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Sensory evaluation of white asparagus (*Asparagus officinalis* L.) hybrids

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Summary: Comprehensive system of sensory evaluation was developed to obtain information on the different varieties by determining asparagus quality parameters. 9 sensory characteristics were estimated to describe flavour differences. The tests were carried out in 4 varieties of white asparagus (*Asparagus officinalis* L.) grown on brown humus sand soil by etiolate method in ridge cultivation. The experiment was performed at the University of Debrecen in Debrecen-Pallag. To increase the Hungarian asparagus consumption, a classification of varieties regarding to asparagus flavour is necessary.

In our experiment it could be stated that there are strict correlations (0.892) between the sweetness – total impression and between lacks of unpleasant aftertaste – total impression (0.870). The result of surveys can lead to higher popularity of the asparagus. These results are presented in order to recommend the varieties to producers for a successful marketing. The taste of asparagus is mostly influenced by variety, soil type and growing conditions. In our experiment, *'Vitalim'* hybrid exceeded by several sensory parameters. This hybrid scored 788.38 over 900. The elder population showed more interest in asparagus consumption than younger ones. 50% of the participants are able to pay only 500-600 HUF/kg. It could be realized to ensure the proper growing place, hybrid and direct trade. Marketing and more information is necessary to increase the popularity of this vegetable among the younger generation.

Keywords: *asparagus hybrids, white asparagus, sensory evaluation, consumption, total impression, organoleptic evaluation*

Introduction

White asparagus is one of the 30 vegetables most consumed in the world (Arana et al., 2016).

The asparagus (*Asparagus officinalis* L.) is origin Pre- and Middle Asia and seashore of Europe. Asparagus is a perennial stem vegetable which may take 2 to 3 years to get started and produce, but it can be productive up to 15 years by rentable production. Asparagus has male and female plants, but with the breading process, most productive hybrids are super-male types. For growing, the best regions are the ones with cool winter because it is a cool-season crop. For the proper growing area, special attention must be paid in the soil moisture content in order not to keep it very high. Therefore, before transplanting the soil drainage has to be well prepared.

In Hungary, asparagus production shows an increasing tendency. In 2014 the growing area was 1200 hectares, but in 2016 it reached 1600 ha. It obeys to an increase in exports, because nearly 90% of asparagus yield is sold abroad. In Europe, white asparagus is particularly appreciated during the asparagus season as a gourmet vegetable (Hoberg et al., 2008). This culinary reason plays a pivotal role for the high requirements in harvesting asparagus with particular characteristics like butter-soft, full-bodied and pleasantly mild. Therefore, breeders and producers have to follow it. The good raw material must not be fibrous, woody or stringy. The flavour has not to be too mild or tasteless, but characterized by a pleasant bitterness or a bit of sweetness. The asparagus has very high nutrition value which can give a reason for increasing the local consumption (Hoberg et al., 2003).

The asparagus can be harvested for a period of 5 weeks in spring time. After that, we have to allow the ferns to grow which replenishes the nutrients for next year's spear production.

Asparagus has not only high vitamin C content but also contains pro vitamin A (30 µg/100 g) and vitamin E (2 mg/100 g) (SOUCI et al., 2000).

Earlier results stated (Takács-Hájos & Zsombik, 2015) that there is significant difference amongst the varieties in the average of the observed years. *'Vitalim'* was prominent with its high total polyphenol (35.16 mg/100g), vitamin C (59.34 mg/100 g) and flavonoid (0.52 mg/100g) content. High sulphate-S content, which is characteristic for asparagus, has been measured in the case of *'Cumulus'* (287.77 mg/100 g), together with the highest protein content (2.23%). Among the microelements, high Fe content (4.93–7.63 mg kg^{-1} fresh weight) deserves attention. Fe is variety dependent at different genotypes. The highest value was found in *'Gijnlim'*

with 7.63 mg kg^{-1} on fresh weight basis (Takács-Hájos et al., 2013).

