



QUALITY ASSESSMENT OF SELECTED VARIETIES OF APRICOT FRUITS AS POTENTIALLY SUITABLE FOR THE BABY FOOD PRODUCTION

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ABSTRACT

Apricots are major fruit crop in our climatic zone. They have become a strategic crop raw material due to their chemical composition and wide usefulness for food processors. Fruits contain high levels of antioxidant active substances such as vitamins, provitamins, minerals and polyphenols. The aim of this study was to assess the quality of the eight varieties of apricots ('Detskij', 'Cegledi kedves', 'Goldtropfen', 'Velkopavlovická', 'Maďarská', 'Vestar', 'Velbora' and 'Veharda') for their potential use in the production of baby food based on soluble dry matter content, total and reducing sugars, organic acids and carotenoid content. Based on our results, as the most suitable for the production of baby food were identified varieties 'Cegledi kedves', 'Goldtropfen' and 'Detskij' which were the best in all key indicators monitored compared to all selected varieties.

Keywords: apricot, dry matter, sugars, organic acids, carotenoids

INTRODUCTION

Apricots are grown in many countries in the world. Turkey, Iran, Pakistan, Uzbekistan and Italy are the major apricot producers. Turkey is also a primary supplier of dried apricots to the world (FAOSTAT, 2011). In fact, Turkey makes up to 84% of the world's total dried apricot production, supplying 98,000 tons (FAOSTAT, 2011).

Fresh apricots have great nutritional value: their composition indicates that this fruit is a good source of fibre, minerals (especially potassium but also calcium, iron, magnesium, zinc, phosphorus and selenium) and vitamins (such as vitamin A, vitamin C, thiamin, riboflavin, niacin and pantothenic acid) compared to the very low energy intake of 50 kcal (200 kJ) per 100 g of fresh product (Gatti *et al.*, 2009; Munzuroglu *et al.*, 2003; Ruiz *et al.*, 2005 a, b). In addition, this species is known to be a rich source of carotenoids, responsible for fruit colour during ripening, an aesthetic commercial attribute for apricots. In the carotenoid biosynthetic pathway, the precursors, phytoene and phytofluene, are colourless and subsequent carotenes, ζ -carotene (pale yellow), β -carotene (orange), or lycopene (red) are coloured compounds (Dragovic-Uzelac, 2007). The importance of carotenoids has been reported in literature (Yildirim *et al.*, 2010), referred to β -carotene and other pigments such as β -cryptoxanthin and α -carotene, known to be precursors of vitamin A and to lutein and zeaxanthin involved in the retina health. Recently, the antioxidative effect of the carotenoids phytoene and phytofluene has been investigated suggesting that they can be part of the defense system against oxidative stress in human tissues (Kähkönen *et al.*, 2001; Arcan and Yemencioğlu, 2009). In apricot mature fruit, the most representative carotene is β -carotene accounting for more than 50% of the total carotenoid content (Capocasa, 2008). Other types, such as α -carotene, β - cryptoxanthin, γ -carotene zeaxanthin and lutein are only present in very low concentrations (Pérez-Jiménez *et al.*, 2008).

Fresh apricot fruits are good source of antioxidants such as chlorogenic acid, neochlorogenic acid, caffeic acid, p-coumaric acid, ferulic acid (Scalzo *et al.*, 2005; Leccese, 2008).

The aim of the study was to assess the quality of eight varieties of apricots ('Detskij', 'Cegledi kedves', 'Goldtropfen', 'Velkopavlovická', 'Maďarská', 'Vestar', 'Velbora' and 'Veharda') collected at full technological maturity and potentially suitable for the production of baby food.

MATERIAL AND METHODS

The fruits originated from the Plant Production Research Center in Piešťany. Fruits were harvested at the stage of full technological maturity, they were typically colored, with full flavor and aroma characteristic for the variety. The average sample weight was 1 kg. Each sample was evaluated in triplicate. The soluble dry matter content (by refractometry), the content of total and reducing sugars (Schoorl method), organic acids content (by titration) and carotenoid content (spectrophotometric method by STN 12136) were determined.

