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New or lesser known cultivar selection as a tool for sensory and nutritional value enhancement of osmo-convectively dried sour cherries

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ABSTRACT

Taking into consideration the economic importance of sour cherry growing in Europe as well as the arising perspective of novel sour cherry product development, an investigation outlining the processing usefulness of some promising sour cherry cultivars that could lead to a better final product quality was undertaken. Nine new or lesser popular cultivars of sour cherries were compared to 'English Morello' with particular consideration given to processing suitability for osmo-convective drying. The quality of raw material was characterized taking into account fruit size, soluble solids content, acidity and pro-health properties. To assess the quality trait stability of individual cultivars, standard deviations were calculated. As a measure of ascertaining the fruits' suitability for drying, the sensory properties of osmo-dried products produced by the examined cultivars were considered. The gathered data demonstrates high seasonal variations in quality traits of the most investigated cultivars, which could well restrict their processing usefulness, especially for osmo-drying, as this product was found highly sensitive to fluctuation of raw material uniformity. Among the tested cultivars 'Nefris' emerged the most suitable for processing purposes. Fruits of this cultivar gave high quality dried product of repeatable sensory attributes characterized by significantly better pro-health properties than that of 'English Morello'.

1. Introduction

Sour cherries (*Prunus cerasus* L.) are characterized by high nutritional value. They are considered a valuable source of dietary fibre, folic acid and potassium. Due to the high level of anthocyanins and other phenolic compounds, they are also able to protect human organism against harmful free radicals (Halvorsen et al., 2002; Kirakosyan, Seymour, Llanes, Kaufman, & Bolling, 2009) and are recommended as a good source of biofunctional phytochemicals in the human diet (Kim, Heo, Kim, Yang, & Lee, 2005). Recent studies have not only confirmed strong antioxidant potential of sour cherry anthocyanins, but have also proved their anti-carcinogenic, anti-inflammatory and anti-neurodegenerative activity (Kang, Seeram, Nair, & Bourquin, 2003; Kim et al., 2005; Ou, Bosak, Brickner, Iezzoni, & Seymour, 2012; Traustadóttir et al., 2009; Wang et al., 1999).

With availability of fresh fruits on the market being rather limited, any novel ideas leading to attractive products produced from sour cherries, that could, in turn lead to higher consumption of these fruits, may be deemed advisable. One such promising, though still insufficiently exploited method is that of osmo-dried fruit production. Although both osmotic treatment and drying process lead to certain loss in anthocyanins (Jesionkowska, 2010; Lohachoompol, Srzednicki, & Craske, 2004) dried sour cherries are still a valuable source of antioxidants (Konopacka, Jesionkowska, Mieszczakowska, & Płocharski, 2008; Vinson, Zubik, Bose, Samman, & Proch, 2005). Moreover, according to recent consumer research (Bonazzi et al., 2010; Jesionkowska, 2010; Sijtsema, Jesionkowska, Symoneaux, Konopacka, & Snoek, 2012; Sijtsema, Zimmermann, et al., 2012) osmo-convectively dried sour cherries have a chance to be adopted by European citizens as a popular fruit snack having strong functional properties. This data seems to offer encouragement for sour cherries producers, as introducing such cherry products into the market place creates viable alternatives for post-harvest utilisation of their crop.

However, strict quality requirements must be established to ensure consumers are provided with products of high, uniform and repeatable quality distinguished by substantial pro-health properties. One of the conditions for obtaining such a target is an appropriate selection of cultivars.

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Although a wide range of sour cherry cultivars are recommended to commercial planting, in Poland 'English Morello' still accounts for up to 70% of the planted trees (Mika, Buler, & Michalska, 2011). The Research Institute of Horticulture (Skierniewice, Poland) has long-standing experience in the breeding of sour cherries and several new prospective cultivars, highly varying in taste and composition are available (Grzyb & Rozpara, 2009; Rozpara, Grzyb, Guzowska-Batko, Lisowski, & Czynczyk, 1996). Taking into consideration the considerable economic importance of sour cherry growing in Poland as well as the arising perspective of novel sour cherry product development, an investigation outlining the processing usefulness of lesser known sour cherry cultivars that could enhance final product quality was undertaken.

The aim of the present work was to determine the processing usefulness of new, or lesser known, sour cherry cultivars grown in Poland, taking into consideration their chemical composition, as well as their suitability for osmo-dried fruit production. Special attention was paid to the repeatability of fruit quality traits expressed as well as cultivars' tendency to seasonal variation. Apart from basic quality traits, screening was also carried out for bioactive compounds as additional indices influencing quality characteristics, and additionally commercial attractiveness, as they are of special interest for both processors and consumers.