According to Leung & Foster (1996) the asparagus is considered as an herb because its diuretic effect and its consumption can release harmful materials. Furthermore, it is suitable for heart disease treatment due to its antioxidant activity. The asparagine as amino-acid is isolated from asparagus at first, being this the main cause of the strange odour of urine sensed after an increase in asparagus consumption (Bordoni & Danesi, 2004).

The most important competition factors of asparagus are sensory quality and freshness. For sensory evaluations it is possible to create parameters depending on different researchers. Hoberg and co-workers (2003) subdivided the quality parameters into the following – the direct odour (typical, sweetish, pungent, musty, earthy), the taste (bitter, sweet, typical, tasteless), the mouth sensation (metallic, astringent, crisp, tough, stringy), the aftertaste (bitter, astringent) and the non-dominant, occasionally appearing sensations (cake, bread, potato, soup, stinky, lemon-like, burnt, buttery, sour-like, flowery). They found the interaction of the main influencing factors – variety, location, year and harvest date – are remarkable, causing great effect on sensory results.

The sensory evaluation is a good tool to have information about the costumer's preferences about asparagus. This evaluation method is a scientific discipline that analyses and measures human responses to the composition of food for different parameters, for instance appearance, odour, texture and taste. The effects of the varieties on consumer's acceptance are represented. The results can serve as comparison for the variety selection and bring about purchasing recommendations according to customer's opinion (Hoberg et al., 2008).

Sensory evaluation can be used to compare and evaluate similarities/differences in a range of products, gauge responses to product, e.g. acceptable or unacceptable, explore specific characteristics of product, check whether a final product meets its original specification, provide objective and subjective feedback data to enable informed decisions to be made.

The sensory profile of canned white asparagus was clearly defined through the evaluation of 16 descriptors. According to this method, Arana and co-workers (2016) proved that the asparagus with the highest quality scores in certain descriptors can give real results about quality and therefore qualify the asparagus due to its visual valuation. On the contrary, Hui (2005) stated that after blanching, there were not significant differences in asparagus texture, flavour and general acceptability.

Materials and methods

The evaluation has been carried out in Debrecen-Pallag in 2013. The meteorological data are shown in *Table 1*.

Table 1. Meteorological data of the research field in Debrecen-Pallag (2013)

Parameters	Quantity
Total temperature (year) (°C)	3200-3300
Total sunshine (hour/year)	2000
Mean temperature in the year (°C)	9.99
Number of frosty days (day/year)	100-110
Total year precipitation (mm)	500-550
Precipitation during vegetation period (mm)	340

The soil type of plantation was brown humus sand soil. The data of soil analysis are shown in *Table 2*.

Table 2. Soil analysis data (Debrecen-Pallag, 2013)

Parameters	Quantity
pH (KCl)	6.7
pH (in distilled water)	6.9
Compactness after Arany K_A	27
Water-soluble total salt content % (m/m)	0.02
Humus content % (m/m)	1.74
AL-soluble P content as P_2O_5 (mg/kg)	534
AL-soluble K content as K_2O (mg/kg)	593
KCl-soluble NO_3^- + NO_2^- - N (mg/kg)	45.6
AL-soluble Na (mg/kg)	22.8
KCl-soluble Mg (mg/kg)	164

The plantation was carried out on 20th of May, 2010, where the row distance was 180 cm and there was 25 cm between the plants. In the evaluation we followed 4 hybrids which attributes are below.

- ***'Cumulus'*** is a 100% male hybrid that is suitable for white asparagus production in northern and central Europe. This is an early hybrid with high yields. *'Cumulus'* has an excellent flavour.
- ***'Gijnlim'*** is a 100% male hybrid and ideally suited for cultivation of both white and green asparagus in temperate climate zones. This variety is an exceptionally early grower and gives very high productivity. *'Gijnlim'* is ideal for forced cultivation conditions. This variety is highly valued for direct from farm sales.
- ***'Grolim'*** is a 100% male hybrid, suitable for cultivation of white asparagus in both temperate climate zones and climates similar to South Europe. '*Grolim'* is ideal as a "high yield variety", as its exceptionally high stem weight contributes towards reducing labour costs. This early variety gives above average production.
- ***'Vitalim'*** is a 100% male hybrid and is extremely suited for the cultivation of white asparagus in regions with a Mediterranean climate. *'Vitalim'* combines very early production with a high yield and a long profitable lifetime. *'Vitalim'* is also extremely suitable for cultivation systems aimed at early harvesting.

