WHAT KIND OF SWEET CHERRIES DO THE FINAL CONSUMERS PREFER?

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ABSTRACT. *One of the important aims of the COST (Cooperation of Science and Technology) Action FA1104: "Sustainable production of high-quality cherries for the European market" is to exchange information on the new achievements related to cherry production and cultivars. During the project some differences in the consumer preferences in the participating countries were compared. The results from Bulgaria, Chile, Hungary, Italy, Japan, Latvia, and Turkey show that the most important characteristics for the cherry consumers are the taste followed by skin color. The most preferable cherries are sweet, but fruits with not very sweet taste, large fruit size, red color, reniform fruit shape and medium long stalk are also preferred.*

KEY WORDS: *Prunus avium L., costumers' preference, profile, fruit size, fruit color.*

INTRODUCTION

The world leading sweet cherry producing country is Turkey, followed by

the United States of America, Iran, Italy, Spain, Chile and the Russian Federation. During the period of 1980 and 2013 sweet cherry production in Turkey, the United States, Chile, and China showed a very dynamic increase, while production in France, Germany, Bulgaria and Hungary exhibited a strong decrease (Food and Agricultural Organization of United Nation, 2016). However, there are same innovations in the Bulgarian, German, French and Hungarian cherry industry to improve the sweet cherry production (Koumanov 2015, Zhivandov 2008, Hrotkó 2010, Moreno et al. 2012, Robinson et al. 2014, Bujdosó & Hrotkó 2015a, 2015b, 2016). The grown cultivars play the most important role in the sweet cherry production. To satisfy market requirements the cherry growers need cultivars with regular bearing, big yield annually, large fruit size, firm fruit flesh, good, sweet taste, crunchiness, long stalk length, very early or very late ripening time, good shelf life, and resistance to the most important diseases (Apostol 2008). The fruit size as very important characteristic for consumers which among other factors highly depends on the vigor and leaf/fruit ratio of the rootstock/scion combination (Bujdosó & Hrotkó 2015a). It is proven that the rootstocks have an effect on the inner content value of grafted cultivars. Among Slovene climate conditions the 'Lapins' on 'Weiroot 72' and 'Edabriz' resulted in high soluble solids content and fruit firmness. 'Weiroot 13', 'F 12/1', 'GiSelA 195/20' and 'MaxMa 14' effected the lowest fruit firmness (Usenik et al. 2010). Main usage of the sweet cherry is for fresh consumption therefore appearance (including shape, shiny fruit skin, fruit color, length of the stalk but also taste) are really important in order to define the good quality. In order to achieve good eating quality the cherries must be harvested at fully ripe, knowing that the cherries are non-climacteric fruit species. In order to determinate the optimal eating quality, analysis of different chemical compounds can be useful to have some information on the maturity stage. In some cases delaying the harvest for some days can lead to achieve the maximal nutritional, sensory, and functional quality (Díaz-Mula et al. 2009). Color measurement, mainly color charts can also help in determination the optimal maturity stage for the growers. For fresh consumption purposes the evidences of the freshness of the stem is very important (Pallotino et al. 2013). Cherry cultivars from the breeding program located at Agriculture and Agri-Food Canada, Research Centre, Summerland, B.C., were profiled for their sensory characteristics. Judges found significant differences in external firmness, size, and color intensity as well as differences in flesh firmness, juiciness, sweetness,

sourness, and intensity of cherry flavor among the cultivars. The judges preferred cherries exhibiting dark color fruit skin, medium fruit size (around 26 mm in diameter), medium fruit flesh firmness, sweet flavor and the juicy fruit flesh (Dever et al. 1996). Kappel et al. (1996), Bujdosó & Hrotkó (2016) reported about 29 to 30 mm in diameter as an ideal fruit size for sweet cherry industry members in general. These results were also confirmed by Turner et al. (2008) for Oregon State, USA. The red colored sweet cherry cultivars dominate in assortments of all cherry producing countries; the blush cherries have just small importance (Bujdosó & Hrotkó 2017). The sweet cherry aroma consists of many constituents, mainly aldehydes, alcohols, and esters (Zhang et al. 2007). There are strong differences in the inner content value of different cultivars, grown at the same place among the same fruit site conditions (Göksel & Aksoy 2014). The eating quality of fruits can decreased during the short-term storage, if the ripening stage is not optimal (Serrano et al. 2009). Low temperature is absolutely necessary during storage to decrease the loss of water and retarding the color change. Puniran et al. (2012) reported that the optimal temperature during the storage is 0°C. The aim of this study was to evaluate the Bulgarian, Chilean, Hungarian, Italian, Japanese, Latvian and Turkish costumer's preference to the main sweet cherry fruit characteristics. The results could be very useful information for growers, cooperatives and breeders, about the cultivars that costumers would prefer to buy. This survey is also useful as one of indicators for the export and import companies too about the customers behavior in different countries.

