

CORRELATIONS BETWEEN SENSORY TRAITS OF BOILED POTATOES

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Abstract

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Boiled potatoes from twelve cultivars grown at two altitudes were evaluated for appearance, aroma, colour, texture, friability, starch taste, sweetness, sourness and overall taste. Correlation analysis was applied to estimate the significance of the sensory traits for the whole human perception. It was found that the total sensory evaluation was in correlation at the highest degree with taste (average $r = 0.800$), followed by texture (average $r = 0.679$), colour (average $r = 0.617$) and appearance (average $r = 0.614$). Their assessment during the breeding process has to be taken into account in order to create high quality potato cultivars. The lack of significant correlations between identical sensory traits of potatoes grown under field and mountain conditions is a proof for impossibility to predict sensory profile of boiled potatoes by results from only one altitude.

Key words: (*Solanum tuberosum* L.), panel test, sensory properties, relation, field growth, mountain growth

Introduction

Creation of new cultivars for industrial processing is a basic goal of the potato breeding programme at Maritsa Vegetable Crops Research Institute, Plovdiv (Nacheva, 2004a, 2004b). In order to achieve complex quality determined by high productivity, appropriate morphology, disease resistance and good sensory properties, it is necessary to work in different breeding directions in parallel. Information obtained from sensory analysis contributes to create this complex quality (Abbott, 1999; Dale and Mackay, 1994; Pevicharova and Nacheva, 2004; Styszko et al., 2000).

In most cases, the panel test of processed potatoes has to be done in a very short time and with a big number of cultivars. An effective way to accelerate this procedure is to reduce the organoleptic traits which influence at lower degree on the whole sensory awareness.

The aim of this study was to establish the most significant sensory characters influencing on the total sensory evaluation of boiled potatoes grown at two altitudes by use of correlation analysis.

Materials and Methods

During the period 2004-2006 twelve potato cultivars of early (Concorde, E 292, E 147, E 154), mid-early (Sante, E

170, E 68, E 193) and late types (Kondor, E 136, E 158, E 28) were evaluated for their suitability for processing. The plants were grown under field (160 m altitude) and mountain (1600 m altitude) conditions. The two experiments were performed by block method in four replications (100 plants per replication), in planting scheme 70/25 cm, applying the technologies for early and late potato productions.

Sensory analysis of boiled tubers was done on the traits appearance, aroma, colour, texture, friability, starch taste, sourness, sweetness and overall taste. A five-point hedonic scale with 0.25 steps was used. The evaluation criteria were as followed:

- Appearance: 5 – over 95% of the tubers were of uniform shape and smooth surface; 1 – over 40% of the tubes were not uniform, with rough or injured surface
- Aroma: 5 – typical, well expressed aroma; 1 – atypical, unpleasant aroma
- Colour: 5 – homogeneous, saturated colour; 1- variegated, mosaic colour
- Texture: 5 – uniform, no core perception, tender; 1 – deep perception of core and surface separately
- Friability: 5 – smooth surface, whole shape; 1 – shapeless mass
- Starch taste: 5 – non-expressed; 1 – well expressed
- Sourness: 5 – non-expressed; 1 – well expressed
- Sweetness: 5 – pleasant perception of sweetness; 1 – non-expressed

- Overall taste: 5 – specific, uniform, pleasant taste; 1 – un-specific, unpleasant taste

The same five panelists have participated during the experiment. The total sensory evaluation was formed on the basis of their complete perception but not as an arithmetic average from evaluations for individual sensory traits.

Correlation coefficients between sensory parameters were calculated individually for each of the three years and each studied altitude as well as totally for the whole period of investigation (Lakin, 1990).

Results and Discussion

The values of the studied characters obtained from the panel test have already been reported (Pevicharova and Nacheva, 2009).

