Electric properties utilization at quality of blueberry evaluation

Lenka Priatková, Zuzana Hlaváčová, Ákos Kertész

Department of Physics,
Faculty of Engineering,
Slovak University of
Agriculture, Nitra

Lenka.Priatkova@uniag.sk,
Zuzana.Hlavacova@uniag.sk

Abstract. Blueberries have become a product of interest in recent years due to their nutritional and health benefits. Electrical properties are important when processing foods involving electrical fields, electric current conduction, or heating through electromagnetic waves. These properties are also useful in the detection of processing conditions or quality of foods. Good correlations were obtained between dielectric properties measurements and human sensory analysis at the temperature 15 °C for the capacity range 640.98 nF to 1048.78 nF. The correlations, between human sensory and dielectric properties evaluation, show that in this range of capacity will be accepted as in the best quality by consumers.

Keywords:
blueberries, capacity, sensory analysis, quality,

INTRODUCTION

Interest in electrical properties of agricultural products for useful purposes dates back more than 80 years (Bauchot et al. 2000, Harker et al. 1994, Varlan et al. 1996). There are two main electrical properties in food engineering: electrical conductivity and electrical permittivity. These properties are also useful in the detection of processing conditions or quality of foods (Nelson, 1994). Other electric properties are: electric conductance, electric resistivity, impedance, admittance, relative permittivity, complex permittivity with the components – real part that is equal to permittivity and imaginary part characterizing dielectric losses in material, further we can mention dielectric loss angle, loss tangent, Maxwell relaxation constant (Hlaváčová, 2011).

Dielectric properties are primarily determined by their chemical composition (presence of mobile ions and permanent dipole moments associated with water and other molecules) and too much lesser extent, by their physical structure.

Nelson et al. (1994) measured the permittivity of twenty three kinds of fresh fruits and vegetables at 23 °C. A few samples of fresh fruits and vegetables were selected to study the variation of permittivity with temperature and frequency in the range from 10 MHz to 1.8 GHz. They included apple, orange, grape, banana, potato, cucumber, carrot, cantaloupe, and avocado, Dielectric properties of a commercial apple juice product were also measured over the 200 MHz to 20 GHz frequency range (Nelson, Bartley, 2002).

MATERIALS AND METHODS

Electrical properties

The measurements were done with 15 cultivars of *Vaccinium corymbosum* L. The samples were from Research Institute of Grassed Growth and the Mountain Agriculture in Krivá on Orava. Electrical capacity was measured by LCR Good Will

821 at frequency from 50 Hz to 200 kHz, which is connected to personal computer. The parallel plate capacitor which was used during the measurement is created by two parallel electrodes. The each sample (blueberries with the same dimensions) was pouring into the parallel plate capacitor and connected by electrodes on LCR meter. Samples with different temperatures were measured at the frequency (0.05 kHz, 0.1 kHz, 0.2 kHz, 0.5 kHz, 1 kHz, 3 kHz, 10 kHz, 50 kHz, 100 kHz, 200 kHz).

Sensory analyses

Each panellist (5) 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.

RESULTS AND DISCUSSION

New data were obtained on the dielectric properties of the blueberries in the frequency between 0.05 kHz and 200 kHz with using LCR meter. Correlations were studied between the dielectric properties and human sensory analysis as a quality factor of interest of blueberries.