MATERIAL AND METHODS

A questionnaire about the most important sweet cherry characteristics (fruit skin color, fruit shape, fruit size, taste, fruit flesh firmness, length of the stalk) was created and distributed to the "final" costumers, who buy the fruits on the market. All characteristics in the questionnaire were described using the UPOV, Sweet Cherry, Guidelines for the conduct of tests for distinctness, uniformity and stability, TG/35/7, Geneva, 2006. On the survey sheet the very small fruit size indicated size of 18.9 mm in diameter or smaller size, the small fruit size was equal to range of 19 and 21.3 mm, the medium fruit size was between 21.4 and 25.4 mm. The range of 25.6 and 29.8 mm in diameter composed the large fruit size category, and the fruit size category reached at least 29.9 mm recorded as very large fruit size in the UPOV description. In Bulgaria, the survey was conducted among different groups

Table 1. Number of customers in the participating countries in percentage.

Country	Number of customers	Female customers (%)	Male customers (%)
Bulgaria	150	50	50
Chile	100	58	42
Hungary	200	50	50
Italy	276	46	54
Japan	38	58	42
Latvia	32	65	35
Turkey	100	44	56

Table 2. Costumers' age distribution in percentage.

	under 20 years	21 – 30 years	31 – 50 years	51 years or older
Bulgaria	0	50	42	8
Chile	7	18	51	24
Hungary	9	17	41	23
Italy	12	25	38	25
Japan	5	76	6	3
Latvia	3	34	38	25
Turkey	2	24	59	15

of people at a supermarket, Agricultural University of Plovdiv and AGRA International Agricultural Exhibition located in Plovdiv. In Chile, the survery let costumers filled at "Mercado Vega" located in the center of the Chilean capital. In Hungary the survey was made on the 2nd cherry week in the Great Market Hall and in a supermarket in Budapest. The data collection was made in Yamagata (Yamagata provice, Japan) and in Forli in Italy. The survey was conducted among a randomly chosen visitors in several events at the Institute of Horticulture in Latvia. The participants from Turkey were randomly selected by Ondokuz Mayıs University staff and horticulture student families. And also they represented different professional groups such as farmer, worker, doctor, officer, student, engineer etc (Table 1). The most asked participants took part in the trial were from ages between 31 and 50 (Table 2).

RESULTS

Fruit skin color. The costumers prefer dark red sweet cherries, instead of other skin colors except in Chile and in Japan. Ratio of the costumers