Very weak to negligible correlations between sensory traits and total sensory evaluation of boiled potatoes from field and mountain production were not found (Table 1, 2 and 3). The other correlations could be divided into the following groups:

- I group: with correlation coefficients for each year over 0.500 and a constant manifestation not depended essentially by the conditions of cultivation
- II group: with correlation coefficients for each year over 0.500 and an inconstant manifestation during the experimental period
- III group: with average correlation coefficient over 0.500 and a lower value during at least one year of the study

The first group includes moderate correlation of the total sensory evaluation with appearance and colour when the tu-

Table 1
Correlation coefficients between sensory traits of boiled potatoes grown under field conditions

Sensory traits	Appearance	Aroma	Colour	Texture	Friability	Starch taste	Sourness	Sweetness	Overall taste	Total sensory evaluation
	2004 (n = 60)									
Appearance	◆	0.590**	0.477**	0.274*	0.815**	0.504**	0.140	0.172	0.209	0.591**
Aroma	0.446**	◆	0.453**	0.281*	0.593**	0.297*	0.134	0.241	0.313*	0.500**
Colour	0.760**	0.437**	◆	0.303*	0.492**	0.339**	0.028	0.027	0.238	0.543**
Texture	0.238	0.487**	0.323*	◆	0.173	0.457**	0.506**	0.611**	0.808**	0.702**
Friability	0.645**	0.211	0.508**	0.143	◆	0.452**	0.024	0.139	0.187	0.643**
Starch taste	0.282*	0.592**	0.210	0.587**	0.140	◆	0.246	0.234	0.266*	0.504**
Sourness	0.166	0.319*	0.046	0.362**	0.207	0.200	◆	0.563**	0.573**	0.456**
Sweetness	0.265*	0.363**	0.165	0.378**	0.129	0.136	0.451**	◆	0.761**	0.541**
Overall taste	0.368**	0.596**	0.334**	0.699**	0.221	0.484**	0.551**	0.507**	◆	0.736**
Total sensory evaluation	0.509**	0.663**	0.503**	0.648**	0.315*	0.539**	0.559**	0.486**	0.842**	◆
2005 (n = 60)										
2006 (n = 36)										
Appearance	◆	0.495**	0.756**	0.441**	0.754**	0.542**	0.425**	0.255	0.271	0.534**
Aroma	0.456**	◆	0.592**	0.704**	0.285	0.648**	0.572**	0.559**	0.722**	0.713**
Colour	0.588**	0.440**	◆	0.539**	0.570**	0.490**	0.467**	0.278	0.431**	0.650**
Texture	0.307**	0.393**	0.355**	◆	0.469**	0.798**	0.620**	0.646**	0.779**	0.822**
Friability	0.780**	0.318**	0.494**	0.238**	◆	0.572**	0.215	0.240	0.167	0.407*
Starch taste	0.452**	0.431**	0.326**	0.539**	0.394**	◆	0.488**	0.591**	0.598**	0.786**
Sourness	0.212**	0.278**	0.131	0.501**	0.116	0.280**	◆	0.733**	0.766**	0.774**
Sweetness	0.219**	0.327**	0.119	0.554**	0.173*	0.282**	0.570**	◆	0.785**	0.782**
Overall taste	0.260**	0.463**	0.304**	0.778**	0.198*	0.379**	0.622**	0.694**	◆	0.841**
Total sensory evaluation	0.563**	0.556**	0.550**	0.715**	0.530**	0.555**	0.560**	0.583**	0.784**	◆
For the whole period (n = 156)										

bers were grown under field conditions (Table 1) and with appearance, texture and friability under mountain conditions (Table 2). Strong high correlation was found with texture and overall taste of boiled potatoes from field production and very strong with overall taste of boiled potatoes from mountain production (Table 1 and 2).

The establishment of correlation coefficients with high values during each experimental year shows that the relationships of the total sensory evaluation with appearance, colour, texture and overall taste have manifested regardless of the conditions in the year of cultivation and the studied altitudes. These sensory traits seem to play a significant role for the whole sensory perception of boiled potatoes.

