

THE EFFECT OF PROCESSING ON THE COMPOSITION OF SEA BUCKTHORN JUICE

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A B S T R A C T

Sea buckthorn juice is one of the most popular processing products used as raw material for further processing, for example, making of syrup. Biochemical content of juice and syrup depends on processing technologies and equipment used. The aim of the study was to test the changes of vitamin C, total carotenoids, total acids and soluble solids in the juice and syrup depending on processing technology. Three different techniques were used for juicing:

- Voran cold: frozen berries were thawed to room temperature and pressed in a Voran 60 K press at a pressure of 300 bars;
- Condo Line: frozen berries were thawed to room temperature and pressed in a Condo Line RD press, which partially disrupts the berry peel;
- Voran heated: frozen berries were heated to 98°C for five minutes immediately before pressing with a Voran 60 K press at 300 bars.

The obtained juices were separated and processing product – syrup was made. As a result of the testing the conclusion was made that vitamin C in sea buckthorn fruits have good stability in processing. The highest content of total carotenoids was found in the flesh and in the peel of sea buckthorn, and it is essentially different depending on the processing technology – the juice and syrup with the highest content of total carotenoids (in medium 10.7 mg·100 g⁻¹) can be obtained by heating of berries over a period of five minutes before juice processing.

Key words: sea buckthorn, juice, technologies

INTRODUCTION

Fruit and berry juices are usually made by pressing (Baltess, 1998). To ensure maximal yield, it is necessary to choose the right press. Different kinds of presses include basket, strap, roll and screw presses. All can be used to make sea buckthorn juice. However, yield also depends on how the berries are prepared for pressing (Zeb, 2004). Sea buckthorn juice can be made by pressing fresh berries or berries which have been heated to 98°C for five minutes just before pressing. For sea buckthorn, juice yield by simple pressing ranges from 60 to 85% (Beveridge et al., 1999).

Raw sea buckthorn juice has is not attractive for consumers because it separates into three layers. The top layer is thick, creamy and orange, the middle layer contains the lipid fraction from the pulp, and the lower fraction consists of the sediment. To prevent natural separation, the juice is separated in a cream separator, which separates the juice into two fractions: fat rich “cream” and opalescent juice. The cream contains sea buckthorn oil and makes up 3 to 4% of the total juice mass (Beveridge et al., 1999; Li, 2001; Zeb, 2004). The cream can be used to make medical products and cosmetics. The opalescent juice can be processed into juices, jellies, syrups, purees, and other products (Li, 2003).

The biochemical composition of sea buckthorn juice depends on the cultivar used, growing conditions, harvest time, ripeness and processing technology.

Vitamin C is one of the most important antioxidants. Sea buckthorn juice can contain anywhere from 28 to even 2,500 mg·100 g⁻¹ (Beveridge et al., 2002). Sea buckthorn does not ascorbinoxidase, so vitamin C is largely retained during processing (Artemova, 2001; Prokkola and Mäyrä, 2003).

Soluble solids content ranges from 7.0 to 22.7° Brix. Sea buckthorn juice contains large amounts of different organic acids. Titratable acidity ranges from 3.5 to 7.3%, and pH ranges from 2.7 to 3.1). Carotenoids content ranges from 6.3 to 34.5 mg·100 g⁻¹ depending on cultivar and growing site (Beveridge et al., 1999; Zhang et al., 1989).

The aim of this study was to determine how different processing techniques affect vitamin C content, carotenoids content, titratable acidity and soluble solids content in sea buckthorn juice and products, and to choose the best technique for preserving biologically active compounds in sea buckthorn juice.

MATERIAL AND METHODS

The study was carried out at the processing centre of Dobeles HPBES in 2005. Sea buckthorn berries were harvested at Baltplant, Ltd, near Dobeles. Berries were harvested in 2004 and kept frozen at – 18°C.

Three different techniques were used for juicing:

- Voran cold: frozen berries were thawed to room temperature and pressed in a Voran 60 K press at a pressure of 300 bars;
- Condo Line: frozen berries were thawed to room temperature and pressed in a Condo Line RD press, which partially disrupts the berry peel;
- Voran heated: frozen berries were heated to 98°C for five minutes immediately before pressing with a Voran 60 K press at 300 bars.

The raw juices were then separated in a ESB-02 cream separator at 11,000 rpm. Syrup was made by mixing one part of raw or opalescent juice and one part of sugar and pasteurizing for three minutes at 95°C.