preferring dark red cherry was 35% in Bulgaria, 45% in Hungary, 28% in Italy, 25% in Latvia, 49% in Turkey. In Chile the red (medium red) skin color is preferred (28% of the asked costumers preferred it), followed by cultivars with light red color (17%). In Japan the cultivars with light red fruit skin were dominant (38% of the asked costumers selected this answer) followed by cultivars having orange red (27%) and blush fruit skins (12.5%) (Figure 1).
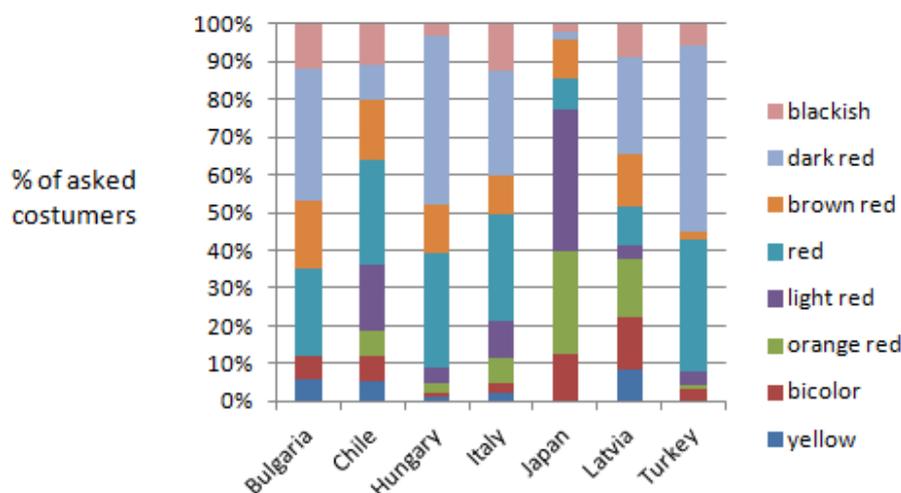

Figure 1. Relative frequency of cherries fruit skin color in % of the asked costumers.

Fruit shape. The sweet cherries having reniform shape dominated in Bulgaria (69%), Chile (64%), Hungary (62%), Japan (68%), Turkey (45%). In Italy the cordate and circular fruit shape are favorite for local customers (39% of each), but in Latvia the asked costumers selected oblate fruit shape the most (47%) (Figure 2).

Fruit size. The fruit size is always very important for both growers and the costumers as well. The very large fruit size category dominated in Chile, 53% of the asked costumers preferred this category. The very large fruit size category was important for the Bulgarian costumers as well, but beside this category the large fruit size was also dominant, their rate was 36% of each. In Turkey and Latvia the large fruit size were selected the most. In average 56% of the Turkish and 40% of the Latvia costumers choose this category. In Italy and Hungary the medium fruit size category was the most

preferable by customers followed by large fruit size. There was a small difference between medium and the large fruit size category (Figure 3).
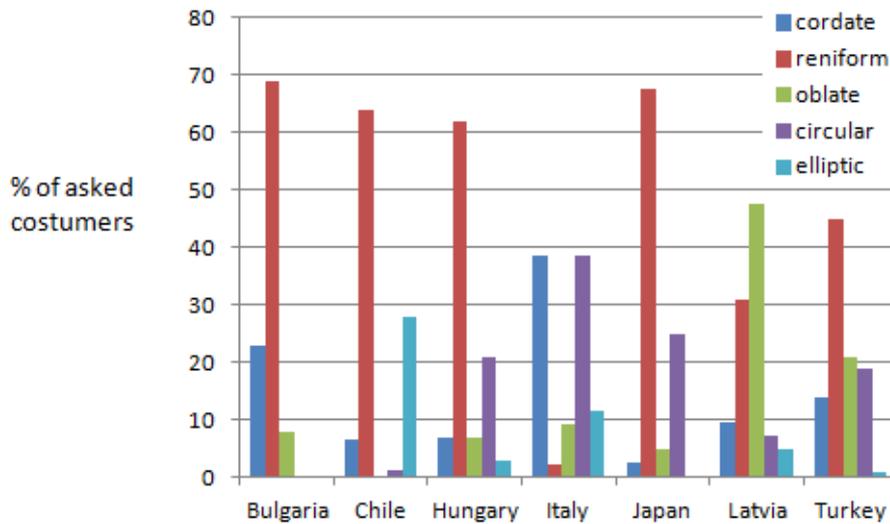