Table 3. Parameters of the organoleptic evaluation (Debrecen, 2013)

Colour	purple-greenish ……ivory-white	1…100 score
Texture	soft, stringy ……optimal	1…100 score
Odour	sulphuric …… typical	1…100 score
Flavour	none..……sweetcorn.……sweet potato	1…100 score
Stringiness	stringy……none	1…100 score
Juiciness	none…..……juicy, optimal	1…100 score
Sweet taste	low intensity…..……sweet	1…100 score
Unpleasant aftertaste	bitter……buttery, meat-like …..……none	1…100 score
Total impression	not popular……..……very popular	1…100 score

Characteristic **cultivation** was made for the asparagus, in this way we used soil loosening, nutrition supply (mineral and organic manure), preparation of ridge and its covering with the special black-white plastic sheet. In spring time the black part of the foil was outside to warm the soil, for promoting the earliness. When the temperature increased, the covering sheet was changed to the other side because the white colour protecting the soil against overheating.

The harvest period was from 22 of April to 23 of May, 2013. The sample collection was from early morning. The organoleptic evaluation was on 17th of May, 2013 with 18 participants. The sensory profiles of the varieties were established with the following parameters (Table 3).

The preparation of samples was the following. After peeling, the spears were blanched for 10 minutes, cut into 2-3 cm long pieces. For the evaluation every parameter was scored from 1 to 100.

Results

Sensory evaluation

For asparagus the most important competition factors are sensory quality and freshness. Therefore, the aim of the study was to evaluate the impact of cultivars in given location, harvest date per year on the asparagus flavour quality by etiolated/white spear samples. The sensory analyses were carried out immediately after sampling.

Besides the high yield, the quality is very important, too. It is determined by not only the growing area, climatic and soil circumstances, but the genetic factors, too.

In our experiment we evaluated the quality parameters of different white asparagus spears.

For the evaluation we used 9 parameters to define clearly the range of varieties. The size of polygon is supposed to show the homogeneous of different properties (Figure 1).

The sensory evaluation proved that the '*Vitalim'* genotype excelled in quality over the other hybrids. It reached the highest score for nearly every parameters except of juiciness and colour of spears. This differences were little comparing to the '*Cumulus'* and '*Grolim'* which were the best in this properties.

Finally, we can state that all hybrids got more than 70 scores. *'Cumulus'* and *'Gijnlim'* hybrids have showed the lowest quality in flavour and sweetness. It proved that this important parameters are depending on the genotypes. The total score given from the participants are presented in *Figure 2*.

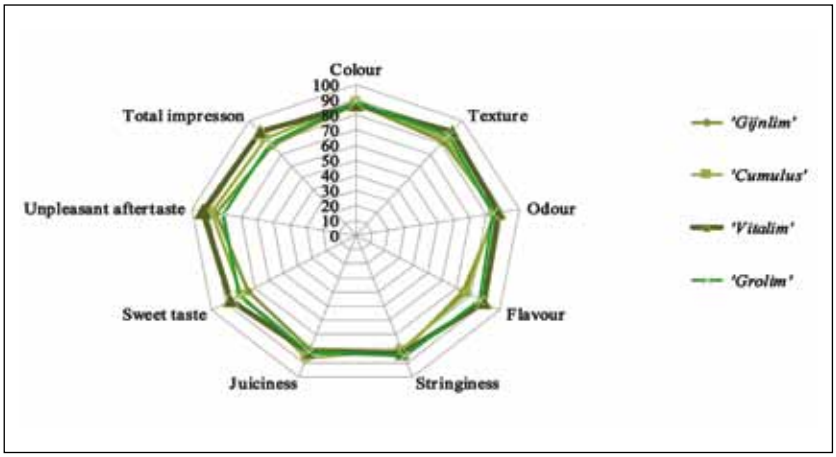

Figure 1. Sensory evaluation of asparagus hybrids (Debrecen-Pallag, 2013)