The following parameters were recorded for raw juice, cream, opalescent juice, syrup from raw juice and syrup from opalescent juice:

- Total acidity by titration in mg/100 g;
- Soluble solids by refractometry in degrees Brix;
- Vitamin C by the iodine method in mg/100 g;
- Total carotenoids by spectrophotometry in mg/100 g.

Data were statistically elaborated using SPSS for Windows and MS Excel.

RESULTS AND DISCUSSION

Juice yield depended on juicing technique (Fig. 1). With the Voran cold technique, yield ranged from 65-70%. With the Condo Line technique, in which the berry peels were partially disrupted, yield ranged from 72 to 82%. With the Voran heated technique, in which the berry peel was completely disrupted during the heating process, yield ranged from 93 to 95% of the total mass of the berries.

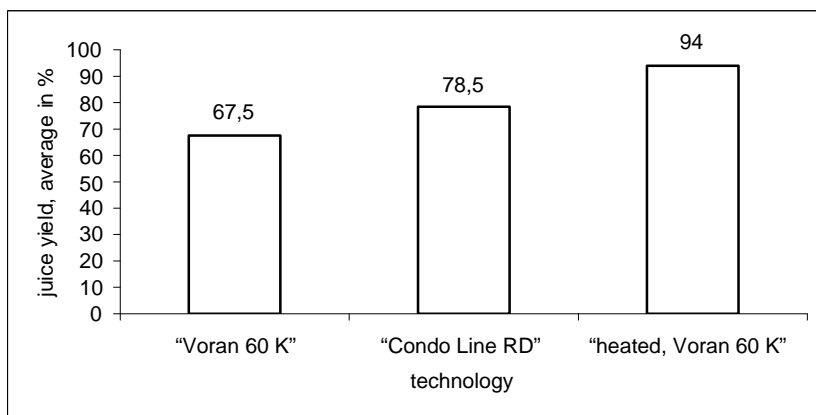


Figure 1. Juice yield depending on processing technology

Vitamin C content depended on juicing technique (Fig 2). Vitamin C content was low in juice made with the Condo Line technique, probably because of the fact that the berries were disrupted.

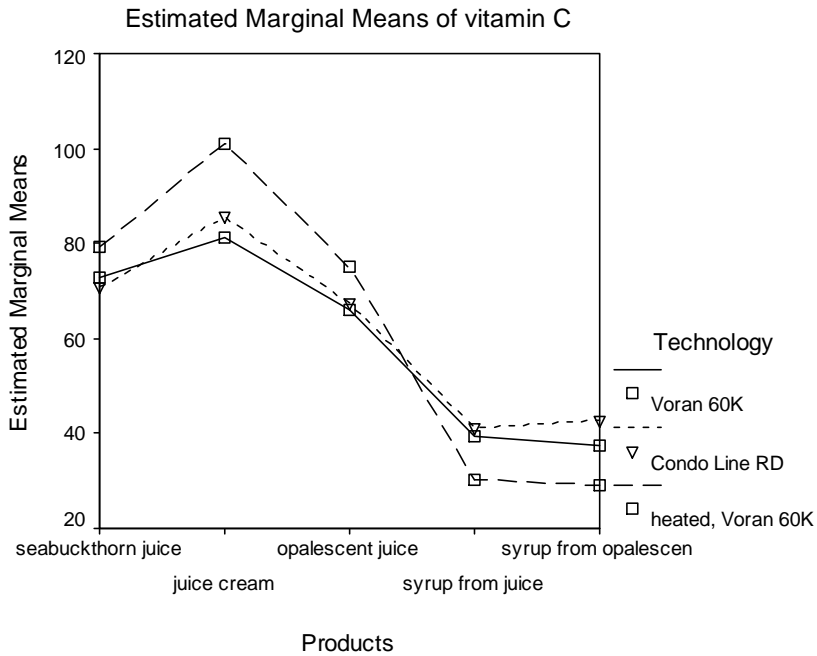


Figure 2. The content of vitamin C in sea buckthorn juice and its processing products [mg/100g]