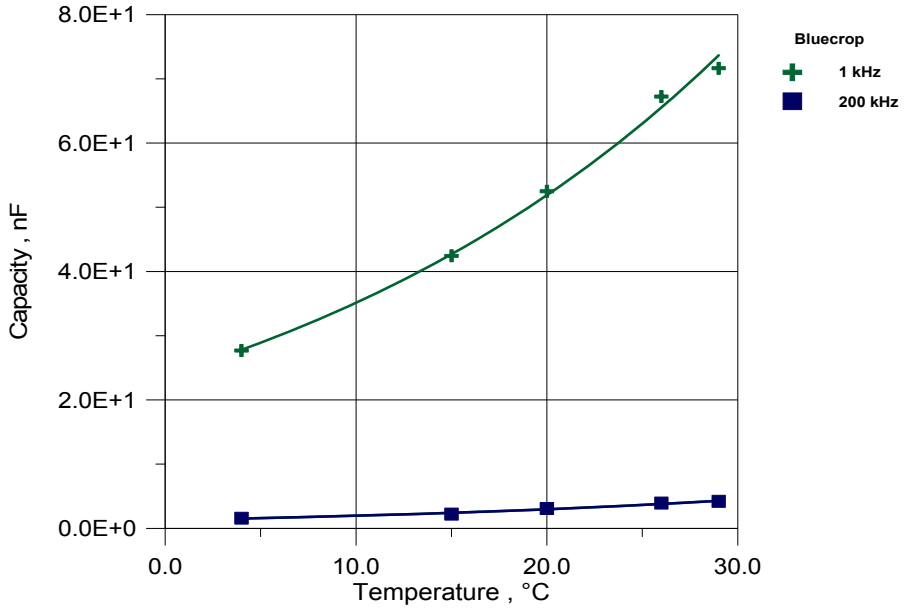

Figure 1
Shows temperature and frequency dependencies of capacity for cultivar Bluecrop at two frequencies

The temperature dependence of capacity, are shown at two frequencies, over the temperature range from 4 °C to 29 °C for cultivars Bluecrop (Fig. 1). The value of capacity had the increasing dependence with increasing temperature and decreasing dependence with increasing frequency. The highest values of capacity were obtained at the highest temperature

(29 °C), and the lowest values of capacity are at the lowest temperature (4 °C).

The follow Fig. 2 shows the frequency and temperature dependencies of capacity for cultivar Nelson. As we already mentioned, we can see that the capacity is increasing with increasing temperature and decreasing with decreasing frequency.

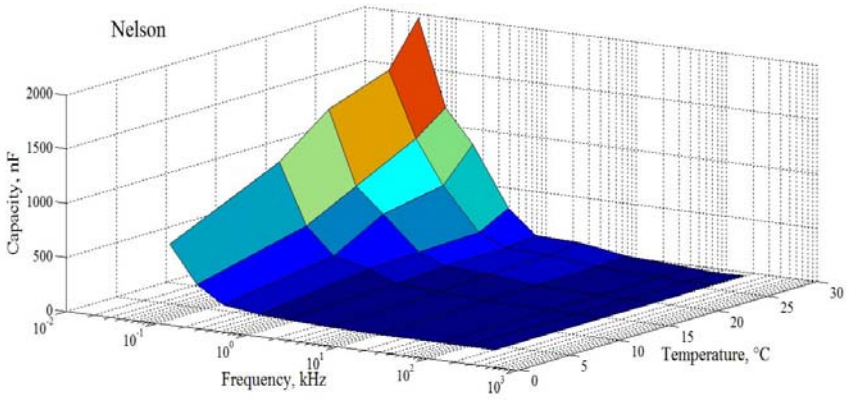

Figure 2
Frequency and temperature dependencies of capacity for cultivar Nelson

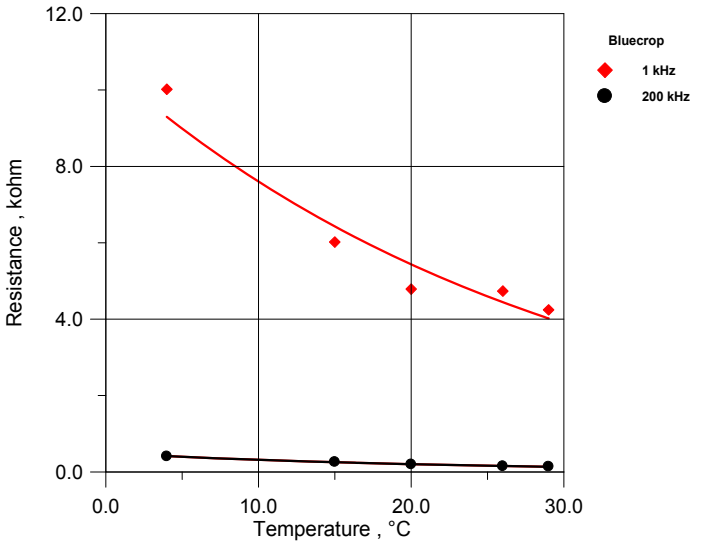

Figure 3
Temperature and frequency dependencies of resistance for cultivar Bluecrop at two frequencies

Resistance seems to decrease exponentialy with increasing temperature. Resistance values had decreasing tendency with increasing frequency. Resisatnce at 1 kHz is decreasing more rapidly like at frequency 200 kHz (Fig. 3).

