WILD BLACKTHORN (*Prunus spinosa* L.) AND CORNELIAN CHERRY (*Cornus mas L.)* FRUITS AND JUICES - VALUABLE SOURCES OF CHEMICALS AS NOURISHING COMPONENTS

Călina Petruţa CORNEA[1], Ruxandra CÎRCIU[1], Maria Pele[1*]

Abstract. *This paper presents the importance of cornelian cherry and blackthorn as well as juices obtained from them, for human health. Fruits were obtained from Dagita village, Iasi County, Romania. Clear juices from berries was done by proper technology establishing the specific consumptions. Thus, for 1000 kg clear juice are required 1612.9 kg cornelian cherry and 1594.8 kg blackthorn fruits. Complex analysis of fruits and their clear juices showed a slight decline of nutrients in juices compared to pulp. To assess the comparative quality of fruits and obtained juices, carbohydrates, pectin, polyphenols, minerals, vitamin C and beta-carotene were determined.*

Key words: cornelian cherry, blackthorn, carbohydrates, minerals, vitamins, polyphenols

1. Introduction

Rational alimentation is one of the most important links in the complex of factors that have a direct influence on human health and the ability to work. Specialists have concluded that our health depends on the amount of fruits and vegetables we use to eat. Thus, the World Health Organization promotes "5 A Day" concept, meaning five fruits and vegetables a day. According to WHO, lack of fruit and vegetables in our diet is among the top 10 risk factors contributing to increase of mortality overall.

Changes throughout the centuries have gradually made food consumption, at least for some parts of Earth's population, to turn from necessity into pleasure, with its undesirable effects such as diseases due to vitamins lack etc.

In this context, it was concluded that one way to resolve the food correction due to acute lack of natural vitamins, may be developing and widening the daily consumption of drinks and fruit and /or vegetables juices by people [1]. Processing of fruit vegetables into juice has emerged as a necessity to take over

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest – Faculty of Biotechnologies. 59 Mărăşti Blvd. District 1. 011464. Bucharest. Romania
*Corresponding author email: mpele50@yahoo.com

the fresh fruits and vegetables excess. Currently, the production of fruit and vegetable juices is an industrial branch.

A special place in the development of fruit industry is occupied by berries juice production, fruits that enjoy from farthest times of therapeutic and nutritious qualities recognition. Fruit and vegetable juice industry is developing in two directions: production of clear juices and juices with pulp (nectars) [2].

Development of biochemical knowledge constantly leading to modernization processes in order to increase nutritional and sensory qualities of fruit and vegetable juices. Although these studies and research, knowledge of juices chemistry and biochemistry are incomplete and often contradictory. Reasons for this is that fruit and vegetable juices have a complex composition and a great variability and some important components are found in extremely small quantities. Development of modern analytical techniques (spectrophotometry, GC etc.) lead to partially overcome this difficulty, but the complexity and variability of the composition of fruit and vegetables hampering the development of fundamental knowledge.

Thus, juices obtained from the same species of fruit have a variable composition depending on the variety, maturity stage, agro technical conditions, technology applied and the same substance or class of substances takes into juice a different structure or a different mode of action (example: pectic substances, phenol, oxidative enzymes). However, current knowledge allow that technological processes to be driven so that unwanted changes to be reduced or eliminated to yield fruit and vegetable higher quality juices [3].

The most required fruits to obtain juices, clear or pulp, and which are found commonly in the market are: apples, pears, grapes, cherries, peaches, apricots and citrus fruits (oranges, lemons and grapefruit). Among berries which are found in trade itself and as juices it can be enumerated raspberries, blackberries, blueberries, seabuckthornh and rosehip. Unfortunately, the promotion of cornelian cherry and blackthorn, fruit and/or or juice, is extremely low, although these fruits are produced in large amounts by the respective shrubs and have excellent homeopathic properties being used in the treatment for various diseases, fatigue or stress, from ancient times [4-7].

Thus, cornelian cherry and blackthorn contain a rich assortment of carbohydrates (sucrose, reducing sugars, cellulose and pectin) and organic acids that define "harmonic report". This is the mathematical expression of organoleptic characteristics essential in defining the palatability of fruit preparations [8-15]. The forest fruits have an important vitamins content [16]. For example, it were found average quantities of β-carotene of 5 mg per 100 g of cornelian cherry fresh pulp and 3.5 mg per 100 g pulp of blackthorn. Also vitamin C content is quite

high in berries, thereby cornelian cherries contain on average 95 mg /100g and blackthorns 64 mg/100g [10, 11, 13].

