SENSORY ANALYSIS OF BLUEBERRY CULTIVARS

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ABSTRACT

Blueberries have become a product of interest in recent years due to their nutritional and health benefits. The sensory quality of food is a subject of constant and active producer's interest. As a unique source of product information, sensory analysis has also important marketing consequences because it provides direct, low cost, fast and actionable information. When a consumer buys a food product, they can buy nutrition, convenience, and image. Therefore, sensory evaluation should be an integral part in defining and controlling product quality. The measurements were done with 15 cultivars of *Vaccinium corymbosum* L. The samples were stored in the fridge at 8 °C for 1 or 2 days before aromatic volatile and sensory quality analyses. On unstructured scales labelled on both ends, panellists rated in for the acceptability of appearance, colour, skin toughness, flavour, taste, fruit size, size uniformity of berries and texture quality during eating. For each sample, the consumer was asked to taste it, and then asked to indicate which statement best described how they felt about the sample on a 9-point hedonic scale (dislike extremely to like extremely). Values from Sensory analysis which are liking were analyzed with analysis of variance (multifactor ANOVA). For testing of normal distribution we had used Shapiro – Wilk test with the software Panelcheck. Factor Analysis was conducted on the sensory data to identify variability shared in common among the sensory descriptors (i.e., Dim 1 and Dim 2) for the 15 cultivars examined. The cultivars Sierra and Sunrise had most of the significant differences with each cultivars. Cultivars varied in sensory quality characteristics with trained panellist and of preference map. The cultivars Spartan and Bluecrop having the best and Berkeley and Patriot having the lowest, but still acceptable, sensory quality. Flavour quality characteristics best predicted overall eating quality of blueberries. Various textural and visual quality characteristics also influenced consumer assessment of overall eating quality of blueberries. It is therefore necessary to evaluate sensory blueberries and meet the requirements of consumers.

Key words: sensory analysis, *Vaccinium corymbosum* L., preference map, panellists, descriptors

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INTRODUCTION

The origin of blueberries and the biggest tradition of their growing is in the North America, where their big fruit cultivars are also growing. The big plantation is also in the all Europe, Australia and New Zeland (Dierking W., Dierking S. 1993). On Slovakia, there does not exist a big tradition in growing of blueberries. The main production of blueberries of Slovakia is in Orava. The *Vaccinium corymbosum* L. is cultivated from traditional vegetation. Fruits of blueberries belong to the healthiest cultivars on the world. They have got high biological and dietetic value (Šimala, 2000). From the nutritional point of view, blueberries has got also high concentration of ferrum in compare with other cultivars of small berrylike fruits. It is also very rich in carbohydrates, it has got a low content of fat and a lot of vitamins from the category of vitamins C, K, A, magnesium and it is also rich source of fibre (Kováčiková et al., 1997).

With an increased consumption of fresh blueberries in the past two decades, a whole new generation of cultivars has been released that were bred, at least in part, for improved fruit quality, shelf stability and extension of the fresh-market harvest season.

While many research papers have been published on instrumental quality characteristics of highbush and rabbiteye blueberries (Silva et al., 2005), very little information is available regarding their sensory characteristics. Sensory evaluations of thawed highbush and rabbiteye blueberries showed that 17 panellists preferred the colour of rabbiteye to highbush blueberries, but thawed fruit of highbush cultivars had superior taste and texture and less seediness (Makus and Morris, 1993). More recent sensory evaluations of fresh highbush and rabbiteye blueberries showed that 10 trained panellists found no differences in fruit colour, flavour or skin toughness among three rabbiteye and two highbush cultivars (Silva et al., 2005).

It is well known that food provides not only indispensable for life nutrients but it is a source of psychological satisfaction for every human being. The sensory quality of food is a subject of constant and active producer´s interest. As a unique source of product information, sensory analysis has also important marketing consequences because it provides direct, low cost, fast and actionable information. Therefore, after about 70 years of its own development and growth, sensory evaluation has emerged as a distinct and recognized scientific specialization that offers unique procedures, methods and standards in order to make analysis reliable and valid. Sensory evaluation is a scientific discipline used to evoke measure, analyse and interpret reactions to those characteristics of food and other materials as they are perceived by the senses of sight, smell, taste, hearing and tough. A scientific discipline used to evoke, measure, analyse and interpret those responses to product that are perceived by the senses of sight, smell, taste and hearing. A way

to ensure cost-efficient delivery of new products with high consumer acceptability. Sensory preferences including consumer preferences influence of sensitivity differences, personality differences, expectations and context effect, dependent and different for evaluators.