In Fig. 4 we can see the differences between temperatures, frequency dependencies for cultivar Bluecrop at 1 kHz and 200 kHz for both years (2009, 2010). In comparison of both years we can see the similar capacity increase with increasing temperature and decrease with decreasing frequency. As we can see the differences are not very big. At frequency 200 kHz we can see that in 2009 the capacity values were a bit lower that in 2010. At 1 kHz it was quite similar. For capacity there are not visible differences.

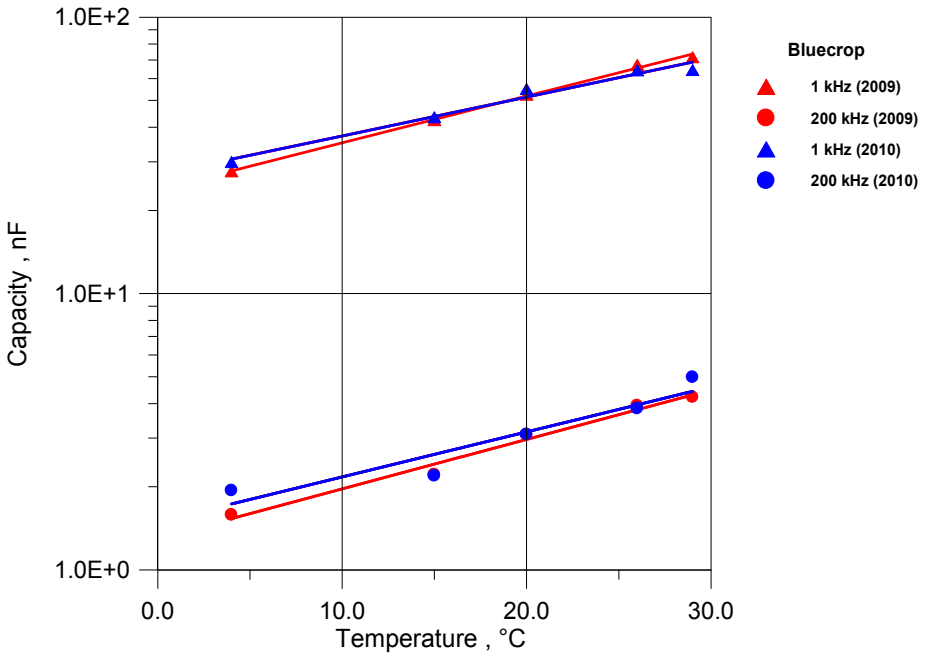

Figure 4
Temperature and frequency dependence of capacity for both years (2009, 2010)

The maximum score was 45 point for each evaluated descriptor and maximum score for all evaluated cultivar was 360 points. The panellists evaluated descriptor of appearances acceptability of blueberries cultivars using 9-point hedonic scale in follow order Tab. The best score (40) for descriptor of appearances acceptability had cultivar Duke. The descriptor of skin colour the highest score had cultivar Sierra (44). The descriptor skin toughness was evaluated with high score for 3 cultivars Pemberton, Polaris and Sierra, which had the same score 34. Cultivar Sunrise had the highest score for evaluated descriptor

flavour (36). For taste were scored high (27) cultivars Bluecrop and Nelson.

