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Editorial Office: Budapesti Corvinus Egyetem
Élelmiszertudományi Kar
Corvinus University of Budapest
Faculty of Food Science
1118 Budapest, Somlói street 14-16.
Hungary
Phone: (36)1-482-6013, 482-6205
E-mail: andras.szabo@uni-corvinus.hu
peter.laszlo@uni-corvinus.hu

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Az alapítvány vagyonkezelő szerve a kuratórium, képviselője a kuratórium elnöke. Az alapítvány nyilt alapítvány, minden magyar és külföldi természetes és jogi személy jogosult az alapítványt pénzzel vagy egyéb módon támogatni, segíteni. A felajánlott pénz vagy egyéb hozzájárulás az alapítvány vagyonát gyarapítja. A kuratórium tagjai és elnöke díjazást nem kapnak.

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EDITORIAL

This is the XXIII Volume of the Journal of Food Physics, and as You know the first issue was published in 1988, 22 years ago. So we are over 2 decades of existence, as well. Many thanks for your kind help, cooperation, support and understanding.
This issue gives the opportunity for the readers to get interesting and useful information about some special questions of food physics. The topics of the scientific articles cover the following fields:

- pharinographic characteristics of wheat dough
- thermophysical and rheological dependencies
- Hunter colour dependencies of blueberry
- cow casein quantitation in sheep milk by ELISA
- rheological parameters of fruit gums
- shape and contour determination in case of coffee bean
- sensory evaluation of Chio chips products

The first 5 papers were reported as lectures at the 9th ISFP Nitra Conference, 2010. As You probably know or remember the first conference we organized in Budapest, Hungary, 1994, followed by the second one in Bucharest, Romania, 1996. The place of the third meeting was Poland, Lublin, 1998, and in 2000 we met in Turkey, Istanbul. Later we decided to organize the conference in Brno, Czech Republic, 2002, and 2 years later, in 2004 we came back again to Hungary, but the place was Pecs. The 2006 meeting we had in Serbia, in a beautiful small town, Senta, and the next one in Plovdiv, Bulgaria, 2008. The place of he last conference was Nitra, Slovakia, 2010. So we will be really happy to have the possibility to continue the organisation of the ISFP conferences.
Anyway, You can find also some other information (list of scientific papers and lectures of the editor-in-chief between 1993 and 2002, Food Physics public utility foundation) and invitation to the next Biophysics Conference in 2011.

Thanks for the material support of the Szegedi Paprika Spice and Canned Food Producing Co. Read and enjoy this issue! And please - if You can - support the Food Physics Public Utility Foundation! We need help and donations for existence.

Andras S. SZABO — Editor-in-chief

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Address of Szegedi Paprika CCo.'s central premises:
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Tr. A. Hlinku 2
949 76 Nitra
Slovakia

PHARINOGRAPHIC CHARACTERISTICS OF WHEAT DOUGH WITH NATURAL ADDITIVES

T. BOJŇANSKÁ, M. TOKÁR, R. GAŽAR
Slovak University of Agriculture in Nitra,
Faculty of Biotechnology and Food Science
Trieda A. Hlinku 2, 949 76 Nitra, Slovak Republic
E-mail: Tatiana.Bojnanska@uniag.sk

INTRODUCTION

Bread is one of the most important foods consumed all over the world. Measuring the rheologic properties of dough intended for bread production is relatively complicated, connected with exploitation of specific equipment. Rheology studies relations between tension which the material is exposed to, final dimension of material deformation and time. It is very important to understand the rheologic behaviour of bread dough as well as mechanical properties of the dough and control finished products (Příhoda et al., 2003, Mirsaeedghazi et al., 2008).
The main aim of rheologic measurement is to obtain quantitative description of mechanical properties of material, gain information related to molecular structure and composition of material as well as to characterise and simulate efficiency of material during the production and the quality check (Dobraszczyk, Morgenstern, 2003). Rheology is now well established as the science of the deformation and flow of matter. All materials have rheologic properties. These properties are described by rheometers. Many rheometers are used for the measurement of the dough rheologic properties such as penetrometer, consistometer, amylograph, farinograph, mixograph, extensigraph and alveograph (Mirsaeedghazi et al., 2008). The influence of additives of non bakery crops on the dough rheology is related mainly to their different (in comparison to wheat) saccharide and protein complex. The effect of hydrocolloids on rheologic properties of wheat dough and final quality of bread have been observed with some interesting findings, which showed that hydrocolloids might become suitable additives as quality enhancers in bread production. Generally, with addition of natural additives the rheological properties have worsen (Izydorczyk et al., 2001, Sindhuja et al., 2005, Dongovski et al., 2005, Jacob - Leelavathi 2006, and other.)
The paper gives the results of rheological evaluation of dough intended for bread production prepared with the addition of selected non bakery raw materials of high nutritive value.