RESULTS AND DISCUSSION

Soluble dry matter content in the selected samples was determined by refractometry. It is a quick method which is in the present time usually used to control the fruit quality at purchase. Based on the content of soluble dry matter it is possible to determine the approximate amount of sugars found in fruits and thus the maturity of the fruit. In our work, we found that the dry matter content is strongly affected by the variety and the ripeness of the fruit as well.

The dry matter content in the samples of fresh fruits ranged from 11.4% to 14.8%. Minimum dry matter content was found in the sample of 'Velbora' (11.4%), 'Veharda' (12.2%), 'Vesna' (12.2%). Maximum dry matter content was found at samples 'Detskij' (13.4%), 'Goldtropfen' (13.3%) and 'Cegledi kedves' (14.8%).

Our findings correspond with the findings of **Mratič et al. (2011)**, who monitored physical and chemical characteristics of the apricot fruits from Macedonia to find clones with worse characteristics of fruit for industrial processing. Authors found that the proportion of soluble dry matter in the fruit of different clones of apricots ranged from 14.4% at clone K - 3/1/04 by 11.7% in clone X-1/1/04, that were clones of Macedonian origin, grown in Skopje.

Asma and Ozturk (2005) indicate that the soluble dry matter content in the fruit of apricot was higher than we found in our work, which is most likely associated with more favorable agro-ecological conditions for growing apricots in Turkey as well as the authors point out the different eco-geographical groups of grown apricots.

Vachůn (2001) observed the dry matter content of 14 varieties of apricots, which originated from the Bohemian and Moravian breeding and he found a quite wide range of this indicator. The content of soluble dry matter ranged from 8.0% to 15.5%. The highest proportion of genotypes to 10 of 14 studied had the dry matter content in the range of 8.0% -

12.0%. **Ruiz and Egea (2008)** state that if the fruits of apricots have soluble dry matter content more than 11% , they show excellent taste characteristics.

For processing of fruits for baby food is sugar content of great importance. The target group for which the product is intended prefers sweet taste and from health perspective as well as from an economic point of processing is more suitable variety of fruit species, which show a higher sugar content. In terms of healthy nutrition, simple sugars are easily digested in the body of the young child's developing organism compared to sucrose.

In our work we found the reducing sugars content from 6.59% to 10.53% in apricot fruit. As the fruits with the lowest content of reducing sugars were identified 'Veharda' (6.59%), 'Velbora' (6.72%) and 'Vestar' (7.53%) varieties. Middle content group consisted of fruit 'Maďarská' (9.2%), 'Detskij' (9.4%) and 'Velkopavlovická' (9.72%). The highest reducing sugar content was detected in the fruit varieties of 'Goldtropfen' (10.16%) and 'Ceglédi kedves' (10.53%). These apricots were appeared to be the sweetest ones.

The content of total sugars (Tab.1) varied in observed varieties from 10.65% to 12.99%. The reducing sugar content was confirmed the highest at the variety 'Ceglédi kedves'. The content of total sugars in the fruit decreased in the order: 'Ceglédi Kedves' (12.99%) > 'Detskij' (12.72%) > 'Velkopavlovická' (12.3%) > 'Maďarská' (12.08%) > 'Goldtropfen' (12.0%) > 'Vestar' (11.63%) > 'Velbora' (10.96 %) > 'Veharda' (10.65%).

Mratič et al. (2011) determined the content of reducing sugars in the fruit of apricots originating from Macedonia and grown in warm area of Macedonia, ranging from 8.49% to 10.39%. Comparable with the best clone proved by **Mratič et al. (2011)**, in our case were varieties detected 'Ceglédi Kedves' and 'Goldtropfen'. **Mratič et al. (2011)** observed in addition to reducing sugars, also sucrose content in fruits of apricots. They found that sucrose content is present in the fruit of apricots in the amount 1.2% - 0.72%.