Among the essential nutrients to human body, mineral elements are included. The number and concentration of these components in fruits is typical of the species, environmental conditions and soil where the plant grows. The amount of minerals present in cornelian cherries and blackthorns varies in very broad limits [8, 13, 17-20].

A characteristic of berries consists of their content in antioxidants, namely polyphenols, phenols and tannins. Cornelian cherries and blackthorns are excellent sources of polyphenolic compounds with strong ability to capture free radicals, compounds with negative effects on the human body. Therefore, these fruits have both treatment and prevention capacities for various diseases from which some very severe such as neurodegenerative diseases, cardiovascular and cancer. In this context in recent years there were developed researches on the determination of antioxidants in berries. Thus it was determined that in cornelian cherries there are broad areas of tannins between 0.57 to 1.28%, anthocyanins between 36.35 to 292.00 mg per 100 g pulp and total phenols between 281-579 mg / 100g pulp [8, 9, 11]. Blackthorn fruits (*Prunus spinosa*) have significantly higher amounts of phenolics and anthocyanins. Thus, concentrations between 599.2 and 1630 mg phenols per 100 g fruit pulp and anthocyanin concentrations between 71.75 and 1431.75 mg/100g fruit pulp were determined [8, 14, 21, 22].

European cornelian cherry (*Cornus mas*, *Cornelian cherry* or *European cornel*) is a woody plant species that may encounter relatively common in deciduous forests from Romania, as well as ornamental plants in parks and gardens. Cornelian cherries, edible fruits from the distant past had a big search and even today are harvested both for food and pharmaceutical purposes. For example, some studies showed that medicinal preparations obtained from fresh fruit of *Cornus mas L*, have significant antimicrobial activity against *Staphylococcus aureus* and *Pseudomonas aeruginosa* [23].

Blackthorn (*Prunus spinosa* L) belonging to the genus Prunus, Rosaceae family, grows on the hills and plains, in clearings, on pastures and hay fields, roadsides and forests, forming thickets dense that no wildness did not dare to fear of thorns. It is suitable for the formation of curtains for field and roads protection. Blackthorns have antidiarrheal and astringent action, while the buds have immunomodulatory activity, general tonic and stimulant of growth and development mechanisms and activates the hypothalamic-pituitary-adrenal axis, regulating hormonal imbalances [6, 24]. Fresh fruit juice is also used for stopping the flow of blood from the nose.

Given the special qualities of these fruits, in the present work it was evaluated fresh fruit composition compared to clear juices from these fruits.

2. Experimental part

2.1. Materials

The experimental material consited of samples of cornelian cherries and blackthorns, purchased from inhabitants of the village Dagita, Iasi County, Romania. The cornelian cherries were harvested between 24 and 26 September, and blackthorns between 29 to 31 October 2015.

The equipment used was, in addition to equipment usual in laboratory, spectrophotometer Metertek SP830 Plus, Flam - photometer (Model 410, Sherwood), Metler Tolledo pH meter, juicer Star-Light DPJ-800W (800W, container juice, pulp container, 5 speed, feeding tube 75 mm, digital control), centrifugal Braun homogenizer, distillation plant Millipore, bathroom thermostat, stirring mixer, rare cloth similar to that for cheese.

Distilled water was used for the preparation of the necessary solutions and samples. Chemically pure reagents used were purchase from Merck or Sigma.

2.2. Methods

In order to discern the behavior of fruit (cornelian cherries and blackthorns) during processing them into juices, it was considered necessary to establish their anatomical structure.

The process of obtaining clear juices was carried out following the usual technological line for berries. Thus, sorted fruits

were processed as follows:

– Pressing of primary fruit (cornelian cherries and blackthorns).

– The remained residue represent about 70% of the total weight of fruits. This residue loose and moistened with very little juice was passed through a sieve with 0.8 mm diameter. This process resulted in removing the seeds and other anatomical impurities. They were obtained fruit marcs, close to pulp juices consistency.

– Fruit marcs obtained were pressed by 4 layers of canvas with different densities (canavs commonly used in cheese processing: the first layer was layer with large pores and the last one with the smallest pores). The juice yield has increased considerably.

– The juice from the first press and the one obtained from marc were homogenised and the resulting juice was processed further.

