06-05: Effect of volatile organic compounds and taste-related primary metabolites on sensory perception of tomato cultivars in an organic low-input system

Cut Erika[1], Marcel Naumann[1], Bernd Horneburg[2], Inga Smit[1], Detlef Ulrich[3], Elke Pawelzik[1]

[1]*Division Quality of Plant Products, Department of Crop Science, University of Goettingen, Carl-Sprengel-Weg 1, 37075 Goettingen, Germany*
[2]*Division of Plant Breeding, Department of Crop Sciences, University of Goettingen, Von Siebold-Str. 8, 37075 Goettingen, Germany*
[3]*Institute for Ecological Chemistry, Federal Research Centre for Cultivated Plants, Julius Kühn-Institute (JKI), Erwin-Baur-Str. 27, 06484 Quedlinburg, Germany*
E-mail: cut.erika@agr.uni-goettingen.de

Aroma of fruit is a key indicator to depict the quality of fruit flavor and is likely to play an important role in determining the perception and acceptability of products by consumers [1,2]. Flavor has obviously been targeted as a secondary breeding goal in recent decades [3]. Studies reveal that tomatoes grown under organic conditions positively increase the consumer preference [4]. Therefore, it is necessary for plant breeders who are developing cultivars for organic production to select also for better flavor characteristics. Sixty indeterminate cultivars which differ mainly in terms of fruit weight, year of cultivar release and fruit color were grown in an outdoor organic low-input system in a temperate climate. The diversity of volatile organic compounds (VOCs), taste-related primary metabolites, and sensory properties of ripe tomatoes consisting of 27 cocktail and 33 salad tomato cultivars released between 1880 and 2015 from conventional, organic or unknown breeding programs, were investigated at two different harvest dates in 2015. The volatile compounds of tomato fruits were semi-quantified by GC-FID and tentatively identified by GC-MS. Isolation of volatiles were performed through automated headspace solid-phase microextraction (HS-SPME). A non-targeted data analysis (pattern recognition) was used. The evaluation of the cultivars from the two harvest dates exhibited a wide range of variation for all studied traits, with the exception of a few VOCs. Cultivar × harvest date interaction had no significant effect on TA (titratable acidity), TSS (total soluble solid), or overall acceptability but influenced most of the studied VOCs. Further examination was focused on total of 25 VOCs: 7 aldehydes, 5 ketones, 7 alcohols, 4 aliphatic acids, 1 ester and 1 sulfur-containing compound. The main compounds with the highest value in relative concentration in the headspace of tomato fruits include hexanal, 6-me-5-heptene-2-one, (*E*)-2-hexenal, octanal, 1-hexanol, etc., of which aldehydes are the most abundant volatile group. Variation in all studied traits like fruit type, harvest time, or fruit color was observed, and the discriminative variables characterizing the fruit types were revealed. Principal component analysis differentiated cocktail and salad types with a higher contribution of taste related-primary metabolites (TSS and TA), sensory attributes (sweetness, tomato typical-aroma, and sourness) and phenyl ethyl alcohol, the latter is a discriminative key compound to distinguish cocktail from the salad type. The observed correlations among the metabolites give cues for their biosynthesis pathway. The presence of VOCs such as (*Z*)-3-hexen-1-ol, phenyl ethyl alcohol, and benzyl alcohol had effect on the perception of 'sweetness' and 'tomato typical-aroma'. Therefore, the present findings should provide a preliminary knowledge for cultivar selection in breeding programs that perform better in flavor and are suitable for organic low-input production systems.

References

[1] YILMAZ, E., 2001: The chemistry of fresh tomato flavor, Turk. J. Agric. For., **25**, 149–155.

[2] EL HADI, M., ZHANG, F. J., WU, F. F., ZHOU, C. H., and J. TAO, 2013: Advances in fruit aroma volatile research, Molecules, **18**, 8200–8229.

[3] OLBRICHT, K., GRAFE, C., WEISS, K., and D. ULRICH, 2007: Inheritance of aroma compounds in a model population of fragaria × ananassa Duch., Plant breeding, **127**, 87–93.

[4] JOHANSSON, L., HAGLUND, A., BERGLUND, L., LEA, P., and E. RISVIK, 1999: Preference for tomatoes, affected by sensory attributes and information about growth conditions, Food quality and preference, **10**, 289–298.