When a consumer buys a food product, they can buy nutrition, convenience, and image. Nevertheless, most importantly consumers are buying sensory properties/performance and sensory consistency. Therefore, sensory evaluation should be an integral part in defining and controlling product quality.

The objective is to identify sensory quality characteristics that may predict consumer acceptability of blueberry eating quality.

MATRERIAL AND METHODS

Plant material

The measurements were done with 15 cultivars of *Vaccinium corymbosum* L.. The experimental area where are the individual cultivars grown, lies in altitude 700 m.o.s., with geographical latitude 49° 17 ' n.l. and 19° 28,5 ' e.l. The average temperature over the year is 6° C with yearly aggregate amount meteoric water 800 – 900 mm. The manual picking was realized on August in 2010. Highbush blueberries (*Vaccinium corymbosum*) were hand harvested from mature field-grown plants from the Research Institute of Grassed Growth and the Mountain Agriculture in Krivá on Orava. The samples were stored in the fridge at 8 °C for 1 or 2 days before aromatic volatile and sensory quality analyses. The samples were stored in the fridge at 8 ◦C for 1 or 2 day before aromatic volatile and sensory quality analyses.

Sensory analysis

Each panellist evaluated all fifteen samples with the fifteen cultivars serving as a complete block in the statistical design. They were given a questionnaire that included a rating scale for several sensory characteristics Samples were presented one at a time in individual booths under moderate incandescent lighting. On unstructured scales labelled on both ends, panellists rated in for the acceptability of appearance, colour, skin toughness, flavour, taste, fruit size, size uniformity of berries and texture quality during eating. The consumer evaluation had been in sensory laboratory and the berries were evaluated at 23 ◦C for 2 h. A sample consisted of fresh whole blueberries presented in a cup labelled with a three-digit code. For each sample, the consumer was asked to taste it, and then asked to indicate which statement best described how they felt about the sample on a 9-point hedonic scale (dislike extremely to like extremely). In such a case, differences between samples would too be obvious for trained panellist. The chosen experimental design helped to investigate differences between fifteen samples in each context due the qualitative but not quantitative factor. Consumers were instructed to bottled water between samples to cleanse their palates. Data analysis starts from data inspection and data validation and then proceeds in some

steps. First, the analysis of sensory perception and preferences is discussed. Second, preference cluster mapping is described. Blueberry descriptors were chosen based on prior solicited comments from scientists familiar with fresh - market blueberry quality characteristics.

RESULTS AND DISCUSSION

Factor analysis of sensory data describes two dimensional components (Dim) calculated from the trained panel showed 85,87 % of variance.

Factor Analysis was conducted on the sensory data to identify variability shared in common among the sensory descriptors (i.e., Dim 1 and Dim 2) for the 15 cultivars examined. This method was applied to the extracted factors to identify and estimate any correlation among the extracted factors. Cultivars Spartan and Bluecrop that had generally high scores for size uniformity of berries and textural quality characteristics also had positive scores for Dim 1 (explaining 69.67 % of the variation observed among the sensory descriptors), with high loading values for size uniformity of berries (completely balanced, uniform; medium berries balanced and berries very unbalanced) and texture during chewing (Fig. 1). Likewise, cultivars that had generally low scores for size uniformity of berries and textural quality had negative scores on Dim 2, and cultivars that had generally intermediate size uniformity of berries and textural quality characteristics had scores near zero for Dim 2.(Berkeley, Patriot, Goldtraube 23 and Nelson). Cultivars Berkeley, Patriot, Goldtraube 23 and Nelson had also the negative scores on Dim 2, for the skin toughness and taste. Dim 2 explained 16.2 % of the variation observed among the sensory descriptors and the skin toughness and taste and overall eating quality loaded onto this factor. Cultivars (Puru, Pemberton, Sunrise, Sierra) that scored generally high for acceptability of flavour, colour and overall eating quality had positive scores for Dim 1 and cultivars (Polaris, Chippewa, Bluejay, Duke and Blueray) that scored lowest in these sensory quality characteristics had negative scores for Dim 2. (Puru, Pemberton, Sunrise and Sierra). Cultivars Polaris, Chippewa, Bluejay, Duke, Blueray had high scores for the acceptance of appearance and fruit size on Dim 2 (16.2 %) and that cultivars had lowest values for flavour and colour, also for the Dim 1. Just as the sensory descriptors loading onto Dim 1 and 2 are correlated with one another, the oblique rotation of the factors estimates a correlation between Dim 1 and 2 of 0.42. In summary, Factor Analysis indicated that cultivars Spartan and Bluecrop had higher sensory quality than cultivars Berkeley, Patriot, Goldtraube 23 and Nelson. The cultivar Spartan and Bluecrop having the best and Berkeley and Patriot having the lowest, but still acceptable, sensory quality. Results from Factor Analysis were similar to other statistical analyses of the sensory data as described above.