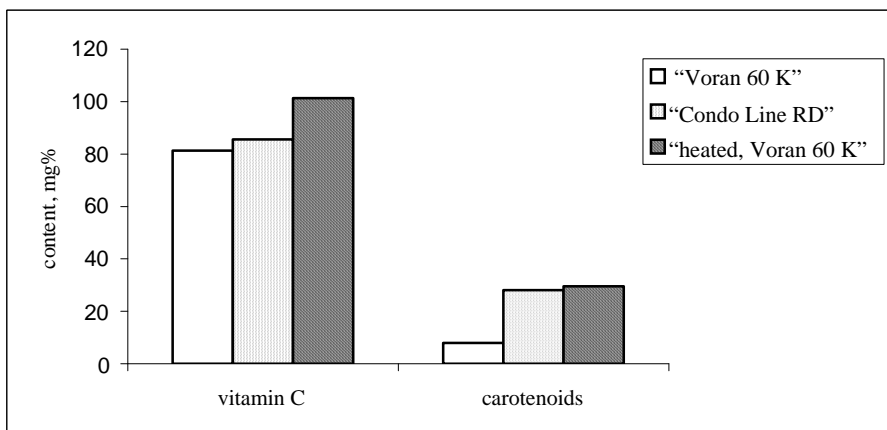


Figure 3. The contents of vitamin C and carotenoids in "cream" of juice

Vitamin C was largely retained during heating, juicing and processing (Fig. 3). Vitamin C content was about 10% higher with the Voran heated technique than with the other techniques, probably because heating rapid destroys enzymes which could break down Vitamin C. After separation, vitamin C content was 11 to 13% higher in the cream and 9 to 10% lower in the opalescent juice than in the raw juice.

Taking into account the fact that the syrups were made by mixing one part of juice with one part of sugar, vitamin C content ranged from 38.0 to 54.6% of the amount present in the juice in syrup made from raw juice, and from 39.0 to 56.6% in syrup made from opalescent juice, depending on the juicing technique. Vitamin C content was lowest in syrups made from juices obtained by the Voran heated technique, probably because the berries had been heated before pressing.

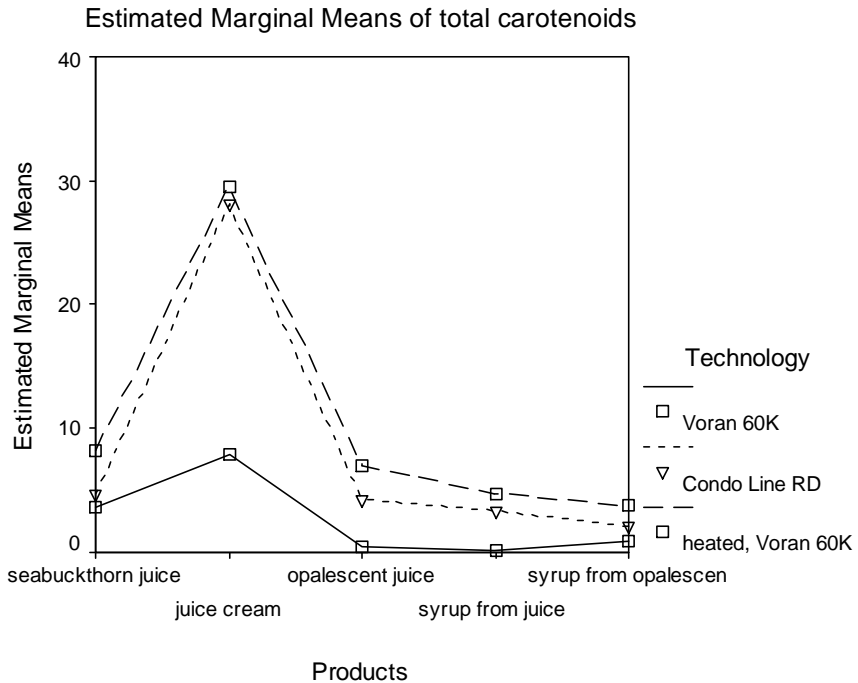


Figure 4. The content of total carotenoids in sea buckthorn juice and its processing products [mg/100g]

Carotenoids content depended on juicing technique (Fig 4). Carotenoids content was 22% with the Condo Line technique and 56% higher with the Voran heated technique than with the Voran cold technique. This is because carotenoids are concentrated mainly in the peel of sea buckthorn berries. For the same reason, the carotenoids content in the cream was about the same with

both the Condo Line and Voran techniques (Fig. 3). In syrup made from raw juice, carotenoids content ranged from 24.7 and 55.0% of the amount present in the juice, depending on juicing technique. In syrup made from opalescent juice, carotenoids content ranged from 46 to 50% of the amount present in the juice, depending on juicing technique.

