

16. **Djeridane,A.,Yousfi,M.,Nadjemi,B.,Boutassouna,D.,Stocker,P.,Vidal,N.(2006).** Antioxydant activity of some Algerian medicinal plants extracts containing phenolics coumpounds. Food Chemistry.97: 654-660.

17. **Dorais, M., Papadopoulos, A.P., Gosselin, A. (2001).** Influence of electric conductivity management on greenhouse tomato yield and fruit quality.Agronomie .21 : 367-383.

18. **Dubois, M., Gilles, K.A, Hamilton, J.K, Rebers, P.A, Smith, F.(1956)**.Colorometric method for determination of sugars and related substances .Analytical Chemistry.28: 350-356

19. **Ergönül, P.G., Nergiz, C. (2010).** Determination of Organic Acids in Olive Fruit by HPLC. Czech J. Food Sci.28 (3) : 202–205.

20. **Favier, J-C., Ireland-Ripert, J., Laussucq, C., Feinberg, M. (1993).** Répertoire général des aliments .Table de composition des fruits exotiques, fruits de cueillette d'Afrique .Ed. Tec et doc. INRA. ORSTOM. France. 269 p.

21. **Fiorucci, S. (2006).** Activités biologiques de composés de la famille de flavonoïdes : approches par des méthodes de chimie quantique et de dynamique moléculaire. Thèse de doctorat en Chimie. Nice. 211 p.

22. **Gancel, A-L., Feneuil, A., Acosta, O., Pérez, A.M., Vaillant,F. (2011).** Impact of industrial processing and storage on major polyphenols and the antioxidant capacity of tropical highland blackberry (Rubus adenotrichus). Food Research International. 44(7): 2243-2251.

23. **González, E.A., Agrasar A.T.,Castro, L.M., Fernández, I.O, Guerra N.P .(2011).** Solid state fermentation of red raspberry (Rubus ideaus L) and Arbutus berry (Arbutus unedo L) and characterization of their distillates. Food Research International. 44:1419–1426.

24. **Hartl, D.L. (2011)**. Essential Genetics: A Genomics Perspective, 5^{ième} Ed. Jones & Bartlett, Sudbury, MA. USA. 500 p.

25. **Henk, J., Zwir, E., Rik, L.(2003).**Caroténoides et flavonoides contre le stress oxydatif. Arômes Ingrédients Additifs .44 : 42-45.

26. **Hodgson, A.S., Kerr, L.H. (1991).**Tropical fruit products. In:«The Chemistry and Technology of Pectin». Ed. Academic Press, New York, 67 p.

27. **IUCN. (2005).** A Guide to Medicinal Plants in North Africa. Ed. IUCN. Malaga (Spain) .256p.

28. **Iwe, M. O., Obaje, P. O., Akpapunam, M. A. (2003).**Organoleptic assessment of selected fruit juices produced with citrus populace gum powder (Okoho) extracted with the aid of edible Starches. NIFOI. 21: 79-84

29. **Jadhav, S. J., Andrew,W.T. (1977).** Effets of cultivars and fertilizers on non-volatile organic acids in potato tubers. Food Science and Technology Journal.10:13-21.

30. **Javanmardi, J ., Kubota, C . (2006).** Variation of lycopene, antioxidant activity, total soluble solids and weight loss of tomato during postharvest storage **.** Postharvest Biology and Technology.41: 151–155.

31. **Kader, A.A.(1986).** Potential applications of ionizing radiation on postharvest handling of fresh fruit and vegetables. Food Technologies.40: 117-121.

32. **Manach,C.,Scalbert,A.,Morand,C.,Remezy,C.,Jimenez,L.(2004).**Polyphenols:food sources and bioavailability American Journal of Clinical Nutrition.79 (5): 727-747.

33. **Marcellin, O., Mourgues, J. Talmann, A. (1990)**. Les polyosides de la goyave (Psidium guajava L).Évolution au cours de la croissance et incidences technologiques liées à l'obtention de purées et de jus. Fruits. 45(5) : 511-520.

34. **Miller, G.L. (1972).** Use of dinitrosalicylic acid reagent for determination of reducing sugars .Analytical Chemistry . 31: 426-428.

35. **Morelle, J. (2003).**L'oxydation des aliments et la santé. Ed. Nouvelle Imprimerie Laballery .Paris.250 p.

36. **Munier, P. (1973) .**Le palmier dattier. Ed. Maisonneuve. Paris. 221 p.

37. **Munzuroglu, O., Karatas, F., Geckil, H. (2003).** The vitamin and selenium contents of apricot fruit of different varieties cultivated in different geographical regions. Food Chemistry.83: 205-212.

38. **Müller, L., Gnoyke, S., Popken, A.M., Böhm, V. (2010).** Antioxidant capacity and related parameters of different fruit formulations. Food Science and Technology. Vol.43 : 992–999.

39. **Multon J.L.(1991).**Techniques d'analyses et de contrôle dans les industries agroalimentaires. Ed. Tech et Doc – Lavoisier .pp.121-137.

40. **Myhara, R.M., Al-Alawi, A., Karkarlas, J. Taylor, M.S. (2000)**. Sensory and textural changes in maturing Omani dates. J. Sci. Food Agric.80: 2181-2185.