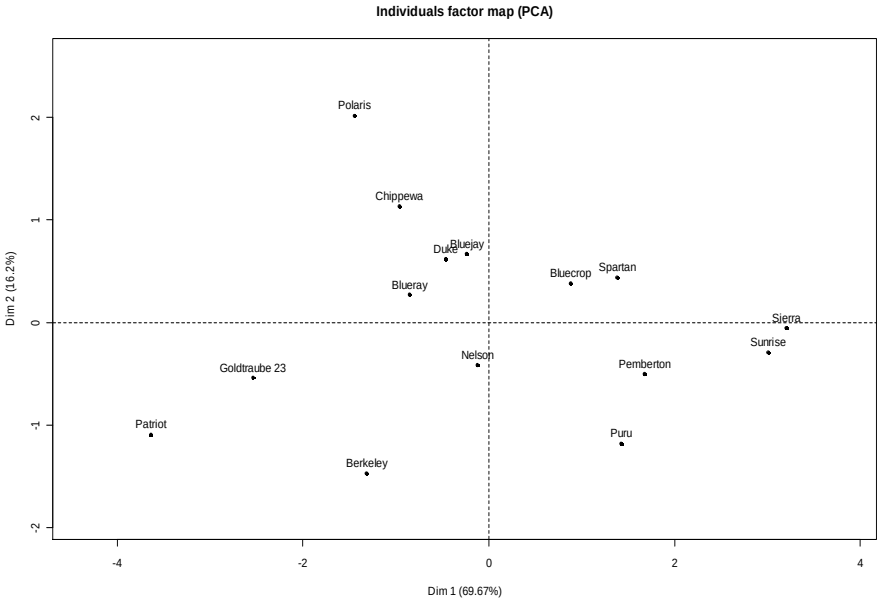

Fig.1Factor Analysis of sensory data for all 15 blueberry cultivars

We also considered the possibility that maturity (i.e., ripeness) differences among cultivars may have affected the sensory results. Care was taken to harvest fruit once the fruit turned fully blue andwas firm to touch, but slight differences in maturity among cultivars probably occurred. For example, the highbush cultivar, Berkeley, scored low for intensity of texture during chewing. Since firmness varies dramatically with the stage of maturity (Ballinger et al., 1973), the relatively low textural quality scores of Berkeley combined with its high sweetness and low tartness scores, which are characteristic of more mature fruit (Galletta et al., 1971), may indicate that these fruit were harvested at a somewhat more advanced stage of maturity than those of other cultivars to which they are being compared. Textural and flavorrelated sensory scores of Berkeley should still be interpreted with caution. When blueberries are grown in a single location and year, genetic factors are more important than environmental differences within the field (Ballington et al., 1984). Thus, this study reflects, by design, primarily genetic differences.

Statistical analysis

Values from Sensory analysis which are liking were analyzed with analysis of variance (multifactor ANOVA). Anova was used for unvaried comparison between the15 cultivars and sensory descriptors significant differences at 0.05 level were considered as variables. For testing of normal distribution we had used Shapiro – Wilk test with the software Panelcheck. The cultivars Sierra and Sunrise had most of the significant differences with each cultivars.

