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Preferences in sweet cherry fruits among consumers in Serbia and Bosnia and Herzegovina

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Abstract: The introduction of new varieties in fruit production should consider consumer attitudes regarding the appearance and taste of the fruits. In order to evaluate the consumer attitudes in Serbia and Bosnia & Herzegovina (B&H), on the most important characteristics of cherry fruits, an online survey was conducted with 402 respondents. Participation in the survey was taken by 53.23% of respondents from Serbia and 46.77% from B&H, most of which were women (54.23%). Consumers expressed their views on the most important external (fruit colour, fruit shape, fruit size, presence of a stalk on the fruit, length of the stalk and the presence of damage to the fruit) and internal (fruit taste, fruit firmness) characteristics of the fruit. According to the results, the attitude toward the fruit size, the presence of a stalk and the stalk length, as well as fruit firmness was dependent upon respondents' residence. Both male and female respondents had similar attitudes toward the cherry characteristics except for the fruit taste and the most important cherry characteristics. The age of a respondent influenced the attitude toward the fruit size and the presence of a stalk, as well as the fruit firmness.

Keywords: survey; attitude; characteristics; appearance; taste

The global demand for sweet cherries has grown rapidly in recent years. Retailers and consumers have welcomed the longer availability of sweet cherries that is now possible with the newer varieties. New varieties ripen over a long, time interval of almost 40 days. At the same time, varietal specifics and modern technologies have also enabled a longer storage period and efficient transport to distant markets. While growers have ready access to a large number of varieties, they still seek new varieties to offer superior tasting and appearing fruit to the customers, as well as to meet grower issues that include cold hardiness, extended storage quality and preferred harvest dates. Like most fresh products, it is predominantly the "market" rather than "grower" requirements that drive the commercial selection with growers primarily adhering to the market requirements before outlining their own requirements (Revell 2008). The market requirements influencing commercial variety selection include the season (availability), fruit size, fruit colour and fruit firmness. The grower must satisfy the above market requirements before taking their own requirements of precocity, productivity, susceptibility to pest and disease and susceptibility to rain-induced cracking into account (Dodd, Bower 2014). Today, hundreds of sweet cherry cultivars are available for growers. A large diver-

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sity of landraces is preserved and many have been used for production at a local level or used in modern breeding programmes more recently (Quero-García et al. 2017). The main quality traits evaluated by sweet cherry breeders are the fruit size, fruit firmness, skin and flesh colour, sugar content and flavour. Many other morphological and biochemical traits can be evaluated in more advanced stages of the selection process, and can be related to the skin, flesh, juice, pit or stalk. Tremendous progress has been achieved in many breeding programmes in terms of the fruit size and firmness with cultivars that can regularly produce very firm fruit of more than 12 g. Growers must make very site-specific evaluations and address a wide range of factors. Probably one factor that growers have not addressed sufficiently in the past is market acceptance. Most consumers prefer large, flavourful, sweet, firm cherries (Long et al. 2021). Fruit properties that may be standardised are mostly based on measurable characteristics, such as the size, shape, and the presence and size of external damage. However, a product is also defined by characteristics which are assessed by subjective evaluation (colour and its presence, internal attributes) which cannot be determined by any standardised procedure although an association can be established with a level of acceptability to consumers (Crisosto 1995). Many studies have confirmed correlations between the physicochemical properties of sweet cherries (weight, appearance of skin and stem, soluble solids content (SSC), titratable acidity (TA), SSC/TA ratio, firmness) and cherry fruit acceptability by taste panellists and consumers (Dever et al. 1996; Kappel et al. 1996; Cristoso et al. 2003; Kahlke et al. 2009). Consumers are willing to pay high prices for cultivars with desirable characteristics. (Zheng et al. 2016). Apart from the variety and the region of cultivation (Asanica et al. 2020; Bujdoso et al. 2020), the harvest period, which affects the manifestation of the varietal characteristics, has a significant role in the consumers' choice. (Long et al. 2007; Chauvin et al. 2009) There are a range of available consumer tests and a range of scales, which can be used when undertaking a consumer test, but the most appropriate technique, like a sensory test, is determined by the type of product being assessed and the objective of the assessment. The objective of those tests is not just to determine the consumer's preference and acceptability, but to determine what key factor drives their preference and acceptability. To understand this, some descriptive analysis of cherries, combined with preference and acceptability data, is required and this can be achieved using preference mapping (Revell 2009). The main objective of the research is to examine the consumers' attitudes in Bosnia & Herzegovina and Serbia toward the importance of certain cherry characteristics in the selection and purchasing of a variety.