Table 1. The content of total acids in sea buckthorn juice and its processing products [mg/100g± sd]

Product	Technology “Vorán 60 K”, [mg /100g]	Technology “Condo Line RD”, [mg /100g]	Technology “heated, Vorán 60 K”, [mg /100g]
Raw juice	7.85 ± 0.05	5.40 ± 0.03	3.30 ± 0.11
Cream	8.20 ± 0.03	4.20 ± 0.02	2.27 ± 0.06
Opalescent juice	6.50 ± 0.01	5.20 ± 0.01	3.23 ± 0.06
Syrup from raw juice	1.40 ± 0.01	2.80 ± 0.01	1.83 ± 0.12
Syrup from opalescent juice	3.70 ± 0.02	3.00 ± 0.02	1.80 ± 0.12

Total acidity varied widely depending on juicing technique (Tab. 1). Total acidity was highest with the Voran cold technique, 32% less with the Condo Line technique, and 58% less with the Voran heated technique. This means that sea buckthorn berries have to be disrupted before pressing to reduce acidity and preserve vitamin C and carotenoids content.

Table 2. The content of soluble solids in sea buckthorn juice and its processing products [°Brix ± sd]

Product	Technology “Vorán 60 K”, [°Brix]	Technology “Condo Line RD”, [°Brix]	Technology “heated, Vorán 60 K”, [°Brix]
Sea buckthorn juice	7.9 ± 0.01	8.0 ± 0.02	9.0 ± 0.10
Juice “cream”	7.3 ± 0.01	14.6 ± 0.09	10.2 ± 0.01
Opalescent juice	7.0 ± 0.01	7.0 ± 0.01	8.2 ± 0.01
Syrup from juice	52.5 ± 0.01	56.7 ± 0.02	60.0 ± 0.02
Syrup from opalescent juice	57.5 ± 0.03	56.5 ± 0.01	62.0 ± 0.03

Soluble solids content in both juices and syrups was highest with the Voran heated technique (Tab. 2). This can be explained by changes in carbohydrate composition during heating. Syrup made from raw or opalescent juice made with the Voran heated technique conforms to Latvian food standards, which state that the soluble solids content as measured by refractometry should be at least 60%.

Data analysis revealed the following correlations:

- a positive correlation between vitamin C content and carotenoids content ($r = 0.685$);
- a negative correlation between vitamin C content and soluble solids content ($r = -0.908$);
- a negative correlation between the soluble solids content and total acidity ($r = -0.656$).

There was no correlation between carotenoids content and total acidity in either the juices or the syrups.

CONCLUSIONS

1. Disrupting the peel before pressing increases juice yield.
2. Vitamin C content, carotenoids content, total acidity and soluble solids content varied widely depending on juicing technique.
3. Vitamin C in sea buckthorn had good stability during a short-time increasing of temperature.
4. Vitamin C and carotenoids content was largely retained during heating, juicing and processing of sea buckthorn juice.
5. Briefly heating sea buckthorn berries before pressing produces juices and products with a relatively high content of biologically active compounds.

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WPLYW TECHNOLOGII PRZETWARZANIA NA SKŁAD SOKU Z ROKITNIKA

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S T R E S Z C Z E N I E

Sok z rokitnika jest jednym z najbardziej popularnych przetworzonych produktów używanych w stanie surowym do dalszego przetwarzania, na przykład do produkcji syropu. Skład biochemiczny soku i syropu zależy od technologii przetwarzania i użytego wyposażenia. Celem pracy było sprawdzenie zmian zawartości witaminy C, karotenoidów, kwasów i związków rozpuszczalnych w soku i syropie w zależności od zastosowanej technologii przetwarzania. Sok uzyskano 3 różnymi metodami:

- Zamrożone jagody rozmrażano w temperaturze pokojowej i sok uzyskiwano używając prasy Voran 60 K pod ciśnieniem 300 barów.
- Zamrożone jagody rozmrażano w temperaturze pokojowej i sok uzyskiwano używając prasy śrubowej Condo Line RD, która częściowo niszczy skórkę jagód.
- Zamrożone jagody ogrzewano do temperatury 98°C przez 5 minut bezpośrednio przed użyciem prasy Voran 60 K pod ciśnieniem 300 barów.

Uzyskany sok był oddzielany i produkowano z niego produkt przetworzony – syrop. W wyniku analiz można stwierdzić, że witamina C w soku rokitnika ma dobrą stabilność w procesie przetwarzania. Najwyższa zawartość ogólnych karotenoidów znajduje się w miąższu i skórce rokitnika i w zależności od zastosowanej technologii różni się istotnie – sok i syrop z najwyższą zawartością ogólnych karotenoidów (10,7 mg 100 g⁻¹) można otrzymać przez ogrzewanie jagód nie wcześniej niż 5 minut przed produkcją soku.

Słowa kluczowe: rokitnik zwyczajny, sok, technologie