MATERIALS AND METHODS

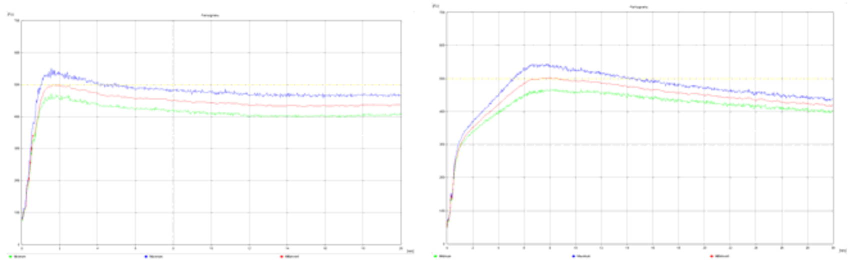
In the experiment we used white wheat bread flour blended with 10 - 50 % of finely grained and homogenised buckwheat flour. Produced blends were evaluated on Farinograph-E, Brabender OhG, Duisburg, Germany (ICC-Standard 115/1, 1992, AACC Method 54-21, 1995). All analyses were performed with the constant farinographic water absorption 58.1 % based on water absorption of wheat flour without additives. Sigma blades of farinograph worked with 3 different speeds: standard - 63 revs. min^{-1}, low - 45 revs.min^{-1} and high - 120 revs.min^{-1}. Following properties have been evaluated: changes of dough consistency (in FU – Farinographic unit) at constant water absorption of 58.1 %, development time (in min), stability (in min) and degree of softening (in FU). Tests were repeated three times and the results presented are means of the three realized measurements.

RESULTS AND DISCUSSION

Gluten removal from the recipes in bread production leads to significant technological problems. Gluten proteins play a key role in guaranteeing the bakery quality of wheat and influence water absorption, cohesion, viscosity, extensibility, elasticity, resistance to deformation, tolerance to kneading, ability to gas retention and dough strengthening properties (Lazaridou et al., 2007, Wieser, 2007). Also non bakery crops content elements (mainly of saccharide complex), which can either positively or negatively influence the rheological properties of dough prepared with addition of these crops.

The influence of non bakery crops added to composite flours on properties evaluated by farinograph was significant. With increasing portion of buckwheat dough consistency decreased statistically significantly (in comparison to wheat flour). In that case the addition of water 58.1 % was redundant; dough became weaker and the resistance against the farinograph blades was lower (Figure 1).

These changes were caused by decreasing of the absorption capacity of composite blend so in the hydrocolloids presented in buckwheat hydrating processes were slower, have lower hydrating ability. With other additives (oat, lentils, chickpea) the dough consistency increased. The change of consistency was reflecting indirectly in the changes of farinographic water absorption, which shows the flour ability to absorb a certain amount of water within its structure while reaching consistency of 500 FU. Decrease of farinographic water absorption is from the economic point of view undesirable since it increases the amount of flour needed to produce bread of the same weight.