MATERIAL AND METHODS

Testing consumer attitudes toward the most important cherry characteristics (Table 1) in choosing a variety was performed by using an online survey created during the project COST Action FA1104 "Sustainable production of high-quality cherries for the European market". The most important categories of the fruit characteristics in the questionnaire were described based on the International Union for the Protection of New Varieties of Plants (UPOV), Sweet Cherry Guidelines for conduct-

Table 1. Sweet cherry characteristics evaluated by consumers during the research

Characteristics	Modality
Fruit colour	yellow, yellow with supplemantary shade, orange-red, light red, red, dark red, mahogany and blackish
Fruit shape	cordate, reniform, oblate, circular, eliptic
Fruit size	very small, small, medium, large, very large
Presence of stalk	stalk absent, stalk present
Stalk length preference	not so important, very short, short, medium, long, very long
Fruit firmness	soft, medium, firm, very firm
Fruit taste	very sweet, sweet, medium, acid, very acid
Presence of damage	defects not acceptable, 5% defects are acceptable, 10% defects are acceptable, 15% defects are acceptable, more than 15% defects are acceptable

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ing tests for distinctness, uniformity and stability (TG/357/7, Geneva, 2006).

In order for the respondents to focus only on the importance of the colour, a template was created with uniform characteristics of the fruit shape and size, whereby the only variety is determined by the fruit colour (Figure 1).

To determine the fruit shape, a template was created (Figure 2), in which the fruit size and colour were the same, while the respondents were offered the five most common shapes of cherry cultivars (heart-shaped, reniform, oval, round and elliptical).

Cultivars are also classified into five categories according to their size: very small (< 19.0 mm), small (19.0–21.4 mm), medium (21.5–25.4 mm), large (25.5–29.8 mm) and very large (> 29.8). The questionnaire schematically shows the relationship between the stated fruit sizes. The respondents answered two questions on the importance of the presence of the stalk on the fruit. The first question referred to the general importance of the presence or absence of the stalk, while the second question referred to the importance of the length of the fruit stalk (not so important, very short, short, medium length, long, and very long). The fruit taste was rated as very sweet, sweet, medium-sweet, sour and very sour, while the firmness of the fruit was rated as soft, medium-firm, firm and very firm. The respondents also answered the question regarding the presence of damage to the fruit (damage is not acceptable, 5% of damage is acceptable, 10% of damage is acceptable, 15% of damage is acceptable and more than 15% of damage is acceptable). In addition to different modalities within the individual characteristics, consumers had an option to choose the most important characteristic when purchasing a cherry. In order to evaluate the consumers' attitudes in Bosna and Herzehovina (B&H) and Serbia on the most important characteristics of cherry fruits, an online survey was conducted with 402 respondents. The distribution of the respondents' characteristics was analysed. The three major characteristics that were used were the respondents' state of origin (Bosnia & Herzegovina or Serbia), gender (male or female) and age (group A from 15 to 19 years old, group B from 20 to 29 years old, group C from 30 to 39 years old, group D from 40 to 49 years old, group E from 50 to 59 years old and group F from 60 to 64 years old). There were slightly more respondents from Serbia (53.23%), while females (54.23%) were more represented. The largest number of respondents (55.97%) belonged to group B, followed by (18.66%) group C and group D (14.43%), while group A consisted of 5.72% of the respondents, while the representation of the older population in groups E and F was almost equal (2.99% and 2.24%). The distribution of the respondents' answers to the survey regarding different cherry fruit characteristics was analysed. The results of the analysis of these distributions were graphically represented by a pie chart, with all the values enumerated as percent-