– In order to remove pectin, the obtained juice has been treated with an appropriate amount of enzyme (UltraZyme 40) for 24 hours at 5 - 7°C.

– Decanting clarified juice after enzymatic treatment was performed by siphoning the portion clarified and dragging it from the layer of yeast. The resulted sediments were added to the remained marc after pressing through the layers of canvas and this mixture was pressed again by canvas above.

– Clarification by thermocoagulation was performed on the enzymatically clarified juice and those obtained by marc pressing. The purpose of this operation was the protein coagulation because the previous operations have not affected them and what remaining in juice it would be coagulated in time. The operation consisted of rapid heating of juice at 80^0C - 88^0C up to 3 minutes.

– The juice cooling was also made as quickly to have no loss of flavor, color and thermosensitive vitamins, by coming down the temperature from 80 - 88^0C to 30 - 40^0C, in a few minutes, where viscosity value of juice was small enough to ease the following operation.

– Juice filtration was performed using a tangential-flow microfiltration module to $\Delta P = 0.5$ bar, using membranes based on cellulose acetate and polyamide. Streams flow occurred at constant ΔP and temperature of 10^0C.

– Clear juices were placed in 250 mL bottles and pasteurized at 100^0C for 20 minutes and then rapidly cooled under running water to 45^0C.

Methods applied for the assessment of the various components from fruits and juices were according to ISO methods or certified methods for analysis of food, namely: *dry matter* - SR ISO 3728:2009, *total acidity* - SR EN 12147:1999/C1:2000, *pH* - SR ISO 1842:2008, *total sugars, sucrose, glucose and fructose* - SR EN 1140:2000 and SR 6182-18:2009, *pectic substances* - ISO/CD 6562-1, *protein* - SR 8613-6:2009, *minerals* - SR EN 1134:1996, *phosphorus* - SR EN 1136:1997, *vitamin C* - SR ISO 6557-2:2008, *β-caroten* - SR EN 12136:1999, *tanning substances* – [25].

3. Results and discussions

Although so far a number of fruit and vegetable nectars have been granted approval and are on the market, with exceptional nutritional value, at present juices that have in their composition certain berries such as cornelian cherries and blackthorns are extremely rare. In this context, the present experiments tested the cornelian cherry and blackthorn juices. They took into account the composition of the cornelian cherries and blackthorns extremely rich in nutrients, vitamins, antioxidants. In order to know the behavior of fruits (cornelian cherries and blackthorns) during the process of obtaining juices, and the choice of an appropriate technology, it has been analyzed their anatomical structure.

Table 1 shows the composition of the cornelian cherries and blackthorns, after principal anatomical components. From this Table it can notice that the practically blackthorns have less pulp compared to cornelian cherries. Given these data and specifications from the literature we processed fruits to obtain clear juices as outlined in the experimental part.

Table 1. Anatomical structure of cornelian cherries and blackthorns

Specifications	*Cornelian cherries, %*	*Blackthorns, %*
Amount of fruit processed	100	100
Amount of seed, skin and other impurities	15.0	19.7
Amount of juice plus pulp	85.0	80.3
Amount of raw juice	76.0	77.3
Amount of pulp	9.0	3.0

Fruit and juice samples were analyzed by determining the specific consumption, the yield of juice, dry matter, the density of the juice, the acidity, pH, total sugars, reducing sugars, sucrose, pectic substances, proteins, polyphenols, vitamin C, β-carotene and minerals (Ca, K, Na, Fe, P). In order to calculate specific consumption the balance sheet of materials was drawn for the main operations of the technological process (Table 2). Specific consumption values and yields obtained at processing of cornelian cherries and blackthorns in the clear juices are presented in Table 3.

Table 2. The material balance to the processing of the cornelian cherries and blackthorns in the clear juices

Technological operation	*Cornelian cherries, %*	*Blackthorns, %*
Amount of juice after primary pressing	29.3	41.7
Amount of juice after marc pressing	46.7	35.7
Total quantity of resulted juice	76.0	77.3
Amount of clear juice	**62.0**	**62.7**

Table 3. Yields and specific consumption for raw and clear juices from cornelian cherries and blackthorns

Fruits	*Yields, %*	*Specific consumption for 1000kg juice, kg*
Raw juicess		
Cornelian cherries	76.0	1315.8
Blackthorns	77.3	1293.1
Clear juices		
Cornelian cherries	62.0	1612.9
Blackthorns	62.7	1594.8

From the data in Tables 2 and 3 it is observed that for both cornelian cherries and blackthorns, the yield in raw juice, namely juice with pulp that can be drunk as such is relatively high, around 76.5%. Clarification process leads to lower yields of clear juice, as a result of removing particles left unchallenged by enzymes and normal losses from the pressing process and microfiltration. It can be seen that to obtain 1000 kg of clear juice is needed around 1600 kg cornelian cherries respectively blackthorns.