Figure 2. Relative frequency of cherries fruit shape in % of the asked costumers.
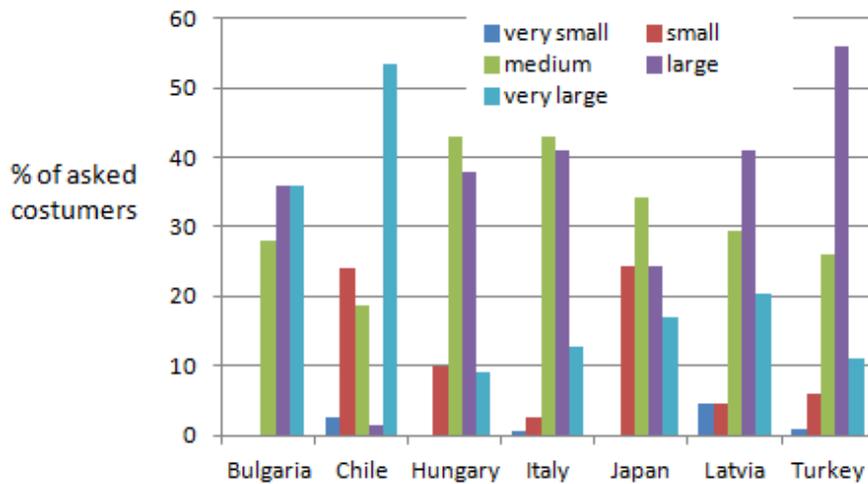

Figure 3. Relative frequency of cherries fruit size in % of the asked costumers.

Taste. The sweet taste was the most important for the asked costumers in almost all countries (50% of the Bulgarian, 68% of the Chilean, 65% of the Hungarian, 46% of the Italian, 45% of the Latvian, and 55% of the Turkish costumers selected this answer) However, 46% of the Japanese costumers preferred the sweet taste, 38% of the asked unskilled people thought that the very acid flavor is also belongs to the sweet cherry. The very sweet taste was important for Latvian customers (27%) followed by Turkish (22%), Italy (18%), Hungarian (17%), Chilean (16%) and Bulgarian (8%) with smaller importance (Figure 4).
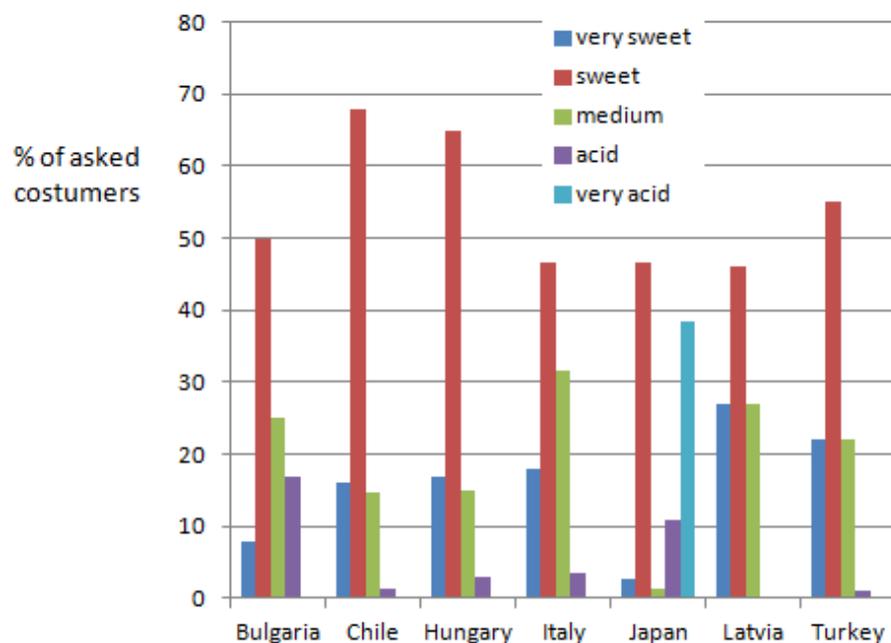

Figure 4. Relative frequency of cherries taste in % of the asked costumers.

