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DRYING BLACKCURRANT FRUIT IN A DRYER WITH AN ALTERNATIVE SOURCE OF ENERGY

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Abstract

The alternative sources of energy for fruit drying preserve to some extent the ecological purity of the final product and its cost-effectiveness. The following cultivars were included in the present study: 'Ometa', 'Titania', 'Neosaipayushtasya', 'Bogatir', 'Byurlovska', 'Ben Lomond' and 'Ben Sarek' in the collection plantation of the Research Institute of Mountain Stockbreeding and Agriculture, Troyan. The experiment on drying blackcurrant fruit, without any direct sun light, was conducted in 2019.

The aim of the present study was to observe the suitability of this type of drying of blackcurrant fruit as well as the changes in their biochemical composition. The highest refractometric substance in fresh fruit was found in 'Ometa' (19.0%). The highest content of total (6.85%) and inverted (5.50) sugar was found in 'Neosaipayushtasya'. Dry matter in dried fruit was within the range of 81.43% ('Neosaipayushtasya') to 87.74% ('Ometa'). The highest values of total and inverted sugar were found in fruit of 'Titania' (6.10%) and sucrose in 'Ometa' (3.04%).

Key words: *blackcurrant, biochemical composition, cultivars, drying, fruit.*

INTRODUCTION

The advantages of blackcurrant over other fruit crops are due to its biological and economic qualities: high plasticity, easy reproduction, rapid return on capital investments, cost-effectiveness, application of modern cultivation technologies, high nutritional and dietary properties (Vater and Arena, 2002; Kampuss and Strautina, 2004; Madry et al., 2010; Sasnauskas et al., 2012).

Its fruits have an attractive appearance, superb aroma and great taste. They are particularly valuable because of their rich and varied mineral composition, including potassium, phosphorus, calcium, magnesium, iron, copper, manganese, zinc, cobalt. Their high levels of ascorbic acid and anthocyanins contribute to the normal course of physiological processes in the human body (Topchiiski, 1968; Häkkanen et al., 2002; Georgiev et al., 2007; Pantelidis et al., 2007).

Except for healing purposes, blackcurrant fruits are used to meet the needs of the population for fresh fruits and processed products. They are very suitable for drying, freezing and processing (Brashlyanova et al., 2014). Fruit drying is one of the most ancient methods of conservation and year-round preservation in order to maintain and restore the human body (Karabadzhov et al., 2011; Georgiev et al., 2014).

The purpose of the present scientific experiment is to monitor changes in the biochemical composition of fresh and dried blackcurrant fruits in a sun drier of different cultivars in order to have fruit all over the year.

MATERIALS AND METHODS

Fruit drying was conducted in the period from 02.07 to 11.07. 2019 in an outdoor dryer using daytime temperatures as the solar energy is transformed within the heat collector. The warm air flow passes through fruits and takes the moisture outside. The drying process in the experiment took ten days.

The scientific experiment included the following cultivars: 'Ometa', 'Titania', 'Neosaipayushtasya', 'Bogatir', 'Byurlovska', 'Ben Lomond' and 'Ben Sarek' from the Institute's collection plantation.

The collection plantation is located on a slope with an eastern exposure and at an altitude of 460 m. The soils are gray forest. The planting schemes are as follows: 1.00 m in the intra row

area and 3.00 m in the row spacing of plantation. The agrotechnics involved naturally grassed row spacings and black fallow in the intra row spacing.

The change in the biochemical composition of fresh and dried fruits of cultivars of different origins on heavy, moist soil in the region of Troyan were observed.

The following biochemical characteristics of selected fruit cultivars were investigated:

- dry weight matter (%) - 5 to 10 g were taken from the sample, using glass weight, glass rod and quartz sand;
- dry matter (DM) according to (refractometer) Re (%);
- Determination of sugars (total, invert and sucrose) and acid, according to the method of Schoorl (Donchev et al., 2001), 25 g of sugars were taken from the sample. Chemicals: 10% $NaCO_3$, $NaHPO_4$, Fehling's solution I, Fehling's solution II (made in the laboratory), 30% KJ, 1:6 H_2SO_4, titrated by 0.1 n $Na_2S_2O_3$ and starch indicator - sugars; 5 ml of acids were taken from the primary filtrate (as malic) by titration with 0.1-n NaOH - (%) and phenolphthalein indicator - acids;
- tanning substances according to the method of Levental (Donchev et al., 2000), 25 g of tannins were taken from the sample. Chemicals: 1:4 H_2SO_4, titrated by 0.1 KM_4O_4 and an indicator (indigo carmine);
- anthocyanins mg/% according to the method of Fuleki and Francis (1968), 2 g were taken from the sample . Chemicals: 96% spirt, buffer with pH - 1.0; buffer with pH - 4.5;
- pectin according to the method of Melitz (Donchev et al., 2000), 12.5 g were taken from the sample. Chemicals: 0.1 n NaOH, 1 n CH_3COOH, $CaCl_2$, $AgNO_3$;

Data processing was performed by the Statistical methods in biology and in agriculture (Lidanski, 1988), using MS Excel software - 2010.