wheat flour wheat flour with 50 % buckwheat

Figure 1

Farinograph wheat flour and farinograph wheat flour with 50 % buckwheat

In order to optimize dough properties related to different rotation speed of farinograph blades, the experiment was provided with three different speeds. The lower amount of energy put in the wheat flour dough system manifested itself at lower revs (45 revs per minute) by decreasing of dough consistency. The energy needed to trigger physico-chemical reactions produced by lower revs was not able to incorporate itself efficiently to the dough structure, which caused lower consistency and viscoelastic dough properties. Lower kneading speed slowed the hydration, swelling and process of chemical reactions among proteins, starch, polysaccharides of non starch type and other flour elements but aided the occurrence of chemical bond by weaker power of intermolecular bonds. This was manifested by prolongation of dough development time in all evaluated doughs. Higher rotation speed of doughs with additives decreased significantly dough development time which is important considering kneading as a high energy-consuming process. On the other hand dough stability was prolonged at lower revs. It means that lower revs can be recommended as suitable to obtain stable dough with additives of non bakery crops. Key factor affecting the rheological properties of doughs with additives is the correct time of kneading. Non adequate time can negatively influence stability; can cause higher degree of dough softening and dough stickiness. The degree of dough softening significantly increased with higher speed of kneading what is from the technological point of view undesirable considering the need of further manipulation with dough during forming and fermentation of products (Dodok, Szemes, 1998).

CONCLUSIONS

Based on the results obtained by observing the rheological properties of tested doughs can be stated that use of natural additives worsened the physical properties of doughs what prediction worsening of the technological quality of final products. Some parameters have been compensated by adjusting the regime of kneading, in particular by lowering the speed of kneading.

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CHOSEN THERMOPHYSICAL AND RHEOLOGIC DEPENDENCIES OF ACIDOPHILUS MILK

M. Božiková – P. Hlaváč

Department of Physics, Faculty of Engineering, SUA in Nitra,
Tr. A. Hlinku 2, 949 76 Nitra, Slovakia
Monika.Bozikova@uniag.sk, Peter.Hlavac.MF@uniag.sk

INTRODUCTION

Basic principle of Hot Wire method is that heat flux is generated for an appropriate time interval through a long thin uniform wire buried in the measured sample and the temperature response is measured by the change in resistance of the wire or by the temperature sensor. The response is analysed in accordance with a model characterised by the particular formula found by solution of the partial differential equations using boundary and initial conditions corresponding to the experimental set up (NPL, 2007). Mathematical model requires ideal, infinitely long thermal source (hot wire) surrounded with infinitely homogenous and isotropic medium with constant starting temperature T_0. If in time $t = 0$ there starts radial heat flow q in measured material, so temperature $T(r,t)$ will have during time t increasing progress in distance r measured from hot wire. This time-temperature function can be described by equation (1)

$$T(r,t) = T_0 - \frac{q}{4\pi\lambda} Ei(-u) \tag{1}$$

Ei is exponential integral with function argument $u = \frac{r^2}{4at}$, where a is thermal diffusivity.

One of the most important rheologic parameters is dynamic viscosity, which is defined as the resistance of a fluid to flow. The unit of dynamic viscosity in SI units is Pas. Viscosity changes with temperature. The difference in the effect of temperature on viscosity of fluids and gases is related to the difference in their molecular structure. Viscosity of most of the liquids decreases with increasing temperature. Theories have been proposed regarding the effect of temperature on viscosity of liquids. According to Eyering theory molecules of liquids continuously move into the vacancies (Bird et al., 1960). This process permits flow but requires energy. Activation energy is more readily audible at higher temperatures and the fluid flows easily. The temperature effect on viscosity can be described by an Arrhenius type equation

$$\eta = \eta_0 \, e^{-\frac{E_A}{RT}} \qquad (2)$$

where η_0 is reference value of dynamic viscosity, E_A is activation energy, R is gas constant and T is absolute temperature (Figura and Teixeira, 2007).
As temperature increases, cohesive forces between the molecules decrease and flow became freer. As a result viscosities of liquids decrease as temperature increases. In liquids, the intermolecular (cohesive) forces play an important role. (Sahin and Sumnu, 2006).
Measurement of dynamic viscosity was performed by digital rotational viscometer Anton Paar DV–3P. Principle of measuring by this viscosimeter is based on dependency of sample resistance against the probe rotation. Temperature dependencies of dynamic viscosity can be described by decreasing exponential functions

$$\eta = A\,e^{-B\left(\frac{t}{t_o}\right)} \qquad (3)$$

where t is temperature, t_o is 1 °C, A, B are constants dependent on kind of material, and on ways of processing and storing .