The second group is comprised of correlations concerning the field production only. The relationship of the to-

tal sensory evaluation with aroma and starch taste was of changeable expression. The differences between maximum and minimum values of correlation coefficients were over 0.2 (Table 1). The inconstant manifestation of the mutual relation between the sensory traits probably has been due to the response to the growth conditions during the experimental period. Nevertheless the correlation coefficients were over 0.500. It permits us to accept that these sensory traits are also important for the total sensory evaluation of boiled potatoes when tubers are grown under field conditions.

In the third group the correlation coefficients were over 0.500 in two years for the total sensory evaluation with sourness and sweetness of potatoes grown under field conditions (Table 1) and for starch taste and sweetness of potatoes grown under mountain conditions (Table 2). The relation of

Table 2
Correlation coefficients between sensory traits of boiled potatoes grown under mountain conditions

Sensory traits	Appearance	Aroma	Colour	Texture	Friability	Starch taste	Sourness	Sweetness	Overall taste	Total sensory evaluation
2004 (n = 60)										
Appearance	◆	0.409**	0.693**	0.240	0.768**	0.251	0.308*	0.295*	0.450**	0.659**
Aroma	0.442**	◆	0.511**	0.276*	0.303*	0.221	0.361**	0.244	0.523**	0.595**
Colour	0.755**	0.428**	◆	0.213	0.461**	0.379**	0.460**	0.236	0.472**	0.578**
Texture	0.408**	0.425**	0.411**	◆	0.292*	0.550**	0.492**	0.712**	0.771**	0.663**
Friability	0.787**	0.444**	0.684**	0.496**	◆	0.218	0.119	0.391**	0.359**	0.527**
Starch taste	0.279*	0.366**	0.218	0.572**	0.314*	◆	0.329*	0.454**	0.587**	0.529**
Sourness	0.180	0.229	0.261*	0.348**	0.105	0.104	◆	0.572**	0.635**	0.570**
Sweetness	0.256*	0.273*	0.171	0.258*	0.246	0.004	0.584**	◆	0.667**	0.644**
Overall taste	0.348**	0.349**	0.399**	0.548**	0.279*	0.375**	0.546**	0.313*	◆	0.910**
Total sensory evaluation	0.659**	0.475**	0.663**	0.657**	0.686**	0.455**	0.402**	0.369**	0.736**	◆
2005 (n = 60)										
2006 (n = 60)										
Appearance	◆	0.152	0.635**	0.237	0.832**	0.247	0.140	0.031	0.281*	0.607**
Aroma	0.325**	◆	0.489**	0.178	0.169	0.371**	0.259*	0.424**	0.271*	0.388**
Colour	0.709**	0.478**	◆	0.287*	0.566**	0.421**	0.301*	0.331**	0.465**	0.716**
Texture	0.318**	0.304**	0.328**	◆	0.160	0.594**	0.387**	0.539**	0.760**	0.642**
Friability	0.818**	0.294**	0.597**	0.336**	◆	0.181	0.143	0.054	0.178	0.522**
Starch taste	0.266**	0.327**	0.346**	0.573**	0.242**	◆	0.419**	0.436**	0.611**	0.561**
Sourness	0.259**	0.295**	0.379**	0.429**	0.183*	0.291**	◆	0.648**	0.566**	0.428**
Sweetness	0.189*	0.315**	0.254**	0.524**	0.231**	0.327**	0.590**	◆	0.686**	0.556**
Overall taste	0.382**	0.386**	0.467**	0.695**	0.300**	0.529**	0.598**	0.591**	◆	0.779**
Total sensory evaluation	0.664**	0.490**	0.672**	0.660**	0.602**	0.513**	0.504**	0.538**	0.818**	◆
For the whole period (n = 180)										

Conclusion

A linear regression between sensory traits of boiled potatoes and the total sensory evaluation was found by calculation of correlation coefficients. Appearance, colour, texture and overall taste are the most important for human perception concerning this potato product. Their assessment during the breeding process has to be taken into account in order to create high quality potato cultivars.

“Genotype x environment” interaction toward sensory properties of boiled potatoes was established. The lack of significant correlations between identical sensory traits of potatoes grown under field and mountain conditions is a proof for impossibility to predict sensory profile by results from only one altitude.

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