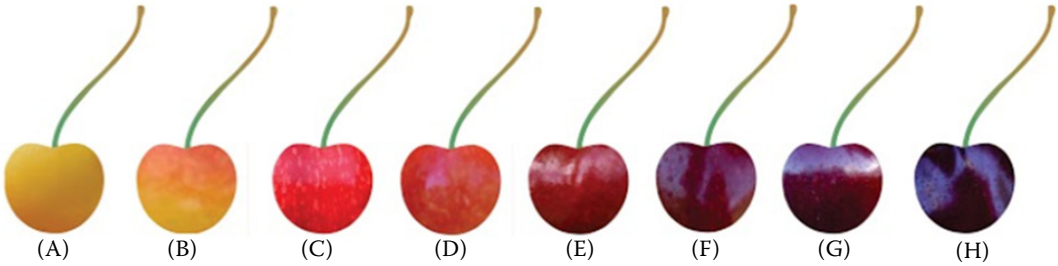

Figure 1. Fruit skin colours most common for the cherry cultivars, based on which the survey respondents indicated their purchasing preferences (fruit shape and fruit size were the same)

(A) – yellow; (B) – yellow with supplementary shade; (C) – orange red; (D) – light red; (E) – red; (F) – dark; (G) – mahogany; (H) – blackish

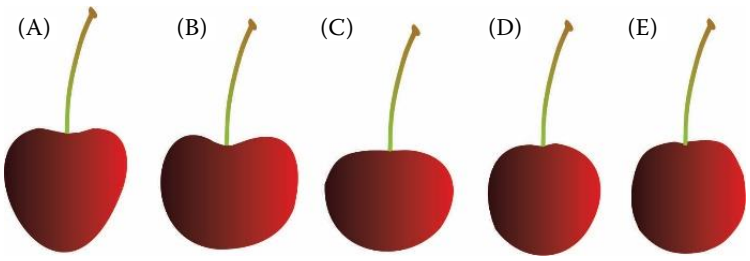

Figure 2. Main cherry cultivars fruit shapes based on which the respondents made their purchasing preferences (fruit colour and fruit size were the same)

(A) – cordate; (B) – reniform; (C) – oblate; (D) – circular; (E) – eliptic

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ages, representing the share of the respondents with a specific attribute or a share of the specific respondents' answers toward the different cherry fruit characteristics. The Chi-Square Test of Contingency was performed in order to evaluate the influence of the respondents' residence, gender and age to the different cherry fruit characteristics. The values of the Chi Square Test Statistics as well as their statistical significance were set at a $P \leq 0.05$ and $P \leq 0.01$ probability level.

RESULTS

Almost the same number of respondents prefer red (31.34%) and dark red (31.09%) as the most desirable cherry fruit colour (Figure 3). Lighter shades of the fruit skin, as well as too dark are significant for a smaller number of respondents (0.50–6.22%). A reniform fruit shape (Figure 4) is the most desirable fruit shape for the largest number of respondents (54.98%), followed by a circular fruit shape which is the most desirable for 20.40% of the respondents. Although, in recent years, more and more work has been performed to create varieties and production methods for obtaining very large fruits (> 30 mm), the research showed that large (45.27%) and medium-sized fruits (43.28%) are almost the same, by percentage, as the most acceptable for the respondents (Figure 5). It is interesting to point out the fact that the respondents are ready to buy fruits that have minor damage on them (Figure 6). This data should be taken