MATERIALS AND METHODS

Acidophilus milk is milk which has been fermented with Lactobacillus acidophilus bacteria, creating a very distinctive tangy flavour and slightly thickened texture. The process used to make acidophilus milk starts with inoculation of sterile milk with the bacteria, and then allowing the milk to sit at a warm or neutral temperature so that the bacteria can thrive. The bacteria thrive in the mildly acidic environment of milk, consuming some of the lactose in the milk in the process. Like other fermented foods, acidophilus milk should be handled with care, as it has active bacteria which can continue reproducing in the milk, changing the flavour and texture.
Measured samples of acidophilus milk were stored in special boxes in the temperature 5 °C and the air moisture content was 92 %. And measurements of thermophysical and rheologic parameters were performed after basic temperature stabilization. Samples were stored for 24 hours before the measurement and the relations of thermophysical and rheologic parameters to the temperature for acidophilus milk were measured during the temperature stabilization to approximately laboratory temperature. Method of measurement was selected according to structural characteristics of the sample which have suspenzoid structure. For thermophysical measurement of suspenzoid materials is convenient Hot Wire (HW) method and for rheologic measurement is convenient method of rotational viscometer described earlier.

RESULTS AND DISCUSSION

Graphic relations of thermal conductivity and diffusivity presented on Figure 1-2 were obtained as averages from twenty measurements for every point in graphical characteristics. Results from rheologic parameters measurements are shown on Figure 3 and coefficients of regression equation (3) and coefficients of determination are in Table 1.

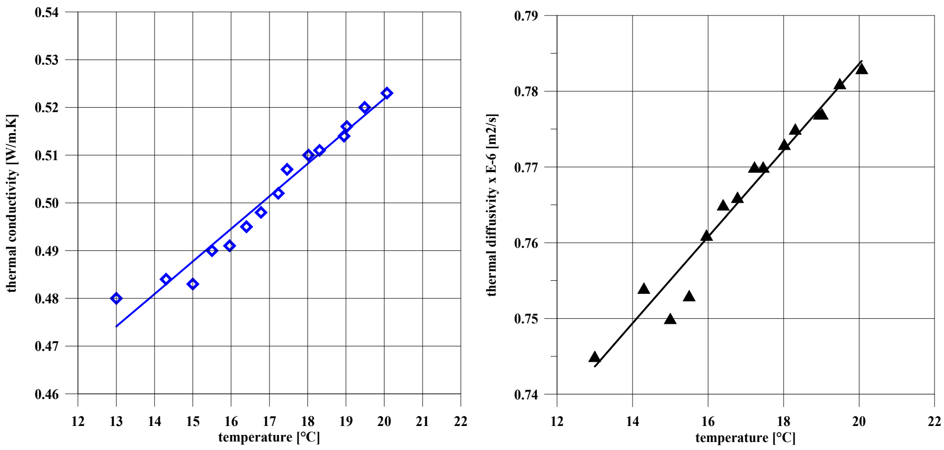

Figure 1-2

Relation of thermal conductivity and diffusivity to temperature in temperature range (13 – 20) °C for sample Acidko

$$\lambda = 0{,}00682162t + 0{,}385418, \; a = 0{,}003570485t + 0{,}669498 \quad (4)$$

Table 1: Coefficients A, B of regression equation (3) and coefficients of determination

Measurement	Exponential function (3)		
	Coefficients		
	A	**B**	**R^2**
First	686.263	0.034 015 3	0.949 287
Second	572.061	0.032 938 2	0.984 487
Third	416.074	0.022 282 0	0.988 512