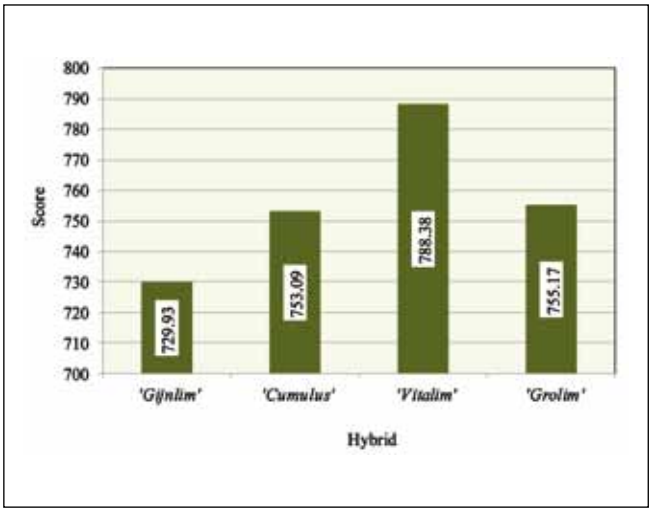

Figure 2. Total score of the hybrids by sensory evaluation (Debrecen-Pallag, 2013)

It is clear, that the *'Vitalim'* got the highest scores, 788.38 points from the possible 900. On the second place the *'Grolim'* scored 755.17 and it is followed by the *'Cumulus'* (753.09 scores).

With the connection between the total impression and unpleasant aftertaste, sweetness, odour and consistence of spears we would like to show these parameters how much can affect the total impression (Figure 3).

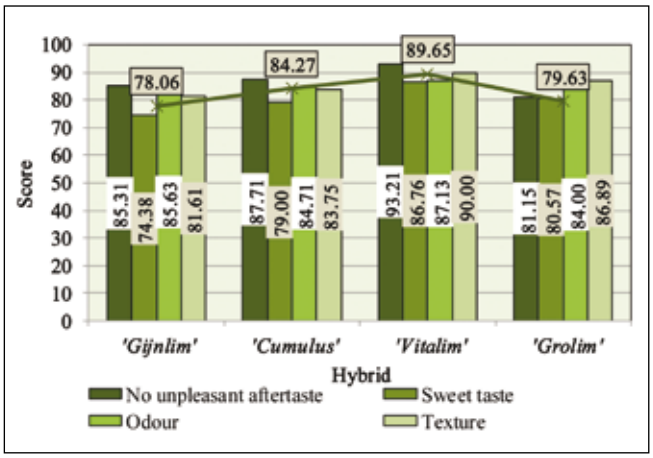

Figure 3. Connection between total impression – aftertaste, sweetness, odour and texture

The data shows that the sweetness and lack of unpleasant aftertaste can determine mostly the total impression (Table 4).

Table 4. Correlation between the properties by the mean of hybrids

Properties	Correlation value (r)
Sweet taste – Total impression	0.870
No unpleasant aftertaste – Total impression	0.892
Odour – Sweet taste	0.498
Flavour – Unpleasant aftertaste	0.273
Stringiness – Total impression	-0.280
Juiciness – Sweet taste	0.216

The hungarian asparagus consumption is rather low, in this way it is very important to know which parameter can influence the acceptibility of this vegetable.