Fruit flesh firmness. The firm fruit flesh is important for the costumers, because 75% of the Bulgarian, 63% of the Turkish, 62% of the Hungarian, 50% of the Chilean and the Italian costumers selected this answer. It is interesting to notice that 56% of the Japanese and 47% of the Latvian respondents liked the medium fruit flesh. However there was a small difference between the medium and the firm fruit flesh categories between the answers from Latvia (Figure 5).
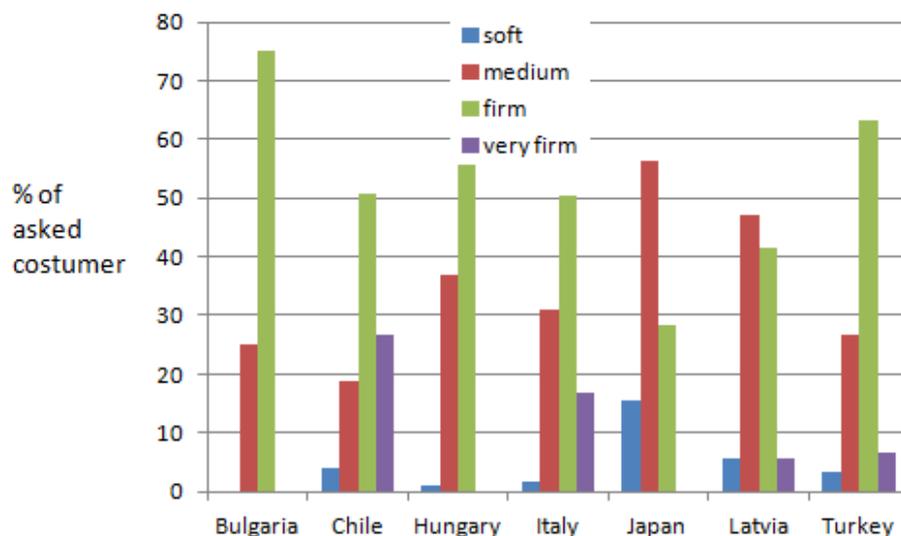
Figure 5. Relative frequency of cherries' fruit flesh firmness in % of the asked costumers

Stalk. During the survey almost all customers from Bulgaria, Chile, Hungary, Italy Japan, and Turkey stated that it must have stalk on the cherries (Table 3.). Huge percentage of costumers from countries participating in the survey (58% of Bulgarian, 71% of Chilean, 75% of Hungarian, 63% Italian, 77% Japanese, 61% of Latvian, 83% of Turkish) preferred cherries with medium stalk. In Latvia 77% of the asked costumers want to buy stem-out cherries (Figure 6).

Table 3. Evaluation of presence of stalk on cherries in percentage of the asked costumers.

	Bulgaria	Chile	Hungary	Italy	Japan	Latvia	Turkey
Absence of stalk	0	0	8	6	2	74	3
Absence of stalk	100	100	92	94	98	26	97

The most important characteristics. Finally, people taking part in this survey were asked about the most important characteristics of the sweet cherry cultivars. The taste was on the first place in all countries (55% in Bulgaria, 49% in Chile, 78% in Hungary, 33% in Italy, 72% in Japan, 65% in Latvia, 57% in Turkey), followed by fruit skin color (18% in Bulgaria, 29% in
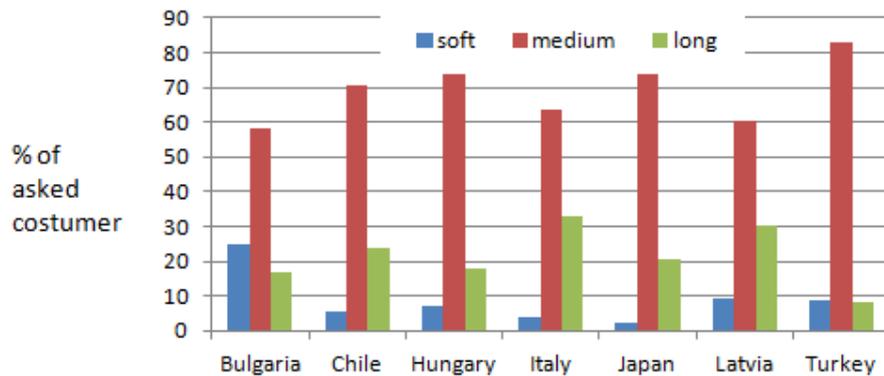
Figure 6. Relative frequency of cherries stalk length in % of the asked costumers.

Chile, 10% in Hungary, 24% in Italy, 13% in Japan, 11% in Latvia, 15% in Turkey). Interesting to see that the fruit size was on the third important character (18% in Bulgaria, 8% in Chile, 3% in Hungary, 12% in Italy, 3% in Japan, 9% in Latvia, 7% in Turkey) with less rate compared to the first two characters (Figure 6).