41. **Nixon, R.W.,Carpenter, B.(1978).** Growing dates in united states. United states department of agriculture. Information bulletin prepared by science and education administration.USA. Pp 44-45.

42. **Oliveira, I., Baptista, P., Bento, A., Pereira, J.A. (2011).** Arbutus unedo L and its benefits on human health. Journal of Food and Nutrition Research. 50: 73-85.

43. **Orak, H.H., Aktas, T., Yagar, H., Selen Isbilir, S., Ekinci, N., Sahin, F.H.(2011).** Antioxydant activity, some nutritional and colour properties of vaccum dried strawberry tree (Arbutus unedo L) fruit. Technol Aliment.10: 327-338.

44. **Özcan, M.M., Hacıseferoğulları, H.(2007).** The strawberry tree **(**Arbutus unedo L.) fruits: Chemical composition, physical properties and mineral contents. Journal of Food Engineering .44: 307-315.

45. **Pacaud, G., Six, M.F. (2004).** Tout savoir sur les vitamins et les minéraux .Ed. Reader's Digest. France. 253 p.

46. **Pallauf, K.,Rivas-Gonzalo, J.C., del Castillo, M.D.,Cano, M.P., S. de Pascual-Teresa, S.(2008).**Characterization of the antioxidant composition of strawberry tree (Arbutus unedo L.) fruits. Journal of Food Composition and Analysis .21:273–281.

47. **Patthamakanokporn, O., Puwastien, P., Nitithamyong, A., Sirichakwal, P.(2007).** Changes of antioxidant activity and total phenolic compounds during storage of selected fruits .Journal of Food Composition and analysis**.** 21:241-248.

48. **Pawlowska, A.M., De Leo, M., Baraca, A. (2006)**. Phenolics of Arbutus unedo L. (Ericaceae) fruits: identification of anthocyanins and gallic acid derivatives .Journal of Agriculture and Food Chemistry .54 (26) :10234-10238.

49. **Ramlu, P., Rao, P .U. (2003).** Total, insoluble and soluble dietary fiber contents of Indian fruits. Journal of Food Composition and Analysis.16 :677-685.

50. **Rice-Evans,C.A., Miller,NJ., Paganga,G .(1995).** Structure-antioxydants activity relationships of flavonoids and phenolic acids.Free Radical Biology and Medicine. 20(07):933-956.

51. **Rodriguez, M.A.R., Oderiz, M.L.V., Lozano, J.S., Hernandez, J.L (1992).** Estudio de la composicion quimica de poquenos fructos: arando, frambuesa, grosella blanca, grosella negra, grosella roja y zarzamora producidos en Galicia. Ind. Conserve. 67 : 29-33.

52. **Ruiz-Rodriquez, B-M., Morales, P.,Fernandz-Ruiz, V.(2011).** Valorization of wild strawberry-tree fruits (Arbutus unedo L) through nutritional assessment and natural production data .Food Research International. 44:1244-1253

53. **Sawaya, W.N., Khalil, J.K., Safi, W.M., Al-Shalat, A.(1983**). Physical and chemical characterization of three Saudi date cultivars at various stages of development. Can. Ins. Food Sci. Technol.J. 16: 87-93.

54. **Scalbert,A.,Morand,C.,Manach,C.,Rémésy,C.(2002).**Absorption and metabolism of polyphenols in the gut and impact on health.Biomed Pharmacother. 56:276-282.

55. **Seker, M .,Toplu, C (2010).** Determination and comparison of chemical characteristics of Arbutus unedo L. and Arbutus andrachnae L. (family Ericaceae) fruits **.**Journal of Medicinal Food . 13 (4): 1013-1018.

56. **Serçe, S .,Özgen, M., Torun, A.A ., Ercisli, S.(2010**). Chemical composition, antioxidant activities and total phenolic content of Arbutus andrachne L. (Fam. Ericaceae) (the Greek strawberry tree) fruits from Turkey. Journal of Food Composition and Analysis. 23: 619 - 623.

57. **Siebert, K.J. (1999).**Modeling the flavor thresholds of organic acids in beer as function of their molecular properties.Food Quality and Performance.10:129-137.

58. **Singleton, V-L., Rossi, J-A.(1965)**. Colorometry of total phenolics with phosphomolybdic-phosphotungstic acid reagents . American Journal of enology and Viticulture. 16:44-158.

59. **Souci, S. W., Fachmann, W., & Kraut, H. (2008).** Food composition and nutrition tables. 7th ed. Stuttgart. Medpharm Scientific Publishers.510 p.

60. **Tavares, L., Fortalezas, S., Carrilho, C., McDougall, G.J., Stewart, D., Ferreira, R.B.(2010).** Antioxidant and antiproliferative properties of strawberry tree tissues. Journal of Berry Research.5:3-12.

61. **Wall, M.M. (2006).** Ascorbic acid, vitamin A and mineral composition of banana (Musa sp.) and papaya (Carica papaya) cultivars grown in Hawaii**.** Journal of Food Composition Analysis .14: 434–445.

62. **Zakari, U.M., Dehinde, A.M., Bello, S.M. (2009).** Effect of different levels of sugar and cooking temperature on the quality of orange (Citrus sinensis) jellies. Patnsuk Journal. 5 (2):301-308.