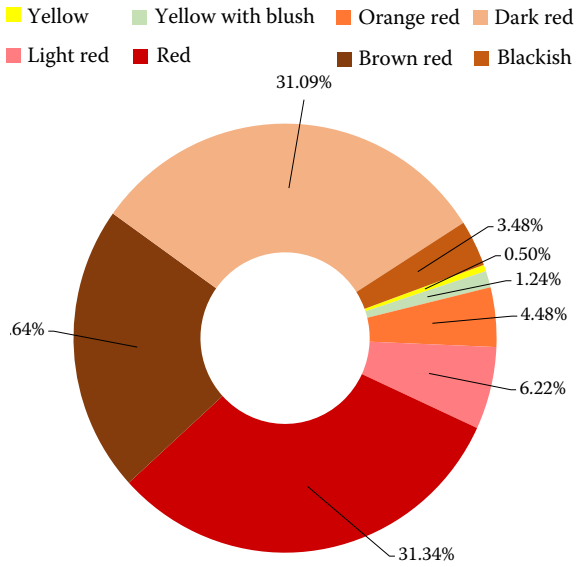

Figure 3. Respondents' attitude toward the fruit colour

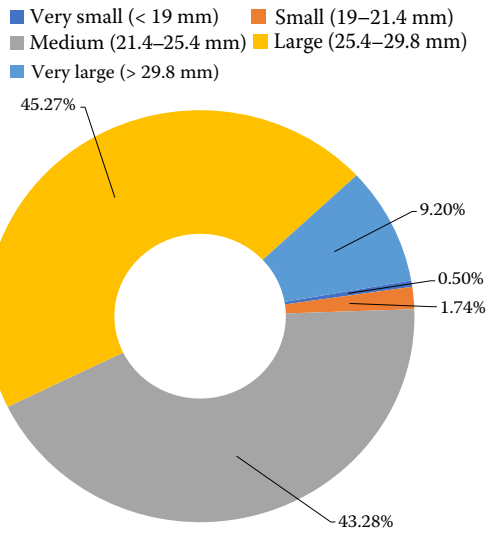

Figure 5. Respondents' attitude toward the fruit size

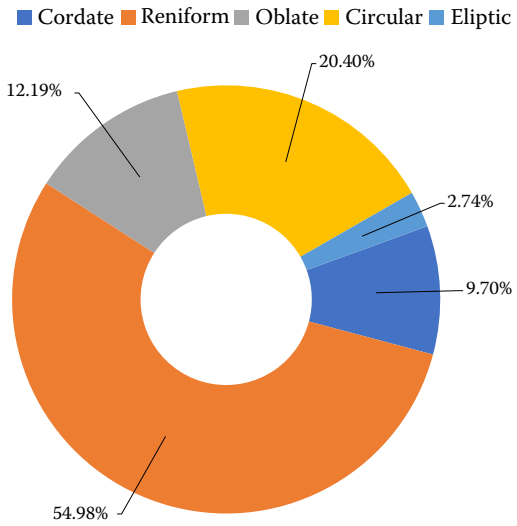

Figure 4. Respondents' attitude toward the fruit shape

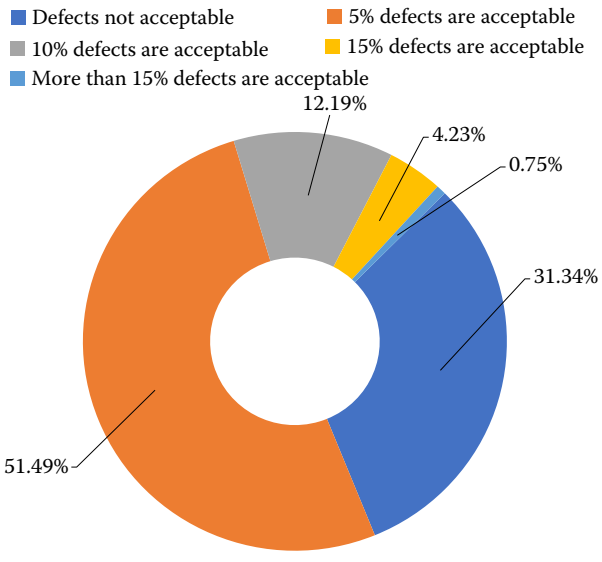

Figure 6. Respondents' attitude toward fruit defects

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with reservations since the survey does not specify the type of damage in question, but it is indicative from the point of view of the product quality that the average consumer demands from the market.

When it comes to the presence of a stalk on the fruit (Figure 7), it is important, for most respondents, that the fruit comes with a stalk (83.58%), although the length of the stalk is not a characteristic of importance when choosing a variety (Figure 8). As much as 42.54% of the respondents do not attach any importance to this attribute, while for those whom it represents a significant characteristic, 41.54% prefer a stalk of medium length. The respondents prefer sweet (55.47%) and medium-sweet fruits (27.36%), while sour as well as too sweet fruits are of interest to only a small number of respondents (Figure 9). Medium-firm fruits (47.51%) as well as firm fruits (43.28%) are the most desirable for the respondents (Figure 10).

When choosing cherries (Figure 11), the most important characteristic for the respondents is the fruit taste (53.73%). The colour (15.42%) and fruit firmness (13.18%) are approximately important. Fruits without the presence of damage are the most important characteristic for 10.45% of the respondents.

In order to assess the relationship between the respondents' residence, gender and age to different cherry characteristics, the Chi-Square Test of Contingency was performed (Table 2).