2. Material and methods

2.1. Materials

As experimental material, nine new or lesser known perspective cultivars for growing in Poland were chosen, which were compared to 'English Morello' taken as a standard. These were: 'Debreceni Bőtermő', 'Morellenfeuer' ('Kelleriis 16'), 'Koral', 'Morina', 'Nefris', 'Oblacińska', 'Safir', 'Słupia Nadbrzeżna' and 'Topas'. All fruit for the experiment originated from the Experimental Orchard of the Research Institute of Horticulture in Dąbrowice (formerly Research Institute Pomology and Floriculture). During the 3 year experiment (2008–2010) due to low fruit yield, fruit of 'Słupia Nadbrzeżna' was investigated only in 2008 and 'Koral' in 2008 and 2009, while the rest were investigated each season. Fruits were collected at the commercial maturity stage, having characteristic colour, aroma and flavour. Considering that sour cherries are highly perishable fruits and available only for a short time during the season, following standard industrial practice the material of all cultivars was frozen to ensure availability for off-season processing. The same procedure was used for all cultivars. Fruits were washed immediately after harvest, then subsequently frozen at −25 °C and stored at that temperature until processing. To avoid the influence of storage length of raw material on the degree of bioactive components degradation (Chaovanalikit & Wrolstad, 2004) in particular seasons all cultivars were stored for a comparable time period.

2.2. Raw material characteristic

Raw material uniformity was characterized by fruit and pit mass (for 100 fruits). Further as basic traits determining the overall processing usefulness soluble solids, dry matter contents and titratable acidity were measured. Additionally, fruits were analysed for their pro-health properties: anthocyanins content, total phenolic compounds content and antioxidative potential, with analysis being carried out on the frozen fruit of every particular cultivar crop stored in bulk, with each cultivar subjected to two independent batch studies.

2.3. Osmo-convectively dried fruit production

The production procedure had been established based on the previous experience of the authors. The technological parameters were selected as optimal for obtaining high quality product out of 'English Morello' (Konopacka et al., 2008; Szymczak & Płocharski, 1999). Fruit was pitted in the frozen state after equilibration to the temperature −5 °C and then submerged in warm (40 °C) sucrose solution (600 g kg^{-1}; fruit to syrup ratio 1:4) and dehydrated for 120 min in beakers placed in a water bath fitted with a shaking plate working at a frequency of 140 rpm (Julabo SW 22, Labortechnik GmbH, Seelbach, Germany). After the dehydration stage, fruits were drained and rinsed with cold distilled water, gently blotted on filter paper and spread in a monolayer on stainless steel sieves and dried in a convective drier with a horizontal air flow (2.5 m s^{-1}) at 60 °C for 9 h resulting in a final water activity below 0.7, in order to minimize the risk of microbial product spoilage. All available cultivars for each season were processed twice, and the obtained product batches were treated as technological repetitions. Dried material was stored in glass jars in darkness at 18 °C temperature prior to analysis, for no longer than two weeks.

2.4. Chemical analyses

Pior to chemical analyses fresh fruits before determination were disintegrated in the frozen state at −25 °C. Total soluble solids were measured employing the refractometric method (RE50 Refractometer, Mettler Toledo, Japan), the titratable acidity was determined by titrating diluted fruit pulp to pH 8.10 with 0.1 mol//L NaOH (DL 58 Titrator, Mettler Toledo, Switzerland) and dry matter content both in fresh and dried fruits was determined using the gravimetric method (drying to constant weight, $3 \cdot 10^3$ Pa vacuum, 70 °C).

To enable determination of dry weight and pro-health components of dried fruits about 300 g of samples were cut into small pieces by means of ceramic knife.

Total anthocyanin content was determined after extraction from the solution of acidified ethanol using homogenizator (Ultra Turrax® T 25 Basic IKA®-WERKE) and quantified spectrometrically according to Wrolstad (1976). The absorbance of aqueous anthocyanin solution adjusted to pH = 1 and pH = 4.5 was measured at wavelengths of 517 and 700 nm (UV/Vis CARY 3E, Varian Inc., Australia). Results were expressed as cyanidin-3- glucose (mg 100 g^{-1} of fruits). Molar absorptivity of 29,600 was used (MW 449.2 g mol^{-1}).

Total phenolics were measured by the modified spectrophotometric method with Folin–Ciocialteau reagent (Tsao & Yang, 2003) at 765 nm using the same extract as was used for anthocyanins. The contents of phenolic compounds were expressed as mg gallic acid equivalents.

The antioxidant activity was determined from samples after grinding in liquid nitrogen using mill (IKA A11 Basic IKA®-WERKE) according Re et al. (1999) and expressed as 50% reduction of $ABTS^{\bullet+}$ solution absorbance and recalculated to mg of Trolox equivalents. All measurements were carried out in two independent replicates per each batch of raw material as well as for processed fruit.

2.5. Sensory analysis

The quality of the dried products was evaluated using a profiling method. The expert panel consisted of 15 persons, mainly women, recruited from the staff of the Research Institute of Horticulture, trained and having extensive experience in performing sensory assessment of dried horticultural products. Prior to each