Hudec et al. (2003) tested the reducing sugar content in the varieties of 'Vesna', 'Veselka', 'Vesprima' and 'Barbara'. They found that reducing sugar content was 2.48% at variety 'Veselka' by 5.94% in varieties 'Vesprima' and 'Vesna'. These amounts of reducing sugars correspond with our findings in varieties of 'Vesna', 'Veharda', 'Velbora' in which we also detected lower levels of reducing sugars.

Sa'ed (2007) tested the reducing sugars content in varieties originating from Bulgaria, Italy and Turkey and he found that the highest sugar content was determined at varieties originating from Italy (7.1%) and Turkey (7.1%) and the lowest was detected in Bulgaria varieties, only 3.1%. Author does not state further specifications of Bulgarian varieties and

therefore any better position to such a low content of reducing sugars in these varieties cannot be taken.

The presence of organic acids in fruits of apricot makes fruit of desired freshness and delicious taste. The content of organic acids is very significantly changed by maturation, when several authors reported decreasing content of organic acids. As **Vachůn (2001)** states titratable acids in fruit of apricot are represented by dominant malic and citric acid. In the smaller amount ascorbic and chlorogenic acids are present.

The content of organic acids in fresh fruits of our samples ranged from 1.36% to 0.88%. Organic acids are expressed as citric acid. The highest acidity content was found in variety 'Veharda' (1.36%) and the lowest in the 'Maďarská' variety (0.88%). As the varieties containing less organic acids amount can be classified varieties 'Ceglédi Kedves' (0.96%), 'Detskij' (1.03%) and 'Goldtropfen' (1.1%). Higher contents of organic acids were measured in 'Veharda' (1.36%), 'Velkopavlovická' (1.24%), 'Vestar' (1.27%) and 'Velbora' (1.24%).

Titratable acids content was observed by **Hudec et al. (2003)** as well. The authors found extremely high content of acids. They state the content of organic acids in varieties of 'Vesna' 4.4% and 3.36% for 'Veselka', 'Vesprima' even 6.0%. In two cases ('Veselka' and 'Vesprima') they indicate higher titratable acids content than the content of reducing sugars.

Vachůn (2001) tested the varieties of 'Olimp' (0.53%) and 'Velvaglo' (1.05%) and as acidic varieties 'Lemira' (1.51%), 'Legolda' (1.62%) and 'Velkopavlovická' (1.64%). Comparable to our findings, we could 'Velkopavlovická' variety containing 1.28% of titratable acids evaluate as the variety with higher acidity. In our work, however, it did not reach as high values as in the findings of **Vachůn (2001)**.

'Vestar' variety, 'Veharda' and 'Velbora' were lower in sugar content and higher in organic acids. In terms of taste, we could classify these varieties as acidic varieties. In contrast, varieties 'Velkopavlovická' and 'Goldtropfen' have a higher content of organic acids, while a higher sugar content, but taste is defined as a harmonious or as delicious. Varieties 'Ceglédi kedves', 'Maďarská' and 'Detskij' had the lowest content of organic acids and the highest sugar content, sweet taste is dominant. For the production of baby food, in which is a sweet flavor and high sugar content desirable, we could definitely recommend them.

Although carotenoids and β - carotene are not dominant nutritional factors necessary for the development of infants and children, their presence in the raw material can improve the nutritive value of the product.

As **Ruiz et al. (2005, 2008)** state the dominant carotenoids in fruits of apricot are β -carotene, β -cryptoxanthin and γ -carotene. **Buerfeind (1981)** indicates that 60 – 70% of all carotenoids in fruits of apricots is β - carotene, 5–7% is γ - carotene, 4-7% cryptoxanthin, 1 – 5% lycopene, and 2 - 1.5% lutein.

In our apricot varieties studied, the content of carotenoids in fresh matter ranged from 7.106 mg. 100 g⁻¹ in the variety of 'Goldtropfen' to 2.023 mg.100 g⁻¹ in 'Maďarská'. Carotenoid content in fresh fruits decreased in the order: 'Goldtropfen' > 'Veľkopavlovická' > 'Vestar' > 'Veharda' > 'Velbora' > 'Detskij' > 'Cegledi kedves' > 'Maďarská'.