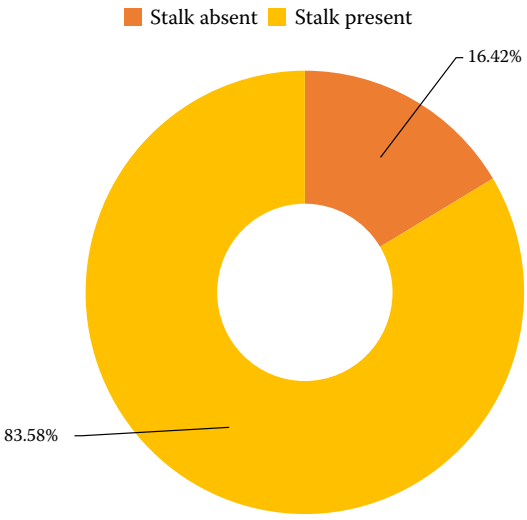

Figure 7. Respondents' attitude toward the presence of a stalk

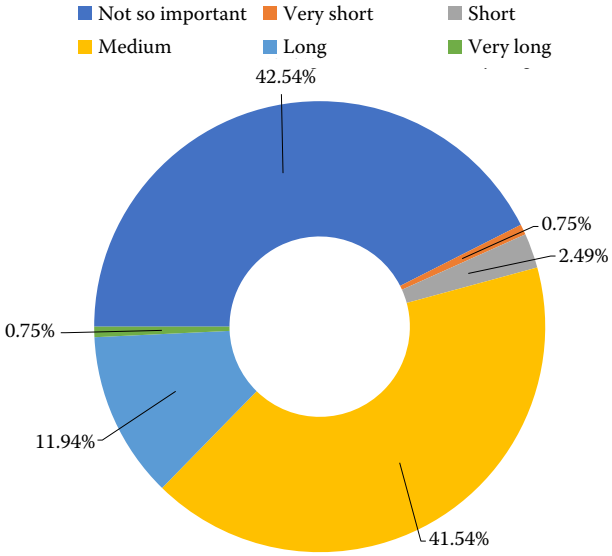

Figure 8. Respondents' attitude toward the length of the stalk

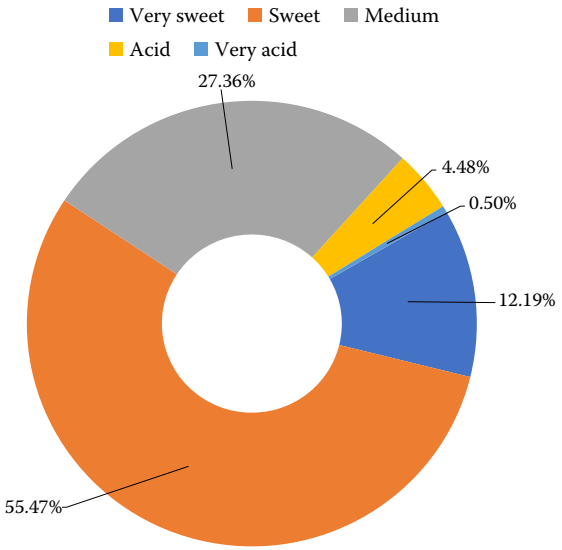

Figure 9. Respondents' attitude toward the fruit taste

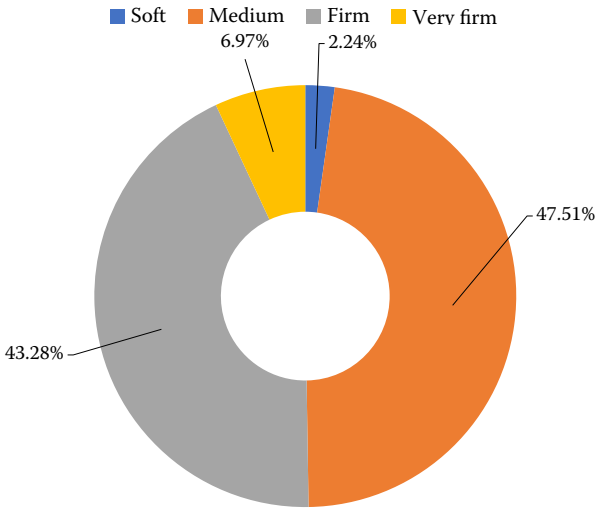

Figure 10. Respondents' attitude toward the fruit firmness

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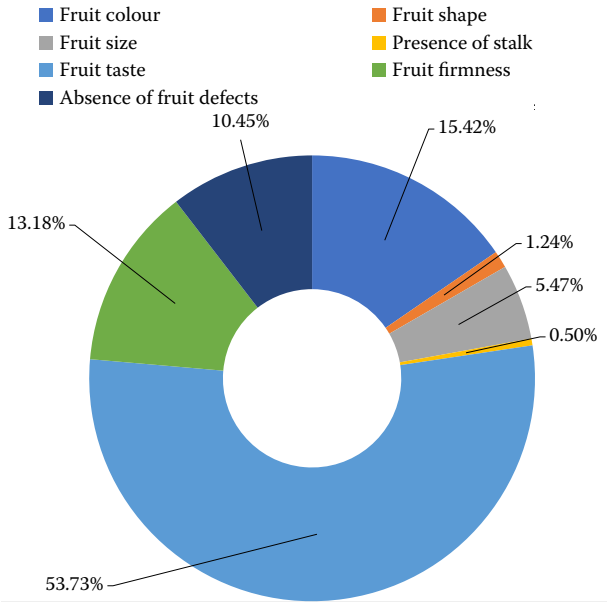

Figure 11. Respondents' attitude toward the most important characteristic when choosing a cherry variety

According to the results, the respondents' residence influenced the attitude toward the fruit size, the presence of a stalk and the stalk length ($P \geq 0.05$), as well as the fruit firmness ($P \geq 0.01$). When it comes to fruit size, 50.00% of respondents from B&H answered that they prefer a large fruit size, while 49.07% of the respondents from Serbia answered they prefer a medium fruit size. The presence of astalk was a avourable trait for 87.77% of the respondents from B&H, mostly demanding a medium stalk size and 79.91% of the respondents from Serbia, who mostly answered that, if a stalk is a present, its size is not so important. When it comes to the fruit firmness, a firm cherry fruit was required by most of the respondents from B&H (49.47%) and a medium firm cherry fruit was required by most of the respondents from Serbia (56.07%). Both male and female respondents had a similar attitude toward the cherry characteristics except for the fruit taste ($P \geq 0.01$) and the most important cherry characteristics ($P \geq 0.01$). Male respondents prefer sweet cherry varieties (49.18%), and though the distribution of answers in the female respondents was generally the same, female respondents noticeably preferred a sweet cherry fruit (26.29%) in comparison to medium sweet