DISCUSSION

The preferences of costumers is very important information for the cherry breeding programs running all around the world, because the final aim of all the intervenient in the chain is the satisfaction of the consumer/costumer. Based on this study it can be stated that the sweet cherry fruits must be red or dark red, which demand is similar to the breeding aims. Yellow, blush, and bicolor cultivars are not important except in Japan (Figure 1). The breeders prefer long stalk to speed up the hand picking; however the medium stalk length is enough for that task and for accomplish consumers' preferences. The stalk is a good marker of freshness; this is a marketing reason for having stalk on cherries. The sweet cherry is used for fresh consumption mostly worldwide, therefore its freshness is important to reach the highest consumer preference. During the past couple of decades the growers re-started some selling methods e.g. U-pick to decrease the picking costs and save the freshness of the fruits. Some new methods, e.g. hydro-cooling harvest system, small plastic boxes having hygroscopic layer
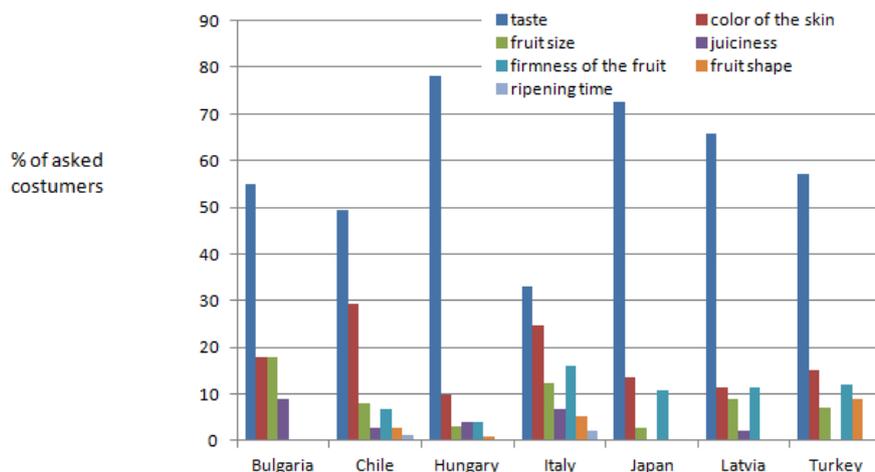
Figure 7. The most important characteristics to choose sweet cherry cultivars.

inside for small amount of fruits, were introduce into the production to save their freshness. The favorite fruit shape in all countries took part in the survey except Latvia and Italy is reniform shape.This is important information because there are a lot of fruit shapes among the cultivars and reniform is really the most preferred (Figure 2). Nowadays there is a major request for large fruit size cultivars, at least 28 mm in diameter, although this quality characteristic is not too important in all countries, where the survey was completed. In Chile the final costumers prefer the very large fruit size, which is larger than 30 mm in diameter. In other countries the range between 25.4 and 29.8 mm matches to the most costumers' preference (Figure 3). Clearly the sweet cherry must be really sweet, because this taste is obviously absolutely connected with the idea of sweet cherries that consumers hold in their minds. The final costumers in Japan prefer the very acid taste beside the sweet taste. Unexpectedly there are few consumers that make a correspondence of acid taste to sweet cherry, maybe they have eaten some unripe cherries in the past and memorize that flavor (Figure 4). The sweet cherry is described as a red and firm fruit, therefore firmness is also important for the costumers too. The firmness dominated in all countries except Japan and Latvia, where the medium firmness was ranked on the first place (Figure 5). The taste is very important, because this category is the first one, when cherries are bought and tasted (Figure 7). The sweet cherry is used for fresh consumption

mainly. The costumers are looking for hand-picked stem-on-cherries (Table 3) with medium stalk length (Figure 7). In Latvia the asked people prefer more the stalkless cherries than the stalk-on-cherries. The breeders prefer long stalk to speed up the hand picking; however the medium stalk length is enough for that task and for accomplish consumers' preferences. The stalk is a good marker of freshness; this is a marketing reason for having stalk on cherries.

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