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SENSORY EVALUATION OF 'KORDIA' SWEET CHERRY AFTER STORAGE*

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Key words: sweet cherry, *Prunus*, 'Kordia', storage, sensory evaluation

The aim of the study was to determinate the changes in sensory characteristics of sweet cherry cv. Kordia during cold storage. Evaluations of fruits were carried out in three consecutive years: 1999, 2000 and 2001. After harvest fruits were divided into two classes according to their colour intensity (lighter, darker) and stored in the air at temperature of: -0.5°C, +2°C, and +9°C. Immediately after the harvest, and also after 2, 3 and 4 weeks of storage the fruit was subjected to sensory evaluation. Unstructured scale method was applied. The following quality characteristics were assessed: fruit attractive appearance, skin smooth, skin colour intensity, skin colour uniformity, stem colour, sweet taste intensity, sour taste intensity, foreign taste intensity, overall flavour, and overall quality.

The results of sensory evaluation immediately after harvest indicated that lighter cherries were scored lower for fruit attractive appearance, overall flavour and overall quality in comparison with darker fruits. During storage a reverse tendency was observed. The lighter fruits obtained higher notes than darker ones. During storage strong skin darkening was observed, especially at +9°C. Sweet cherries, which were the darkest at harvest, were assessed after storage as too dark and for that reason less attractive. After four weeks of storage at -0.5°C and +2°C, the fruits were scored highly with respect to both their appearance and flavour. Fruits stored at the lowest temperature received the highest marks. Data obtained in experiments indicated that storage of sweet cherries at +9°C can be successful for short (up to 2 weeks) storage period.

INTRODUCTION

Sweet cherries orchards in Poland occupy about 8 thousand hectares [Makosz, 2000], and their total area have continuously increased since the nineties of the last century. Polish growers have recently planted a new varieties which are highly acceptable by consumers. 'Kordia' is one of the most popular new-planted sweet cherry varieties. Their excellent big and tasty fruits with glossy and carmine coloured skin are in much demand [Rozpara, 2000]. In Poland, the sweet cherries are produced mainly for a fresh market. In order to extend supply of the fruits it is important to store them without loss of quality. Discoloration, tarnish, darkening and shrivelling of fruits and browning of stem are the serious problems during cold storage of sweet cherries. Prompt cooling is essential for preventing deterioration of quality of sweet cherries [Hardenburg *et al.*, 1986]. The rate of unfavorable changes of quality depends on storage conditions (temperature, humidity and atmosphere of storage). Respiration rates of sweet cherry fruits, expressed as rates of carbon dioxide production (mg $CO_2 \cdot kg^{-1} \cdot h^{-1}$) are equal: 5 at 0°C and 30 at +20°C [Hardenburg *et al.*, 1986]. According to respiratory behaviour during ripening, fruits of sweet cherry belong to nonclimacteric fruit and produce very low ethylene, less than 0.1 μL $C_2H_4 \cdot kg^{-1} \cdot h^{-1}$ at +20°C [Kader, 1985]. A green stem is an important quality factor of sweet cherry [Mitcham *et al.*, 1996]. Improper storage conditions, *e.g.* elevated temperature or high ethylene concentration, accelerate browning of the stem and deterioration of overall quality. The sensory attributes (appearance, texture, taste and smell), chemical composition, physical and mechanical properties, functionality and defects influence fruit overall quality.

Consumer satisfaction is the final and practical evaluation of production, harvest, storage and marketing of fruit. Therefore sensory methods occupy a unique position among analytical methods applied in evaluation of food quality [Baryłko-Pikielna & Matuszewska, 1996]. In particular, sensory assessments inform us, how physical, chemical or microbiological properties are perceived by human senses.

The aim of this study was to determine the influence of storage temperature on changes of sensory attributes and overall quality of sweet cherries.

MATERIAL AND METHODS

Evaluations of 'Kordia' sweet cherry were carried out in three consecutive years: 1999, 2000 and 2001. After harvest, fruits were divided into two classes according to their red colour intensity: lighter (light-red) and darker (dark-red). Then fruits were stored in air at: -0.5°C, +2°C, and +9°C. Fruits were subjected to sensory evaluation immediately after the harvest, and also after 2, 3 and 4 weeks of storage. Unstructured scale method was applied [Land & Shepherd, 1988]. Sweet cherry quality of fruit was determined with descriptors shown in Table 1. The scales were designated

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TABLE 1. Sensory descriptors and scale range for sweet cherries fruit evaluation.