fruits (21.66%). Although the fruit taste was claimed to be the most important cherry characteristics both in the male (51.09%) and female (56.48%) respondents, the male respondents emphasised the fruit colour (17.39%) and the female respondents emphasised the fruit firmness (14.35 %) as the second most important cherry characteristic. The age of a respondent influenced the attitude toward the fruit size and the presence of a stalk ($P \geq 0.05$), as well as the fruit firmness ($P \geq 0.01$). Younger respondents mostly answered that they prefer a medium fruit size and older respondents preferred a large fruit size. The presence of a stalk was a noticeably important trait for all age groups except for the respondents from 15–19 years old (50% of them answered that they prefer when the stalk is absent). A medium firm fruit

Table 2. The Chi-Square test of Contingency for the respondents' attitude toward the cherry fruit characteristics regarding their state of residence (Bosnia & Herzegovina or Serbia), gender (Male or Female) and age

Cherry fruit characteristics	Residence		Gender		Age	
	Chi square test statistics	*P* value	Chi square test statistics	*P* value	Chi square test statistics	*P* value
Fruit colour	6.145 5^{ns}	0.407 1	8.082 6^{ns}	0.232 1	29.571 9^{ns}	0.487 7
Fruit shape	6.847 3^{ns}	0.144 2	0.721 2^{ns}	0.948 7	29.298 0^{ns}	0.082 1
Fruit size	8.226 5*	0.041 6	1.921 5^{ns}	0.588 9	25.295 5*	0.0461
Presence of stalk	4.505 0*	0.033 8	2.815 5^{ns}	0.093 4	13.133 1*	0.022 2
Stalk length if present	8.116 8*	0.043 7	6.618 5^{ns}	0.085 1	23.3666^{ns}	0.076 7
Fruit taste	0.756 5^{ns}	0.859 8	13.273 6**	0.004 1	13.118 9^{ns}	0.593 1
Fruit firmness	17.041 9**	0.000 7	6.748 2^{ns}	0.080 4	35.254 3**	0.002 3
Fruit defects	0.249 8^{ns}	0.969 2	1.071 6^{ns}	0.783 9	11.049 8^{ns}	0.749 1
The most important characteristic	2.605 6^{ns}	0.760 5	19.288 9**	0.001 7	24.797 2^{ns}	0.473 8