RESULTS AND DISCUSSIONS

Fresh blackcurrant fruit

The diverse biochemical composition of blackcurrant fruits has been repeatedly studied. The individual indicators vary widely. Most often researchers have looked for the reasons in cultivar characteristics, not infrequently in the impacts of growing conditions. Different relationships have been found in the accumulation of anthocyanins, ascorbic acid, mineral salts, etc. (Topchiiski et al., 1968) with the content of flavonols (Häkkanen et al., 2002), ferments and enzymes.

The dry weight matter in the examined cultivars ranged from 17.41% ('Ben Sarek') to 23.43% ('Byurlovska'), that is, with a difference of approximately six units (Table 1).

The blackcurrant fruits have a relatively high content of dry refractometric substances, which for 'Titania' and 'Ometa' cultivars reached respectively: 17.3% and 19.0%.

The highest content of total sugars were reported for 'Neosaipayushtasya' (6.85%) and the lowest in 'Ben Sarek' (5.85%). The lowest content was observed is 'Bogatir' (4.20%). Inverted sugar was in approximate values to total sugars. The highest content of it again was found in 'Neosaipayushtasya' (5.50%) and 'Ben Sarek' (5.35%) and the lowest in 'Lisil' (3.70%). Sucrose was available in some cultivars. It was 1.28% for 'Neosaipayushtasya' and slightly lower for 'Lisil' - 0.95%. There is a strong variation of the indicator among the cultivars.

The highest content of organic acids was found in 'Ben Sarek' with a value of 1.40%, lower for 'Titania' (1.15%) and the lowest in 'Byurlovska' with 0.57%.

The tannins were high in blackcurrant fruits, ranging from 0.145% ('Ometa' and 'Ben Lomond') to 0.253% ('Byurlovska').

Pectin levels were high in 'Neosaipayushtasya' up to 4.17%. Fruits of 'Byurlovska' also had high content (3.16%). The lowest pectin level was found in 'Ben Lomond' (1.00%). The variation among cultivars was considerable.

High variation was registered in the values of total sugars, sucrose, organic acids, tannins and pectin among fruit cultivars.

Dried blackcurrant fruit

The biochemical composition of dried fruits indicates that dry weight matter values among cultivars are very close. The highest dry weight content was found in 'Ometa' (87.74%) and for the other cultivars was 81-85% (Table 1).

The content of total sugars is close to fresh fruits. The highest content was found in

'Titania' (6.10%) and significantly lower in 'Ben Lomond' (2.20%).
The content of inverted sugar was lower, compared to fresh fruits.
The highest content was found again in 'Titania' (6.10%) and the lowest in 'Ometa' (1.60%) with four point five units. The decrease in total and inverted sugar towards absolute dry units in fruit of 'Titania' cultivar was 3.1 times compared to fresh fruit. The indicator was highly variable among cultivars.
The highest content of sucrose was found in 'Ometa' (3.04%) and the lowest in 'Neosaipayushtasya' and 'Ben Sarek' (0.57%). It should be noted that 'Titania', 'Byurlovska' and 'Ben Lomond' do not have any sucrose.

Table 1. Biochemical composition of fresh and dried fruits of different blackcurrant cultivars in 2019

Cultivar	Dry weight (%)	DM according to Re (%)	Total sugars (%)	Inverted sugar (%)	Sucrose (%)	Acids (as malic) (%)	Tannins (%)	Pectin (%)
Fresh fruit								
'Ometa'	20.71	19.0	4.35	4.35	-	0.70	0.145	2.05
'Titania'	19.57	17.3	4.50	4.50	-	1.15	0.199	2.35
'Lisil'	23.43	12.0	4.70	3.70	0.95	0.64	0.181	2.35
'Neosaipayushtasya'	19.47	15.5	6.85	5.50	1.28	0.89	0.199	4.17
'Bogatir'	20.17	14.0	4.20	4.20	-	0.64	0.163	2.99
'Byurlovska'	20.75	15.0	4.50	3.85	0.62	0.57	0.253	3.16
'Ben Lomond'	20.08	14.5	5.00	4.50	0.48	0.70	0.145	1.00
'Ben Sarek'	17.41	12.5	5.85	5.35	0.48	1.40	0.199	1.27
ẋ ±SE	0.59	0.82	0.32	0.23	0.17	0.10	0.01	0.36
St Dev	1.68	2.33	0.91	0.64	0.47	0.29	0.04	1.03
VC %	8.32	15.55	22.02	14.25	97.92	34.52	21.05	42.56
Dried fruit								
'Ometa'	87.74	-	4.80	1.60	3.04	0.94	0.208	0.80
'Titania'	83.08	-	6.10	6.10	-	2.01	0.291	1.53
'Lisil'	84.60	-	5.70	3.80	1.81	1.34	0.291	0.53
'Neosaipayushtasya'	81.43	-	3.80	3.20	0.57	1.34	0.208	0.96
'Bogatir'	84.56	-	5.70	3.80	1.81	1.34	0.291	1.51
'Byurlovska'	84.37	-	3.20	3.20	-	1.74	0.208	1.01
'Ben Lomond'	84.61	-	2.20	2.20	-	1.34	0.249	1.06
'Ben Sarek'	84.10	-	3.20	2.60	0.57	2.01	0.291	1.22
ẋ ±SE	0.62		0.51	0.48	0.40	0.13	0.01	0.12
St Dev	1.77		1.44	1.36	1.12	0.38	0.04	0.34
VC %	2.1		33.18	41.09	114.29	25.17	16	31.48