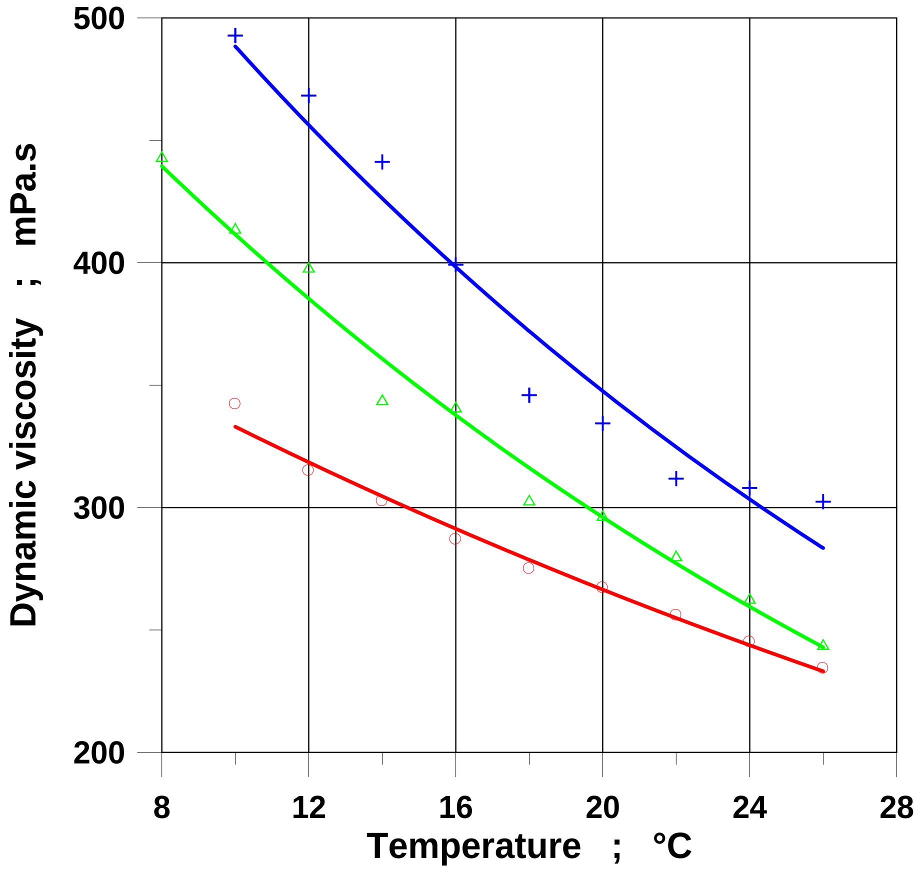

Fig. 3 Dependencies of Acidko dynamic viscosity on temperature in different time of storage: First measurement – at the beginning of storage **(+)**, Second measurement – after five days of storage **(Δ)**, Third measurement – after one week of storage **(o)**

CONCLUSION

Progress of temperature dependency of Acidko dynamic viscosity has decreasing shape which is in accordance with Arrhenius equation (2) and values are lower after storage that can be caused by structural changes in the sample during the storage. Thermophysical parameters of Acidko have increasing progress (4). From presented results is clear that thermophysical and rheologic parameters can determine status of food materials and it can be included between significant characteristics of materials.

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HUNTER COLOUR DETERMINATION OF BLUEBERRY CULTIVARS

L. Priatková, Z. Hlaváčová, Á. Kertész

Department of Physics, Faculty of Engineering,
Slovak University of Agriculture in Nitra
Tr.A.Hlinku 2, 949 76, Slovakia
Lenka.Priatkova@uniag.sk, Zuzana.Hlavacova@uniag.sk

ABSTRACT

Colour has been shown of primary importance in the judgment of food, ultimately influencing the acceptance or rejection of food. Colour is one of the important quality attributes on food. The measurements were done with 10 cultivars of blueberries. The colour was measured by determining Hunter L^* (lightness), a^* (redness/greenness) and b^* (yellowness/blueness) values of blueberries cultivars. Treatment differences were tested using Duncan's Multiple Range test, $\alpha = 0.05$.

INTRODUCTION

Blueberries have become increasingly popular because of their health-promoting (nutraceutical) properties. Blueberry fruits contain an array of phenolics, including anthocyanins, quercetin, kaempferol, myricetin, chlorogenic acid and procyanidins, that contribute to antioxidant capacity (Kalt et al., 1999; Prior et al., 2001.).

Colour has been shown of primary importance in the judgment of food, ultimately influencing the acceptance or rejection of food. Colour is one of the important quality attributes on food. Although it does not necessarily reflect nutritional, flavour or functional values it determines the acceptability of a product by consumers.

A Lab colour space is a colour-opponent space with dimension L for lightness and a^* and b^* for the chromaticity coordinates. The coordinates of the Hunter Lab colour space are L^*, a^* and b^* (1948). However, Lab is now more often used as an informal abbreviation for the CIE L^*, a^*, b^* colour space, also called CIELab (1976).