In order to know the nutritional value of obtained juices some essential chemical components were determined in both fresh pulp fruits and clear juices. The results are presented in Table 4 and Figures 1-4.

Table. 4. Physico-chemical parameters of pulp fruits and clear juices of cornelian cherries and blackthorns

Components determined	*Cornelian cherries*		*Blackthorns*	
	Fruits	*Juice*	*Fruits*	*Juice*
Dry matter, %	13.55	10.00	15.88	13.00
Water content, %	86.45	90.00	84.12	87.00
Total acidity, g malic acid/100g	1.88	2.25	1.75	2.03
pH	3.00	2.25	3.00	2.30
Total sugars, %	2.46	1.35	1.99	1.29
Reducing sugars, %	1.77	1.24	1.19	1.22
Sucrose, %	0.69	0.11	0.80	0.70
Harmonic ratio*, (TS/TA)	1.31	0.60	1.14	0.64
Pectic substances, %	0.47	0.12	0.55	0.17
Proteins, %	3.76	0.19	4.33	0.18
Tanning substances, %	1.76	1.12	2.91	2.22
Calcium, mg/100g	309.00	135.00	135.00	60.00
Potassium, mg/100g	589.00	360.00	1046.00	463.00
Sodium, mg/100g	51.40	27.00	49.80	25.00
Iron, mg/100g	11.29	5.86	21.11	10.64
Phosphorus, mg/100g	149.3	64.5	127.14	51.37
Report: Calcium/ Phosphorus	2.07	2.09	1.06	1.17
Vitamin C, mg/100g	96.49	26.56	64.23	8.76
β-carotene, mg/kg	49.16	34.15	34.25	21.19

* Harmonic ratio is the report between total sugars and total acidity

From data and Figures it can be seen that most nutrients have lower concentrations in juices compared to fruits. This is normal, considering that most of these substances are lost in processing. The exception to this aspect it has the acidity. At both fruits, the acidity increases in juices so that the juices pH is lower.

Harmonic ratio between total sugars and acidity is lower in juices compared to fruits, but for both fruits for soft drinks it is around 0.60. This value shows that

juices have a sweet - sour taste, a balanced taste for forest fruits. This taste is supplemented by the contribution of own tannins and flavors that give them their specific taste, really liked of the cornelian cherry and blackthorn juices. It should be emphasized that at both juices concentrations of reducing sugars are very close to the concentrations from respective fruit pulp. Thus at blackthorns concentration of reducing sugars in fruits is practically the same as in juice (1.19% vs. 1.22%). At cornelian cherries, the difference is slightly larger of 1.77% in fruit compared to 1.24% into juice.

As we know, vitamins and minerals are basic elements of human metabolism. These are responsible for transporting and processing of oxygen, for water content and transmission of stimuli to nerves and muscle, bone health and more others. Their composition bring balance and health in the human body and when it is the case the appropriate treatment. It is underlined that an important role in the relationship between calcium and phosphorus is the ratio value of their concentrations. The optimal ratio of calcium / phosphorus is 1/1. Close values of this report are found only in fruits and vegetables. For example in pork this report is calcium / phosphorus = 1/97 (the amount of phosphorus is 97 times higher!) and this report is entirely unbalanced. The consequence is decreasing calcium concentration in plasma, removing calcium from the bones, at increased risk for osteoporosis.