Interesting results have been obtained regarding the sucrose content of dried fruits. 'Ometa' has registered values of 3.04% and was much lower in other cultivars. A high variation coefficient was reported among cultivars in total, invert sugar and sucrose.
The content of organic acids was close to fresh fruits, which were in the range of 0.94% ('Ometa') to 2.01% (in 'Titania' and 'Ben Sarek').
Higher tannin values were found in dried fruit over 0.200% in all cultivars. The higher concentration of cell sap might be the reason for the greater preservation degree of tannins.
The pectin content in dried fruits was lower than fresh ones in almost all cultivars. The highest was found in 'Titania' (1.53%) and 'Bogatir' (1.51%). The highest values of sugars (total sugars, invert and sucrose) and organic acids were found in dried fruit.

CONCLUSIONS

An experiment was carried out on the opportunity of applying a technology for drying of blackcurrant fruits in a drier with an alternative energy source.
The results show that the blackcurrant is high in refractometric substance, tannins and pectin. The highest DM according to Re was found in 'Ometa' (19.0%). The highest content of tannins (0.253%) was found in 'Byurlovska' and pectin (3.16%).
In dried fruits, the values of tannins are increased in all cultivars, while pectin was greatly reduced in most of them.

REFERENCES

Brashlyanova, B., Georgiev, D., Ludneva, D., Ivanova, P., Georgieva, M. (2014). Suitability of black and red currant fruit for technological processing in nectars and opportunities for their adequate preservation, *Aktualni poznatky v pestovani, slechteni, ochrane rostlin a zpracovani produktu,* 465-468.

Donchev, Hr., Zlateva D, Pashova S. (2000). Food science, laboratory exercise guide, Part Two, Varna, BG: University of Economics Publishing House, 61-63.

Donchev, Hr., Zlateva D, Pashova S, Ivanov A. (2001). *Food science, laboratory exercise guide,* Part First, Varna, BG: University of Economics Publishing House, 103-106.

Fuleki T., Francis F.J. (1968). *Journal of food science,* 33(5), 471.

Georgiev, D., Georgieva, M., Brashlyanova, B., Ivanova, P., Yancheva, S. (2014). Using of organic method to obtain dried apple products, Proceedings Book, 69-71.

Georgiev, D., Ludneva, D., Kakalova, M. Georgieva, M. (2007). Physicochemical composition of blackcurrant, red currant and their products. Proceedings of the Second International Symposium "Environmental Approaches to Food Safety", 321-326.

Häkkanen, A.T. Mikkonen, T.R., Määttä, K.R., Törrönen, A.R., Kärenlampi, H.I. Kokko, S.O., Karjalainen, R.O. (2002). Variation in flavonol content among blackcurrant cultivars, *Acta Hort.* (ISHS), 585,121-124.

Kampuss, K., Strautina, S. (2004). Evaluation of blackcurrant genetic resources for sustainable production. *J. Fruit Ornam. Plant Res.,* 12, 147-158.

Karabadzhov, O., Todorov, M., Paraskova, P., Georgiev, D. (2011). Use of solar energy for obtaining dried vegetable products, *Journal of mountain agriculture on the Balkans*, vol. 14, 4, 932-939.

Lidanski T. (1988). Statistical methods in biology and in agriculture (43-62), Zemizdat, Sofia (Bg).

Madry, W., Pluta, S., Sieczko, L., Studnicki, M. (2010). Phenotypic diversity in a sample of blackcurrant (*Ribes nigrum* L.) cultivars maintained in the Fruit Breeding Department at the Research Institute of Pomology and Floriculture in Skierniewice, Poland. *J. Fruit Ornam. Plant Res.,* 18(2), 23-37.

Pantelidis, GE, Vasilakakis, GA, Diamantidis, Gr. (2007). Antioxidant capacity, phenol, anthocyanin and ascorbic acid content in raspberries, blackberries, red currants, gooseberries and Cornelian cherries. *Food Chemistry,* 102, 777-783.

Sasnauskas, A., Siksnianas, T., Stanys, V., Bobinas, Č. (2012). Evaluation of agronomical characters of blackcurrant cultivars and selections in Lithuania. *Acta Hort*., 946, 189-194.

Topchiiski Sl. (1968). Blackcurrant, Zemizdat, 26-28.

Vater, G., Arena, M.E. (2002). Orchard growth and fruiting of *Ribes nigrum* L. in Tierra del Fuego, Argentina. *Acta Hort*., 585(1), 253-257.