ns – statistically not significant; *statistically significant at $P \leq 0.05$; **statistically significant at $P \leq 0.01$

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was an important cherry characteristic for most of the younger respondents, while most of the older respondents answered that they like firm fruits.

DISCUSSION

Sweet cherries have increased in popularity over the past decade because of their reported health benefits for consumers and the relatively high price premiums that suppliers can charge (Kahlke et al. 2009). A significant number of different components were found in cherries and associated with the consumers' preference. Cherries have a relatively short fresh market season due to the high fruit perishability (Dever et al. 1996). Carew et al. (2012) analysed price-determination factors in the sweet cherry markets in British Columbia, Washington, Oregon, and California. The study applied an inverse demand system to capture the effects of the demand and supply factors relevant to the cherry growers. They found negative substitution effects for the prices of the sweet cherries for all four regions. For consumers in B&H and Serbia, the most important characteristic when choosing a cherry variety is the taste, which indicates the importance of this characteristic in selecting the variety (Revell 2008). Similar data were obtained by Bujdoso et al. (2020) examining consumers' attitudes in seven countries (Bulgaria, Chile, Hungary, Japan, Italy, Latvia and Turkey) who found that the fruit taste was the most important characteristic when choosing a cherry variety. Crisosto et al. (2003) examined the acceptance of sweet cherries by California consumers and found that it was positively influenced by the greater SSC, lower TA, a higher SSC/TA ratio, and darker skin colour. Taste is the most important characteristic of cherries for consumers in Romania, with the "Early Red" and Burlat varieties in particular (Asanica et al. 2020). 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 (Bujdoso et al. 2020). Zheng et al. (2016) found that consumers of sweet cherries will pay the greatest premium for sweetness and the smallest premium for the fruit size. Although consumers prefer large to very large cherry fruits, the fruit size itself is not the primary characteristic when choosing a variety. Similar data were obtained by Bujdoso et al. (2020) who state that although the fruit size is a significant feature in breeding programmes in most countries where research has been conducted, consumers prefer medium-sized fruits. The colour of the cherry fruit should be red or dark red. Previous research has underscored the importance of the exocarp colour, with consumers preferring a dark red or mahogany to lighter and darker-coloured fruit (Long et al. 2007; Long et al. 2021). According to results of Chauvin et al. (2009), mid-harvest and late-harvest cherries of the 'Sweetheart' variety had the highest overall acceptance, while the mid-harvest cherries of the same variety had the highest acceptance for their appearance. These results indicated that cherries harvested at mid-harvest were the most preferred harvest time despite not having the highest colour, sweetness, or flavour intensity. This indicated the importance of the colour, sweetness, and flavour of cherries on the overall acceptance and the possible interaction of these attributes in consumer acceptance. These results corroborated those from a study by Dever et al. (1996), who compared 'Bing' cherries from a third harvest (characterised as a midseason harvest) to 'Bing' cherries from a fifth harvest (late harvest). In comparing these two harvest times, the authors found that the cherry flesh firmness decreased, the juiciness and sourness did not change, and the sweetness and cherry flavour increased. This study also reported that a first harvest of 'Bing' cherries was higher in sourness compared with a second 'Bing' harvest. Fruit firmness is a very important characteristic for repurchasing the cherry. Both consumers in B&H and Serbia prefer medium-firm and firm fruits, which is in accordance with the findings of other researchers (Asanica et al. 2020; Bujdoso et al. 2020). For most of the examined characteristics, no significant differences were found between the different categories of consumers in B&H and Serbia, regardless of their age or gender. Kappel et al. (1996) found positive links between foreign consumers' acceptance and the taste, sweetness, colour, shape, and size of sweet cherries. Cristoso et al. (2003) stated that the highest percentage of American consumers would buy cherries based on a dark skin colour without regard to the ethnic group. Although the presence of the stalk is not a particularly important characteristic for consumers in B&H and Serbia, the presence of the stalk is certainly important from the aspect of the harvest efficiency, as well as an indicator of the fruit

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freshness, so this fruit characteristic must be kept in mind.