Sensory descriptors	Scale range	
	0	100
Fruit attractive appearance	very low	very high
Skin smooth	shrivel	very smooth
Skin colour intensity	very light-red	very dark-red
Skin colour uniformity	non-uniformity	uniformity
Stem colour	brown	green
Sweet taste	low-intensity	high-intensity
Sour taste	low-intensity	high-intensity
Foreign taste	insensible	high-intensity
Flavour	tasteless	very tasty
Overall quality	poor quality	excellent quality

with accurate definitions and terms. Each descriptor was rated on a continuous line scale with anchor points at each end marked as 0 and 100 points.

Additionally after 1 week of storage the stem colour and fruit attractive appearance were assessed. Fruit attractive appearance was defined as the first visual sensation. According to instruction given to the panellists before judgement of the last two descriptors (flavour and overall quality) the short break should be done. Ten trained judges evaluated each sample of sweet cherry fruits. Obtained results were transposed to numeric values considering that the whole scale was 10 points. Sensory trials were made using "ANALSENS NT" (LABNT) software, developed by Prof. Nina Baryłko-Pikielna from Sensory Analysis Laboratory of Agrotechnology and Veterinary Research Center of Polish Academy of Sciences in Warsaw.

Results of experiments were subjected to statistical analysis. Statistical differences were determined by using analysis of variance and Duncan's Multiple Range Test at $\alpha = 0.05$ significance level.

RESULTS AND DISCUSSION

Results of sensory evaluation carried out immediately after harvest indicated that light-red fruits scored lower for following sensory attributes: skin colour intensity and skin colour uniformity, flavour and overall quality in comparison with dark-red fruits (Figure 1). Dark cherries were characterized as having significantly higher sweetness than lighter ones. The foreign taste was not found in fresh sweet cherries immediately after harvest.

During storage skin darkening was observed, especially at +9°C. There were not significant differences in fruit attractive appearance (Figure 2) and overall quality (Figure 5) among the storage temperature and class of colour intensity up to two weeks of storage. Usually storage at –1° to 0°C for sweet cherries is recommended [Hardenburg *et al.*, 1986]. Our findings indicate that storage of sweet cherries at +9°C during short period (up to 2 weeks) can be successful. The significant influence of storage temperature on fruit attractive appearance was observed after three weeks of storage. Storage at lower temperature reduced darkening process and unfavourable changes in fruit quality. Fruits stored at the lowest temperature received higher marks. After four weeks of storage, the lighter cherries received higher notes in attractive appearance in comparison to darker ones.

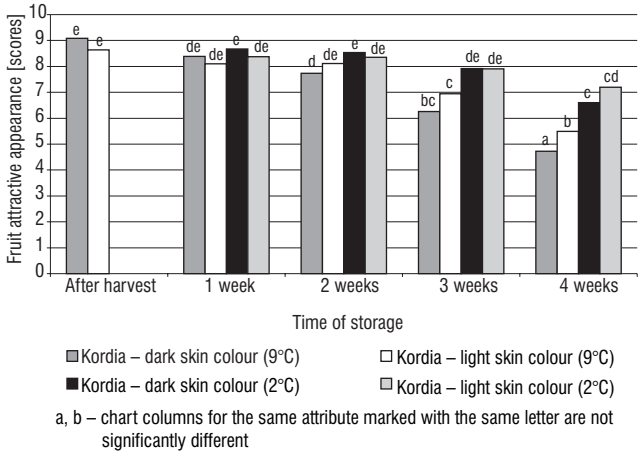

FIGURE 2. Sensory evaluation of fruit attractive appearance of 'Kordia' sweet cherry, during storage at 2°C and 9°C (means of 1999–2001).

A serious problem during storage of sweet cherry was to preserve the green colour of fruit stems. Green fleshy stems are often associated with freshness and quality [Mitcham *et al.*, 1996]. Their drying out and browning caused deterioration of fruit quality. Results shown in Figure 3 indicated that the colour of stem was assessed higher for light cherries than for dark fruits. Similar tendency was observed for cherries evaluated immediately after harvest and during storage within the same temperature. Stems browning was more intensive at higher storage

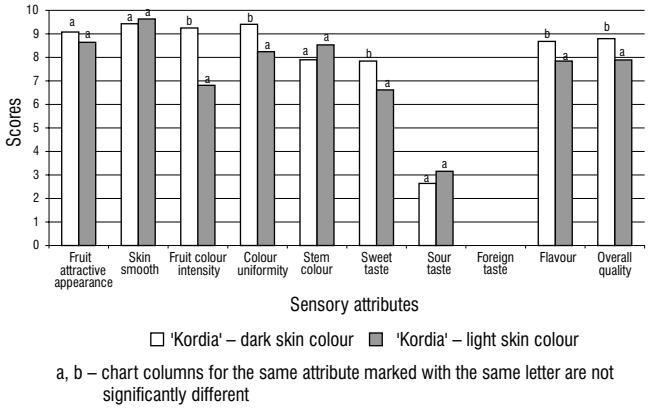

FIGURE 1. Sensory evaluation of 'Kordia' sweet cherry after harvest (means of 1999–2001).