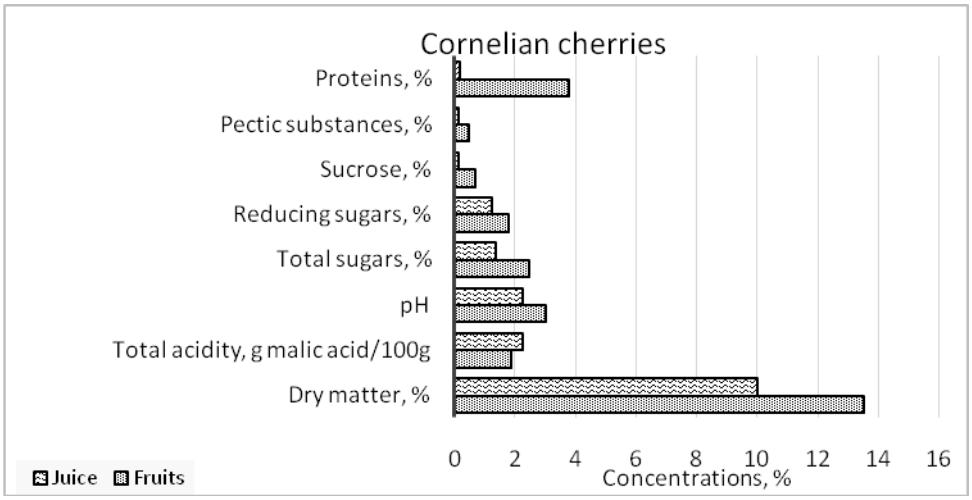

Fig.1. Comparative evaluation of nutrients between the pulp and clear juice of cornelian cherries

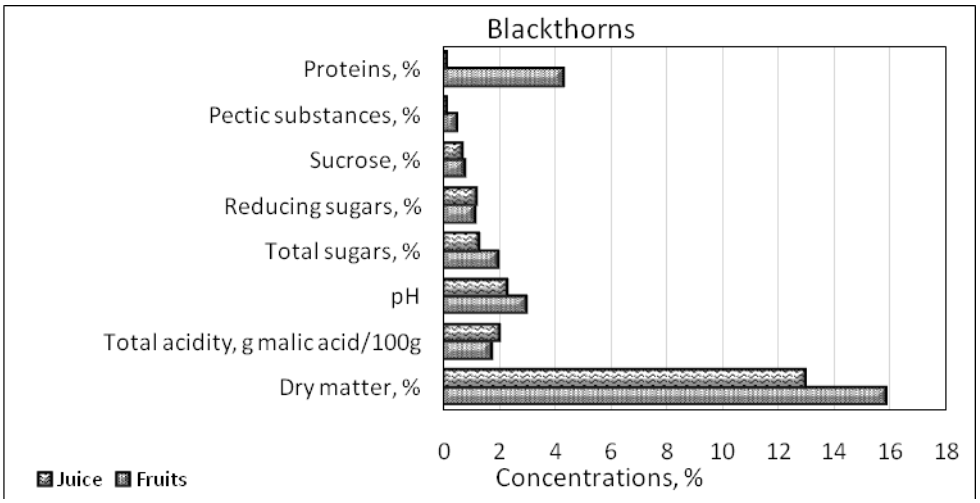

Fig 2. Comparative evaluation of nutrients between the pulp and clear juice of blackthorns

In vegetable cases, carrots have the optimal ratio of 1 / 0.95, and other vegetables have slightly higher values (e.g. potatoes of 1/4and soybeans of 1 / 2.3). Among fruits, hazelnuts have a ratio of 1/1.5. Our data show that blackthorns are closest to the optimum ratio having the value of 1.06 for fruits and 1.17 for juice, while the cornelian cherries have this report higher (2.07 for fruits and 2.09 for juice).