P-values for the Hotelling T2 tests

	Berkeley	Bluecrop	Bluejay	Blueray	Duke	Goldtraube 23	Chippewa	Nelson	Patriot	Pemberton	Polaris	Puru	Sierra	Spartan	Sunrise
Berkeley	1	0.03292	0.05186	0.03463	0.1256	0.4883	0.008313	0.1892	0.2269	0.04335	0.005324	0.1428	0.001758	0.002637	0.004231
Bluecrop	0.03292	1	0.286	0.1788	0.1632	0.0008407	0.03557	0.2397	0.003333	0.7089	0.09067	0.3558	0.0002004	0.7206	0.0007808
Bluejay	0.05186	0.286	1	0.7751	0.9656	0.03524	0.6635	0.4805	0.02597	0.3197	0.3418	0.05184	0.002085	0.2799	0.003152
Blueray	0.03463	0.1788	0.7751	1	0.877	0.1653	0.4619	0.5764	0.07058	0.258	0.1632	0.03157	0.0031	0.1617	0.004309
Duke	0.1256	0.1632	0.9656	0.877	1	0.0535	0.8026	0.6362	0.03483	0.3103	0.454	0.0815	0.001545	0.1942	0.00244
Goldtraube 23	0.4883	0.0008407	0.03524	0.1653	0.0535	1	0.005991	0.08774	0.4955	0.009578	0.007212	0.01701	2.145e-05	0.0005067	5.938e-05
Chippewa	0.008313	0.03557	0.6635	0.4619	0.8026	0.005991	1	0.1847	0.009254	0.1607	0.6241	0.02279	0.0003346	0.08118	0.0007111
Nelson	0.1892	0.2397	0.4805	0.5764	0.6362	0.08774	0.1847	1	0.05199	0.3881	0.07045	0.3725	0.005985	0.05589	0.01455
Patriot	0.2269	0.003333	0.02597	0.07058	0.03483	0.4955	0.009254	0.05199	1	0.01069	0.005945	0.006721	0.0003456	0.002399	0.0004627
Pemberton	0.04335	0.7089	0.3197	0.258	0.3103	0.009578	0.1607	0.3881	0.01069	1	0.07694	0.6761	0.1041	0.2957	0.2958
Polaris	0.005324	0.09067	0.3418	0.1632	0.454	0.007212	0.6241	0.07045	0.005945	0.07694	1	0.01635	0.002604	0.089	0.003675
Puru	0.1428	0.3558	0.05184	0.03157	0.0815	0.01701	0.02279	0.3725	0.006721	0.6761	0.01635	1	0.05702	0.1253	0.1108
Sierra	0.001758	0.0002004	0.002085	0.0031	0.001545	2.145e-05	0.0003346	0.005985	0.0003456	0.1041	0.002604	0.05702	1	0.1147	0.6681
Spartan	0.002637	0.7206	0.2799	0.1617	0.1942	0.0005067	0.08118	0.05589	0.002399	0.2957	0.089	0.1253	0.1147	1	0.1839
Sunrise	0.004231	0.0007808	0.003152	0.004309	0.00244	5.938e-05	0.0007111	0.01455	0.0004627	0.2958	0.003675	0.1108	0.6681	0.1839	1

Fig. 2. ***P- values for the hotelling T2 tests (ANOVA) blueberry fruit from 15 cultivars. Means within a column of followed by the coloured columns were significantly different and non-coloured were not significantly different, Shapiro – Wilk tests, (α = 0.05)***

CONCLUSION

It is well known that food provides not only indispensable for life nutrients but it is a source of psychological satisfaction for every human being. The sensory quality of food is a subject of constant and active producer´s interest. As a unique source of product information, sensory analysis has also important marketing consequences because it provides direct, low cost, fast and actionable information. When a consumer buys a food product, they can buy nutrition, convenience, and image. Nevertheless, most importantly consumers are buying sensory properties/performance and sensory consistency. Therefore, sensory evaluation should be an integral part in defining and controlling product quality. Blueberries have become increasingly popular because of their health-promoting properties. Therefore the objective of our study is to identify sensory quality characteristics that may predict consumer acceptability of blueberry eating quality.

Cultivars varied in sensory quality characteristics with trained panellist and of preference map (Fig.1). The cultivars Spartan and Bluecrop having the best and Berkeley and Patriot having the lowest, but still acceptable, sensory quality. Cultivars Spartan and Bluecrop that had generally high scores for size uniformity of berries and textural quality characteristics, but they had the lowest scores for taste and skin toughness. The cultivars Berkeley, Patriot, Goldtraube 23 and Nelson had generally high scores for taste and skin toughness and the lowest scores for size uniformity of berries and textural quality characteristics. The cultivars Polaris, Chippewa, Bluejay, Duke and Blueray had generally high scores for acceptance of appearance and fruit size and the lowest scores for flavour and colour. However, the cultivars Puru, Pemberton, Sunrise and Sierra they had not the same scored but vice versa. Flavour quality characteristics best predicted overall eating quality of blueberries. Various textural and visual quality characteristics also influenced consumer assessment of overall eating quality of blueberries. It is therefore necessary to evaluate sensory blueberries and meet the requirements of consumers.The cultivar Spartan and Bluecrop having the best and Berkeley and Patriot having the lowest, but still acceptable, sensory quality. Results from Factor Analysis were similar to other statistical analyses of the sensory data as described above. We also considered the possibility that maturity (i.e., ripeness) differences among cultivars may have affected the sensory results. The cultivars Sierra and Sunrise had most of the significant differences with each cultivars (Fig.2).

It is therefore necessary to evaluate sensory blueberries and meet the requirements of consumers. The sensory analysis should be also useful for making decision for making decision pertaining to the marketability of fruits and vegetables.

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