The connection between the total score and consistence of spears, sweetness and total impression is shown in *Figure 4.*

'Vitalim' has got the highest score in all these parameters. The *'Cumulus'* and *'Grolim'* got similar total score, but *'Cumulus'* showed more equilibrate for these parameters than the *'Grolim'*. In our circumstance, the lowest score was given for *'Gijnlim'*.

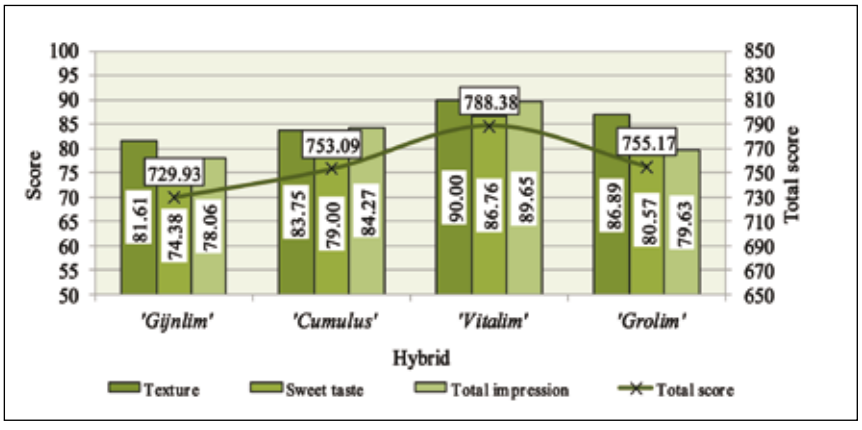

Figure 4. Connection between the total score – texture, sweetness and total impression

Evaluation of local asparagus consumption

With several questions we tried to follow the habit of hungarian consumers (18 people). At first, we wanted to present a global picture about the knowledge of asparagus among the people.

During the survey, 18 people were asked and took part in the sensory evaluation. The results are showed in *Figure 5* and *6* which can represent the answers from the participants (age under and over 30 years). According to these data, it is clear that among the elder population the asparagus is better known (85%) than the younger ones (60%).

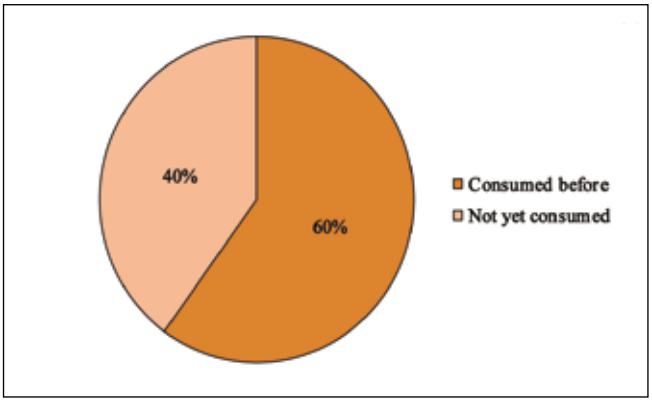

Figure 5. Asparagus consumption by young generation (under 30 years)

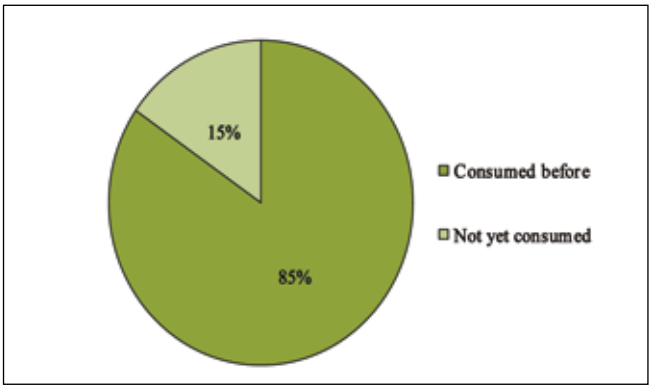

Figure 6. Asparagus consumption by elder generation (over 30 years)

Among the elder population conscious nutrition appears more than among young ones. Our task is to increase the marketing and public information about the nutrition benefits of asparagus. The *Figure 7* shows the satisfaction of consumers.