MATERIALS AND METHODS

The measurements were done with 10 cultivars of blueberries (*Vaccinium corymbosum* L.). The samples were from Research Institute of Grassed Growth

and the Mountain Agriculture in Krivá on Orava. Samples were stored in the fridge in laboratory at the temperature 8 C. The colour was measured by determining Hunter L^*, a^* and b^* values of blueberries cultivars. Lightness axis (L^*) – 0 is black, 100 is white. Red – green axis (a^*) – positive values are red and negative ones are green, 0 is neutral. Yellow – blues (b^*) – positive values are yellow; negative ones are blue, 0 is neutral. For measuring a Spectrophotometer Minolta CM - 2500d reflectance colorimeter was used and all measurements were done at 20°C. Treatment differences were tested using Duncan´s Multiple Range test, $\alpha = 0.05$.
Objective numerical values which express the colour of product show the formula:

$$E^*ab = \sqrt{\left[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2\right]} \qquad (1)$$

RESULTS AND DISCUSSION

Lightness (L^*), red/ greenness (a^*), and yellow/ blueness (b^*) values of the blueberries are shown in Table 1. 'Sierra' and 'Bluejay' had the lowest L^* values of SCI and also of SCE (i.e., were darker) than the other cultivars. Cultivar´s, colour values of Lightness (L^*), did change significantly differenced only for cultivars: Patriot and Polaris. The lightness dependent on exposure to sun rays of growing (Chen, 1996). 'Blueray' had the most blue chroma (i.e., most negative b^*) and 'Polaris' the least (Table 1).

Table 1: Colour determination of blueberry cultivars. (b) - were not significantly different and (a) were significantly differenced.

Blueberries cultivars		**SCI**			**SCE**	
	L*	***a****	***b****	***L****	***a****	***b****
Goldtraube23	28.90[b]	1.60[a]	-3.01[a]	26.77[b]	1.60[a]	-2.90[a]
Sierra	26.11[b]	5.02[b]	-2.55[a]	26.11[b]	5.02[b]	-1.78[a]
Spartan	30.85[b]	2.73[a]	-1.82[a]	28.59[b]	2.73[a]	-2.01[a]
Blueray	29.64[b]	4.08[b]	-0.96[b]	26.89[b]	4.00[b]	-0.90[b]
Nelson	28.98[b]	3.40[b]	-0.99[b]	26.10[b]	3.40[b]	-0.96[b]
Bluejay	28.38[b]	2.33[a]	-2.34[a]	21.27[b]	3.18[a]	-2.81[a]
Patriot	31.56[a]	3.51[b]	-1.86[a]	28.96[a]	4.01[b]	-1.91[a]
Duke	26.78[b]	2.05[a]	-1.90[a]	21.49[b]	2.68[a]	-1.72[a]
Polaris	32.46[a]	3.45[b]	-3.41[a]	29.99[a]	3.90[b]	-3.61[a]
Chippewa	27.30[b]	3.58[b]	-1.62[a]	25.77[b]	3.87[b]	-1.58[a]

The significant differences were cultivars: Goldtraube 23, Sierra, Bluejay, Patriot, Duke, Polaris and Chippewa. All cultivars had negative values of (*b**) it means that they have their typical purple colour. Variations in green (negative *a**) and red (positive *a**) chromas among cultivars was not as large as that for blue chroma. Only the cultivar 'Sierra' had higher values of red (positive *a**) chroma than other cultivars. For redness the lowest score had cultivar 'Goldtraube 23'. The cultivars Goldtraube 23, Spartan, Bluejay and Duke did change significantly differenced. However the chromaticity coordinated *a** is the most important factor of maturity appearance describing colour of the fruit. The intensity of red colour normally indicates full maturity and ripeness (Delwiche et al., 1994).

Table 2: Total colour determination of blueberry cultivars.