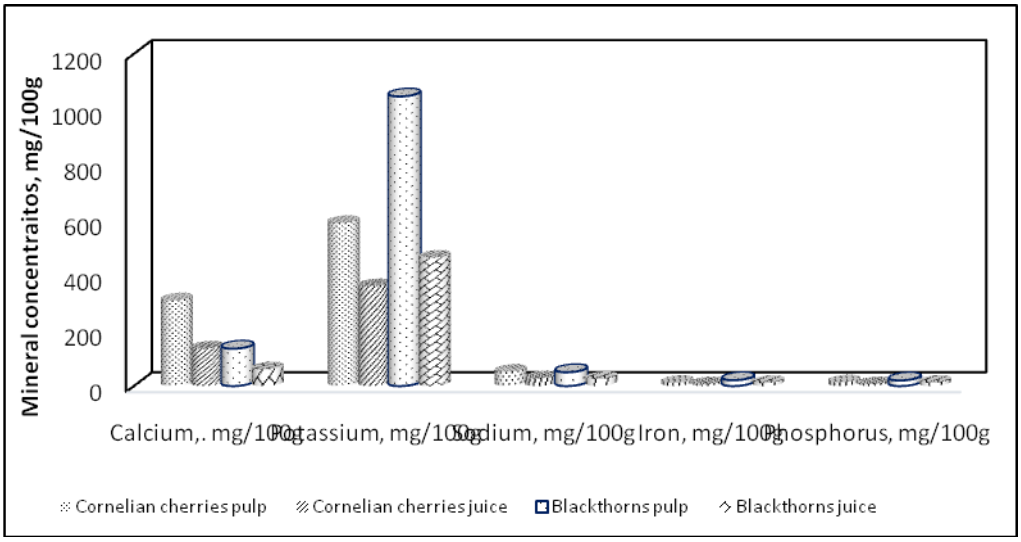

Fig 3. Evolution of mineral substances in fruit respectively juices of cornelian cherries and blackthorns

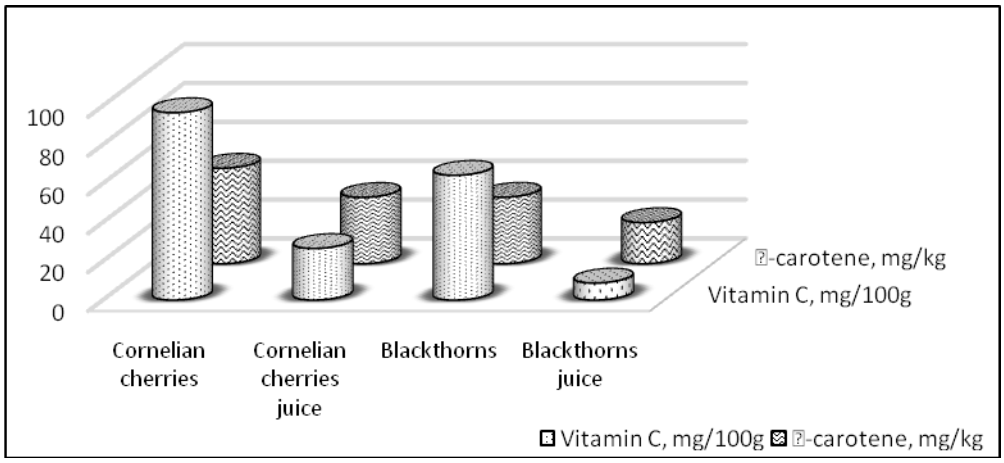

Fig 4. The content of vitamin C and β-carotene in fruits and juice of cornelian cherries respectively blackthorns

In terms of the content vitamins is observed that blackthorn fruits are rich in vitamin C and carotene compared with cornelian cherries. It is however noteworthy that fruits processing to juice leads to loss of vitamins in proportions higher for blackthorns compared to cornelian cherries.

Conclusions

By cornelian cherries and blackthorns processing as juice around 77% raw juice are obtained. To obtain a high yield of juice, the marc from the first pressing was moistened, loose and pressed again. Thus, it was obtained a yield of 76% raw juice for cornelian cherries and 77.3% for blackthorns. Yields obtained for clear juices were 62% for cornelian cherries and 62.7% for blackthorns as a result of the removal of all particles. Specific consumption for obtaining of 1,000 liters clear juice were 1612.9 kg cornelian cherries and 1594.8 kg blackthorns.

It should be emphasized that, after processing as juice, nutrient concentrations were only slightly lower compared to fruits. The exception is the acidity. So, for both fruits, increases acidity in juices and pH value becomes lower. Harmonic ratio is around 0.60, value showing that juices have a sweet - sour taste. This taste is balanced by own tannins and flavors which give their specific taste, very pleasant. The optimal ratio of calcium/phosphorus is 1/1. For both fruits and juices of cornelian cherries and blackthorns, Ca/P ratio was very close to the ideal value (1.06 and 1.17 for blackthorns, respectively 2.07 and 2.09 for cornelian cherries). In terms of content of vitamins blackthorn fruits are richer in vitamin C and carotene compared with cornelian cherries. Clear juice processing lead to loss of vitamins in proportions higher for blackthorns compared to cornelian cherries.

As a general conclusion it can be mentioned that the final products obtained have a pleasant flavor with a mysterious hint and are rich in essential nutrients. The beneficial effect of these products on human health is well known by itself nutrients contained in them.

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