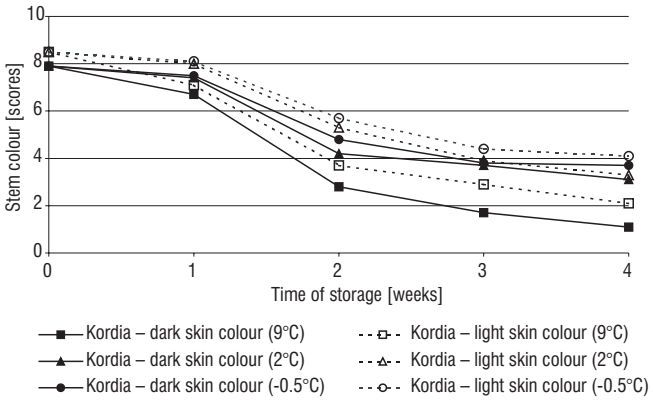

FIGURE 3. The changes of stem colour of 'Kordia' sweet cherry during storage (means of 1999–2001).

temperature. At the beginning of storage, the changes of stem colour were low, especially at -0.5°C and at +2°C. However, after two weeks, all fruits had brown colour of stem, except for light cherries stored at -0.5°C and at +2°C. After three weeks of storage, the green colour of stem disappeared and became brownish, independently of storage temperature.

Sensory analysis of sweet cherry flavour is shown in Figure 4. After the harvest, dark fruits obtained higher notes in fruit flavour than the lighter ones. The dark fruit were more sweeter (7.8 points) and less sour (2.6 points) in comparison to light red fruit (6.6 points and 3.2 points, respectively).

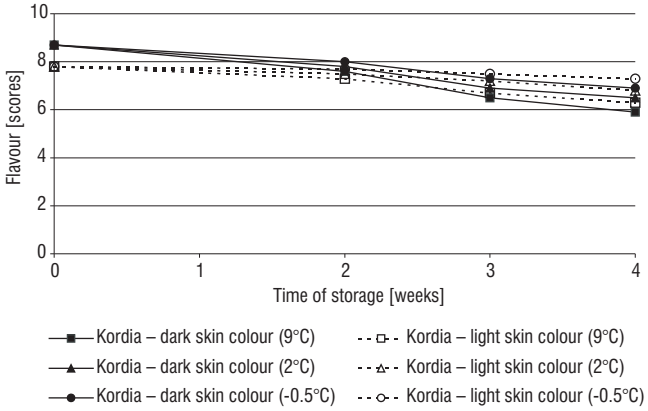

FIGURE 4. The changes of flavour of 'Kordia' sweet cherry during storage (means of 1999-2001).

Sweet and sour taste intensity did not change during cold storage but the fruit flavour decreased, especially in the darker cherries. After three weeks of storage, dark fruits had worse flavour than the lighter fruits within the same temperature. During storage, the foreign taste appeared. Its intensity slightly increased during storage. Although, the intensity of foreign taste was not high (notes below 0.8 point in 10-point scale), it could influence the deterioration of fruit flavour. Ryall and Pentzer [1982] reported that the sweet cherries stored at 1°C and 90–95% RH undergo colour and flavour loss after three weeks.

The flavour of fruits, such as all foods, is a result of a combined effect of their constituents on the taste and olfactory organs. Psychologically, a person's reaction to flavour can be influenced by more remote sensory properties, such as colour, appearance and texture [Williams, 1979]. Therefore the curves describing changes in the overall quality of 'Kordia' sweet cherry (Figure 5) have very similar form as curves described changes in flavour. Immediately after harvest and during two weeks of storage dark cherries were assessed higher in overall quality than light fruits. Light fruits seem to be better for longer storage than the darker ones. Taking into consideration the influence of storage temperature on fruit quality sweet cherry fruits kept at -0.5°C even four weeks were characterized by very good overall quality. Lower overall quality had fruits stored at +2°C, and the lowest quality these stored at +9°C. The changes of fruit quality during storage at +9°C were more intensive, and significant decrease of fruit quality was observed already after two weeks of storage.