94% of all people gave positive feedback about the good taste and total impression. It means that this vegetable would be important specie for Hungarian gastronomy by proper choice of variety and culinary method. The participants were interested in the cooking method and different dishes. *Figure 8* presents the willingness of purchase and price.

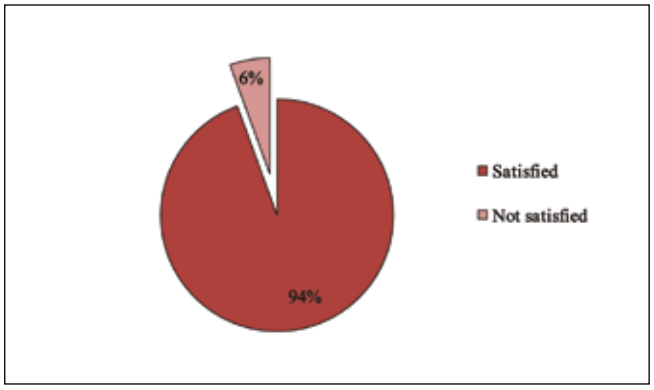

Figure 7. Total satisfaction (%) among participants

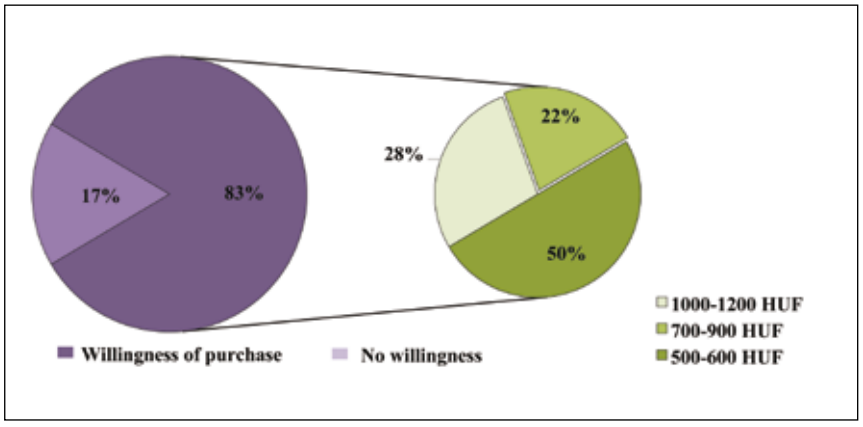

Figure 8. Willingness of purchase (%) and the acceptable price (HUF) by participants

In Hungary this vegetable has higher price than other species which can be explained with the high human labour during the growing period. Hungarian people are very price-sensitive, in this way we tried to get information about the reasonable price for them. 50% of the people who had positive attitude toward asparagus, the most common price would be between 500-600 HUF/kg. Nearly 20% of them would be able to pay 700-900 HUF/kg and 28% of them would buy this vegetable for 1000-1200 HUF/kg.

Despite the fact that asparagus is a healthy food, the purchase of it depends not only on willingness but financial circumstances, too.

Conclusions

According to the results of sensory evaluation we can state that the hybrid *'Vitalim'* was the most favourable between the different hybrids.

Among the 9 parameters which were used for evaluation we found that the most important ones are sweetness, lack of unpleasant aftertaste, odour and flavour.

According to the data, it proved that the hybrid *'Vitalim'* had the highest quality in our circumstances by ridge growing method. We found tight correlation (r=0.892) between the lack of aftertaste and total impression and similar between sweetness and total impression (r=0.870).

Evaluating the survey we found that the asparagus is more popular among elder people (over 30 years) than among the younger ones (under 30 years). However, the consumption is influenced by not only the nutrition value of asparagus, but the prices, too. For increasing the asparagus popularity, it is necessary to have the right variety, the proper growing method and the direct trade. They can help to prepare the reasonable price for this vegetable by rentable production.

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