O'Neill et al. (2001) state that the fruit of apricots is source of β -carotene on average 0.953 mg.100 g⁻¹, 0.037 mg.100 g⁻¹ of α -carotene and 0.66 mg.100 g⁻¹ of lutein. **Sass-Kiss (2005)** observed the carotenoid content in 11 varieties of apricots and they found that β -carotene content was the highest in the 'Royal Ceglédi' variety (3.8 mg.100 g⁻¹) and the lowest in variety 'Roxana'(1.5 mg.100 g⁻¹).

Table 1 Selected monitored parameters of apricots

Variety/Content	Soluble dry matter (%)	Total sugars (%)	Reducing sugars (%)	Organic acids (%)	Carotenoids (mg.100 g ⁻¹)
Cegledi kedves	14.8	12.99	10.53	0.96	2.271
Veharda	12.2	10.65	6.59	1.36	3.410
Detskij	13.4	12.72	9.40	1.03	2.366
Vestar	12.2	11.63	7.53	1.27	3.486
Maďarská clone 255	11.7	12.08	9.20	0.88	2.023
Velbora	11.4	10.96	6.72	1.24	2.945
Goldtropfen	13.3	12.00	10.16	1.10	7.106
Veľkopavlovická clone 12/1	13.2	12.30	9.72	1.28	4.020

After calculating the content of carotenoids per dry matter content (determined by gravimetric method), trend in the content of carotenoids remained similar. The highest was in variety 'Goldtropfen' (77.607 mg.100 g⁻¹) and the lowest in the 'Maďarská' variety (18.352 mg.100 g⁻¹). Hudec et al. (2003) in their work proved the content of β -carotene in variety 'Maďarská' as 10.7 mg. 100 g⁻¹ in dry matter, which would corresponded to our findings, provided that the β -carotene is 70% of the total carotenoids in fruits of apricot.

CONCLUSION

The aim of this work was to evaluate the quality of selected varieties of apricot for the production of apricot baby food. Besides the main parameters (content of dry matter, reducing sugars, total sugars, and organic acids content) apricot is an important source of carotenoids, therefore we tested the quality of the materials in this respect. We evaluated eight varieties that were harvested at the stage of full technological maturity for production of baby food.

Soluble dry matter content in samples of fresh fruits ranged from 11.4% in variety 'Velbora' to 14.8% in variety 'Ceglédi kedves'. The content of soluble dry matter and sugars are the indicators that are based on the strong correlation. For processing fruits for baby food are sugars in fruits of great importance. The target group of children for whom the product is intended prefers a sweet taste, and in some respects more suitable for the production are the varieties that have higher initial sugar content. The highest content of total and reducing sugars were found in varieties 'Ceglédi kedves', 'Goldtropfen' and 'Detskij'. Low sugars were found in varieties of 'Vestar', and 'Velbora' and 'Veharda'. The apricot fruits are the dominant in organic acids such as citric acid and malic acid. In our samples the highest values of organic acids were found in varieties of 'Veharda' (1.36%), 'Vestar' (1.27%), 'Velkopavlovická' clone 12/1 (1.24%) a 'Velbora' (1.24%). Low acid content was determined in 'Ceglédi kedves' (0.96%) a 'Detskij' (1.03%).

In terms of the content of carotenoids as the most valuable varieties were identified 'Goldtropfen' containing 7.11 mg.100 g⁻¹ in fresh matter and 'Velkopavlovická' clone 12/1 containing 4.02 mg.100 g⁻¹ in fresh matter. Low content of carotenoids was detected in a variety of 'Maďarská' clone 255 that contained 2.02 mg.100 g⁻¹ carotenoids in fresh matter. For canning processing for the baby food in terms of production quality control at purchase, based on external characteristics and monitored parameters, all selected varieties met the requirements. All tested varieties of apricots were characterized by desired ripeness, they were found to be in satisfactory health conditions and of good sensory properties. On the basis of detailed analysis by the high sugar content and high levels of carotenoids and low content of organic acids, we would recommend varieties of 'Ceglédi kedves', 'Goldtropfen' and 'Detskij' for baby food production due to they overcome other varieties in all basic indicators monitored.

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