Watada [1980] described that appearance and colour are the most important factors of stored horticultural products,

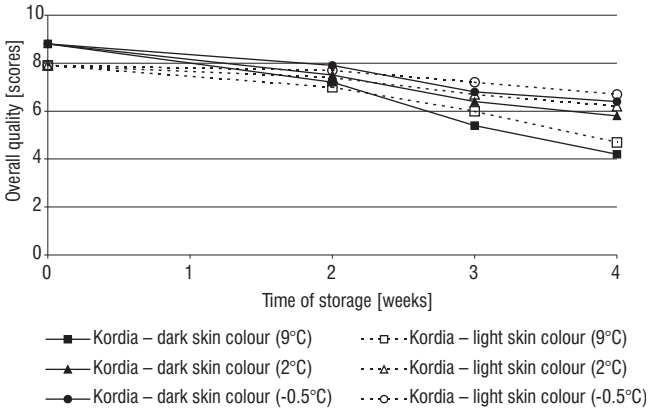

FIGURE 5. The changes of overall quality of 'Kordia' sweet cherry during storage (means of 1999–2001).

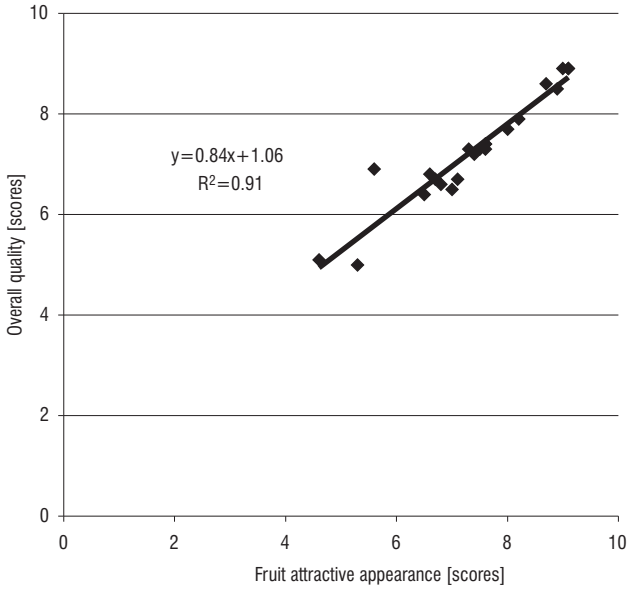

FIGURE 6. Relation between overall quality and fruit attractive appearance of 'Kordia' sweet cherry (means of 1999–2001).

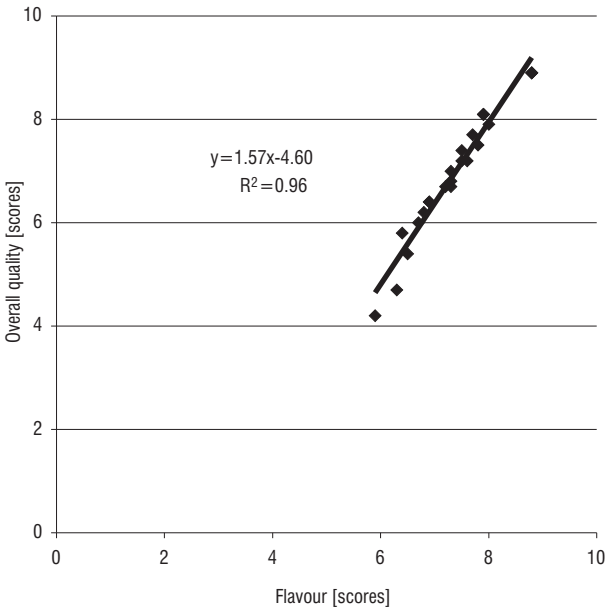

FIGURE 7. Relation between overall quality and flavour of 'Kordia' sweet cherry (means of 1999–2001).

which determine consumer's preference. Results of this experiment indicate that relationships between fruit flavour, fruit attractive appearance, colour of stem and overall quality are described excellently by linear equations (Figures 6–8). Coefficients of determination for these equation were: 0.96, 0.91 and 0.79 for fruit flavour, fruit attractive appearance, colour of stem, respectively. Slope (regression) coefficients for the above relationships were 1.57, 0.84, and 0.49, respectively. Above findings indicate, that fruit flavour was the strongest factor which influenced the overall quality of sweet cherries among descriptors shown in Figures 6–8.