CONCLUSION

Based on the results of the survey conducted with 402 respondents from B&H and Serbia, it can be concluded that when choosing a cherry variety, consumers most often choose red or dark red fruits with a sweet taste and a medium-firm or firm mesocarp. Consumers cite these characteristics as traits of greater importance for their choice. Consumers choose large fruits (not exclusively the largest ones), with a stalk (where the length of the stalk does not matter) and fruits with a kidney shape. The results obtained may be important as a basis for more detailed research, which would include a tasting panel. These results can help growers and retailers to position themselves more effectively in the market, highlighting the characteristics that are most important when making a purchasing decision in the domestic market.

REFERENCES

Asănică A., Stănică F., Tudor V., Iacob A., Zolotoi V., Perojuc L. (2018): Evaluation of the consumer preference for sweet cherry fruits at the „Sweet cherry fest" in Istrița - Buzău. Scientific Papers. Series B, Horticulture: 187–190

Bujdoso G., Hrotko K., Feldmane D., Giovannini D., Demirsoy H., Tao R., Malchev S. (2020): What kind of sweet cherries do the final consumers prefer? South-Western Journal of Horticulture Biology and Environment, 11: 37–48.

Carew R., Florkowski W.J., Doroudian A. (2012): Market Integration and relationship between farm-level prices: Evidence from cherry markets in British Columbia, Washington, and California. Journal of International Agricultural Trade and Development, 8: 1–22.

Crisosto C., Mitchell G., Johnson S. (1995): Factors in fresh market stone fruit quality. Postharvest News and Information 6.2: 17–21.

Crisosto C.H., Crisosto G.M., Metheney P. (2003): Consumer acceptance of 'Brooks' and 'Bing' sweet cherries is mainly dependent on fruit SSC and visual skin color. Postharvest Biology and Technology, 28: 159–167.

Dever M.C., MacDonald R.A., Cliff M.A., Lane W.D. (1996): Sensory evaluation of sweet cherry cultivars. HortScience, 31: 150–153.

Dodd M.C., Bouwer J.J. (2014): The supply value chain of fresh produce from field to home: Refrigeration and other supporting technologies. Postharvest Handling. Academic Press: 449–483

Chauvin M., Whiting M., Ross C. (2009): The Influence of harvest time on sensory properties and consumer acceptance of sweet cherries. HortTechnology, 19: 748–754.

Kahlke C.J., Olga I., Cooley H.J., Robinson T.L. (2009): Shelf-life and marketing window extension in sweet cherries by the use of modified atmosphere packaging. New York Fruit Quarterly, 17: 21–24.

Kappel F., Fisher-Fleming B., Hogue E. (1996): Fruit Characteristics and sensory attributes of an ideal sweet cherry. HortScience, 31: 443–446.

Long L., Lang G., Kaiser C. (2021): Sweet cherries - Crop production Science in Horticulture. Goucester, CABI Severn.

Long L.E., Whiting M.D., Marin A.B. (2007): Consumers show preference for key cherry attributes. Good Fruit Grower, 58: 15–17.

Miller D.C., Casavant K.L., Buteau. J.R. (1996): An analysis of Japanese consumer preferences for Pacific Northwest and Japanese sweet cherries. Research bulletin XB0974, Washington State University, Pullman, WA.

Quero-García J., Schuster M., López-Ortega G., Charlot, G. (2017): Sweet cherry varieties and improvement. Chapter 4. In: Quero-Garcia J., Lezzoni A., Pulawska J., Lang G. (eds): Cherries: botany, production and uses. CAB International, Boston: 60–94.

Revell J.M (2008): Sensory profile & consumer acceptability of sweet cherries. [Mr. Thesis]. Nottingham, University of Nottingham: 1–130.

Zheng X., Yue C., Gallardo K., McCracken V., Luby J., McFerson J. (2016): What attributes are consumers looking for in sweet cherries? Evidence from choice experiments. Agricultural and Resource Economics Review, 45: 124–142.

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