Blueberries cultivars	**SCI**	**SCE**
	E*ab	**E*ab**
Goldtraube23	29.10	26.97
Sierra	26.71	26.65
Spartan	31.02	28.79
Blueray	29.85	27.20
Nelson	29.20	26.34
Bluejay	28.57	21.69
Patriot	31.81	29.29
Duke	26.93	21.72
Polaris	32.82	30.92
Chippewa	27.58	25.72

The evaluation of objective numerical value (1), which expresses the colour of blueberries depicted that the higher value had cultivar 'Polaris' for both of Specular Component (Tab. 2). At the second place was cultivar 'Patriot' and on third place was cultivar 'Spartan'. The lowest values of total colour determination had cultivars 'Sierra' and 'Duke'.

CONCLUSIONS

Estimation of fruit quality based on the system describing colour should be useful for marketing and allowing checking consumer preferences and access maturity, quality of products after storage and at the self – life. The low values of parameter L^* (Tab.1), indicated darkness for cultivars: ‘Polaris’ and ‘Patriot’. The most negative values of parameter b^*, had the cultivar ‘Polaris’, showed darkness of the skin, which results in the purple colour, and similar values had also the other cultivars. The positive values of parameter a^*, showed the saturation of red for each other cultivars. The cultivars ‘Polaris’, ‘Patriot’ and ‘Spartan’ (Table 2), for both of Specular Component, had the higher value evaluated with the formula (1).

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RELIABILITY OF COW CASEIN QUANTITATION IN SHEEP MILK AND CHEESE BY ELISA METHOD

L. ZELEŇÁKOVÁ, R. ŽIDEK, M. ČANIGOVÁ

Slovak Agricultural University in Nitra,
Faculty of Biotechnology and Food Sciences,
Str. A. Hlinku 2, 949 01 Nitra, Slovakia
e-mail: lucia.zelenakova@azet.sk

ABSTRACT

In the present work we studied the use of ELISA method for the detection of the lab-prepared adulteration of sheep milk and cheese with cow milk. The analyses were focused on laboratory testing and evalutation of qualitative parameters commercially used ELISA tests (Casein ELISA set, SEDIUM R&D) based on detection of cow milk casein. Casein was determined in 16 samples of milk and 16 samples of cheese. Measurement of absorbance values were repeated twice under different combination of mixing (0; 0.5; 5; 50; 75 and 100 % of raw and heat treament cow milk in sheep milk). The results showed that this assay takes only about three hours and is suitable for detection of lots of sheep milk adulterated with 0.5 to 50 % cow milk (regression equations with R^2 determination coefficient: $R^2 = 0.965$). Our experiments shown that used ELISA test is not suitable to reliably detect the presence of cow milk casein in sheep cheese ($R^2 = 0.022$).

INTRODUCTION

The substitution of milk from one species by a milk of lower economic importance during the manufacture or manipulation of cheese is a fraudulent practice for consumers an is disloyal competition for other producers (Veloso et al., 2002). The identification of the species that originally produced the milk represents a considerable problem for food analysts (Bottero et al. 2002). ELISA is the most widely used form of immunoassay in milk analysis and has advantages of high sensitivity, low cost and fast application. It is easy to use, reliable, rapid and readily automated. Target antigens are caseins, lactoglobulins, immunoglobulins and other whey proteins (Hurley et al., 2004; Ruprichová et al., 2010). The largest share of pure proteins (on average 80 %) is attributed to proteins of casein fraction. Casein of cow milk represents a set of four phosphor-protein fractions designated as α_{S1}-, α_{S2}-, β- and κ-caseins (Madureira et al., 2007; Buňka et al., 2009). The caseins feature advantage in being more or less stable under high temperature conditions. Therefore they can be successfully used as the main antigens in the heat treatment (pasteurization, UHT) of milk and milk products. Their major disadvantage is weak immunogenicity and higher sensitivity to protheolytic degradation (García-Risco et al., 2002).