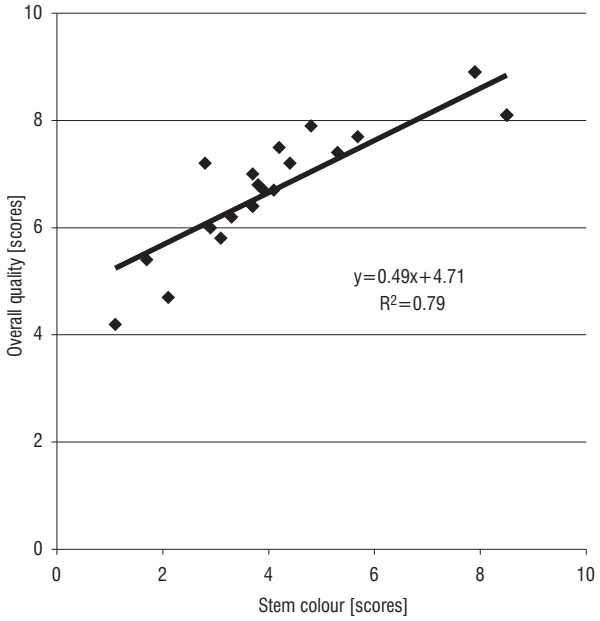

FIGURE 8. Relation between overall quality and stem colour of 'Kordia' sweet cherry (means of 1999–2001).

Studies carried out by Wermund and Fearne [2001] indicated that in the eyes of cunsumer, the ideal sweet cherry, should be large, dark, and sweet, and with a glossy appearance, but consumer preferences are often dependent on: when and for whom cherries are purchased.

CONCLUSIONS

1. Temperature and time of storage influenced significantly the quality of sweet cherry fruits cv. Kordia.

2. During storage, skin darkening was observed, especially at +9°C. Storage at lower temperature reduced darkening process and unfavourable changes in fruit quality. Fruits stored at the lowest temperature (-0.5°C) received the highest marks.

3. Fruit flavour decreased during storage, and foreign taste appeared. The intensity of foreign taste slightly increased during storage.

4. Browning and drying out of stem during storage of sweet cherries caused deterioration of fruit quality. Stem browning was more intensive at higher storage temperature.

5. Sweet cherry fruits stored at -0.5°C even for four weeks were characterized by very good overall quality; lower overall quality had fruits stored at +2°C, and the lowest these stored at +9°C.

6. Storage of sweet cherries at +9°C can be successful for short (up to 2 weeks) storage period.

7. Fruit flavour was the strongest factor which influenced the overall quality of sweet cherries.

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OCENA SENSORYCZNA CZEREŚNI ODMIANY "KORDIA" PO PRZECHOWYWANIU

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Celem badań było określenie zmian cech sensorycznych czereśni odmiany 'Kordia' podczas przechowywania w warunkach chłodni zwykłej. Badania prowadzono w latach 1999–2001. Po zbiorze owoce rozdzielono na dwie klasy biorąc pod uwagę intensywność wybarwienia (jasnoczerwone, ciemnoczerwone). Owoce przechowywano w temperaturach: -0.5°C, +2°C i +9°C. Bezpośrednio po zbiorze, a także po 2, 3 i 4 tygodniach przechowywania owoce poddawano ocenie sensorycznej przy użyciu skomputeryzowanego systemu analizy sensorycznej. Zastosowano niestrukturowaną skalę liniową. Oceniano następujące cechy jakościowe: atrakcyjność wyglądu owoców, gładkość skórki, barwę skórki owoców, jednolitość wybarwienia skórki, kolor szypułki, natężenie smaku słodkiego, natężenie smaku kwaśnego, obce posmaki, ogólną smakowitość oraz ogólną jakość owoców.

Wyniki oceny sensorycznej przeprowadzonej bezpośrednio po zbiorze wskazują, że owoce odmiany 'Kordia' z jaśniejszą barwą skórki miały mniej atrakcyjny wygląd oraz charakteryzowały się gorszą smakowitością i niższą ogólną jakością w porównaniu z owocami intensywniej wybarwionymi. Podczas przechowywania zaobserwowano odwrotną tendencję. Owoce z jaśniejszą barwą skórki po przechowywaniu miały bardziej atrakcyjny wygląd, lepszą smakowitość oraz cechowały się wyższą ogólną jakością. W czasie przechowywania obserwowano silne ciemnienie barwy skórki zwłaszcza w temperaturze +9°C (rys. 2, 3, 4). Owoce, które w czasie zbioru charakteryzowały się intensywnym zabarwieniem, po przechowywaniu oceniano jako zbyt ciemne i z tego powodu mało atrakcyjne. Po czterech tygodniach przechowywania w temperaturze -0.5°C i +2°C nadal wysoko oceniano zarówno wygląd owoców oraz ich smakowitość. Wyższe noty otrzymały jednak owoce przechowywane w niższej temperaturze.