Table 1. Sensory panel scores of visual quality, textural quality and eating quality characteristics for blueberry fruit from 15 cultivars

Cultivar	Acceptability of appearance	Colour of skin	Skin toughness	Flavour	Taste	Fruit size	Size uniformity of berries	Texture quality during eating
Berkeley	**37**	**42**	**32**	**30**	**23**	**34**	**35**	**35**
Bluecrop	**40**	**42**	**32**	**33**	**27**	**38**	**36**	**39**
Bluejay	**35**	**40**	**28**	**25**	**20**	**36**	**34**	**34**
Blueray	**38**	**43**	**30**	**30**	**24**	**38**	**39**	**36**
Duke	**41**	**42**	**33**	**30**	**25**	**38**	**38**	**31**
Goldtraube 23	**32**	**41**	**32**	**27**	**21**	**29**	**33**	**31**
Chippewa	**35**	**32**	**31**	**25**	**22**	**37**	**36**	**36**
Nelson	**39**	**43**	**33**	**33**	**27**	**39**	**41**	**39**
Patriot	**36**	**42**	**33**	**30**	**22**	**40**	**37**	**34**
Pemberton	**39**	**43**	**34**	**31**	**24**	**37**	**39**	**35**
Polaris	**39**	**41**	**34**	**33**	**20**	**38**	**34**	**31**
Puru	**32**	**40**	**31**	**25**	**22**	**28**	**33**	**30**
Sierra	**35**	**44**	**34**	**30**	**25**	**39**	**40**	**32**
Spartan	**37**	**42**	**33**	**30**	**23**	**34**	**35**	**35**
Sunrise	**39**	**41**	**32**	**36**	**23**	**37**	**38**	**35**

CONCLUSION

We found out decreasing tendency of capacity in whole measured frequency range for each from 15 monitored cultivars of blueberries. We can notice that differences between the dependencies are occurred till frequency of 3 kHz (Fig.1). At the higher frequencies are the differences very small. The values of capacity are decreasing more rapidly at 4 °C. The values of the capacity lowest than ones for cultivar Puru are in this order (0.05 kHz, 200kHz): Goldtraube 23, Bluejay, Spartan, Polaris, Patriot, Duke, Blueray, Sierra, Sunrise, Bluecrop, Pemberton, Nelson, Chippewa, Berkeley at each temperatures. The decreasing order of resistance is from cultivar Berkeley to cultivar Puru, through this order: Chippewa, Nelson, Pemberton, Bluecrop, Sunrise, Sierra, Blueray, Duke, Patriot, Polaris, Spartan, Bluejay and Goldtraube 23 at each temperature.

Capacity is the good value for indication the correlation between human sensory analysis and physical properties. For all evaluated 15 blueberries cultivars, sensory scores for intensity and acceptability of visual quality characteristics (acceptability of appearance, colour of skin, fruit size, size and fruit uniformity) were acceptable (scores of 20 – 30) good (scores of 30 – 40) to excellent (scores > 40) (Tab. 1.) The intensity and acceptability of visual quality charac-

teristics were generally in the score of 30 – 40 in 2009, but with relatively low scores for some exceptions like cultivars Godltraube 23 and Puru for more of descriptors. Except the acceptability of appearance and colour of skin, in which more of cultivars were in the scores > 40, these descriptors showed the excellent quality.

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Conference report about ICFP 2012

With help of the International Society of Food Physicists (ISFP) the Department of Physics and Control (Faculty of Food Science, Corvinus University of Budapest)) organized the 10th International Conference on Food Physics, June 4-5, 2012, Budapest. The conference was organized in 4 oral sessions, plus one poster session and laboratory visits.

The participants and conference lecturers represented not only different hungarian universities in Budapest, Gödöllő, Debrecen, Mosonmagyaróvár and Szeged, but came from Bulgaria and Slovakia, as well.

Let us mention some interesting topics of lectures and posters:

heat mass transfer in food products

influence of fat content on the thermal properties

sensory evaluation and electronic tongue measurement

food physics – a helping hand for nutrition science

rheological properties of hydrogels

physical characteristics of whisky

amilograph properties of wheat flours

photoacoustic spectroscopy for quantification of cocoa content

The participants got the book of abstracts and some papers will be published in the 2013 issue of Journal of Food Physics, as well. A special thank to the local organizing committee members, to J. Felföldi, L. Baranyai and V. Zsom-Muha for their work, giving forum for discussions of currant ideas of food physics.

Eszter Vozary Andras S. Szabo