MATERIALS AND METHODS

Raw sheep milk and raw cow milk gained from primary production, respectively heat treatment cow milk was mixed in defined amounts (0; 0.5; 5; 50; 75 and 100 % of cow milk in sheep milk). Cow milk was pasteurized for 15 seconds at 72 °C and 3 seconds at 85 °C. Process of cheese production included: cheesing of milk itself, processing of cheese curd, turning of cheese curd surface, its cutting, harping and miwing and finally formation of cloddish cheese. During the period of 12 days the temperature and pH in individual clods had been observed. The supernatant liquids were stored in freezer until specific preparation for ELISA analysis. The determination of casein is based on its immunochemical reaction with a specific antibody. The intensity of colouration thus developed is proportional to the concentration of casein in calibrators and samples. The measurement of the absorbance was made photometrically at 450 nm (STAT FAX 321/plus microwell reader - Awareness Technology, Palm City, FL).

RESULTS AND DISCUSSION

The objective of analyses was to find out whether the used ELISA test can really detect the defined concentration of cow milk in sheep milk and sheep chesse samples. The detection and quantification of cow milk was based on the presence of the specific caseins.

In line with the test instructions there was performed laboratory analysis of 16 samples of sheep milk and 16 samples of sheep cheese. At the beginning were intentionally contaminated by different cow milk additions. In accordance with the producer´s declared quantitation range contained in the manual to ELISA kit, it is possible to correctly quantify the contamination between 0 – 45 ppm (mg/kg) of cow casein presence in the examined samples. The starting point for obtaining of relevant data was to create 2 calibration curves (for milk: $y = -3.1375x - 0.398$; $R^2 = 0.9485$; for cheese: $y = -2.9743x - 0,3976$; $R^2 = 0.9753$). Majority of the samples were successfully quantified but only thanks to their multiple dilution prior to the analysis itself (0,5; 5 % with 10^{-1} and 10^{-2}; 50 % with 10^{-3}; 75; 100 % with 10^{-4} and 10^{-5}). In some samples, for the purpose of higher quality determination, we propose to increase the dilution by one decimal order, because even in the dilution used by us, the addition of cow milk was not detected.

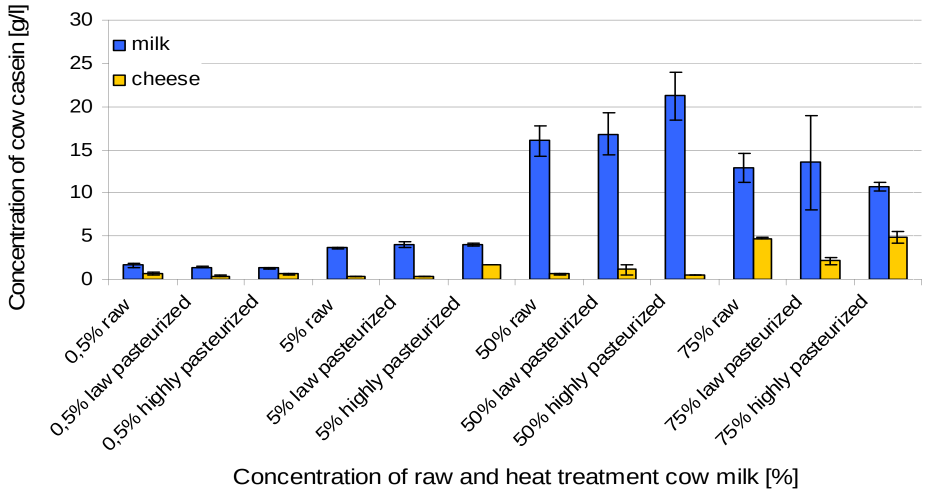

Figure 1.
Amount of detected cow casein in milk and cheese depending on mixing type of cow and sheep milk [g/l]

Results obtained with ELISA applied to the analyses of milk samples showed a correlation of < 0,001 between the detected amount of cow casein and cow milk admixture. The method proved to be specific, precise and accurate within the percentage range 0.5 – 50 %. Hereby it can be observed that on changes in contents of cow casein does not affect the heat treatment of milk within various falsified ratios. However, the test revealed to be more accurate for milk samples than for cheese samples. The presence of cow casein with the increasing proportion of either raw or pasteurized cow milk was not correlated (Figure 1).

As is shown in Figure 2, in sheep milk samples by interpolation of detected content of casein can be reliably determined corresponding content of the addition of cow milk (determination coefficient: $R^2 = 0.965$). In contrast, from samples of cheese the trend of detected amount of cow casein was not reflecting actual addition of cow milk ($R^2 = 0.022$).

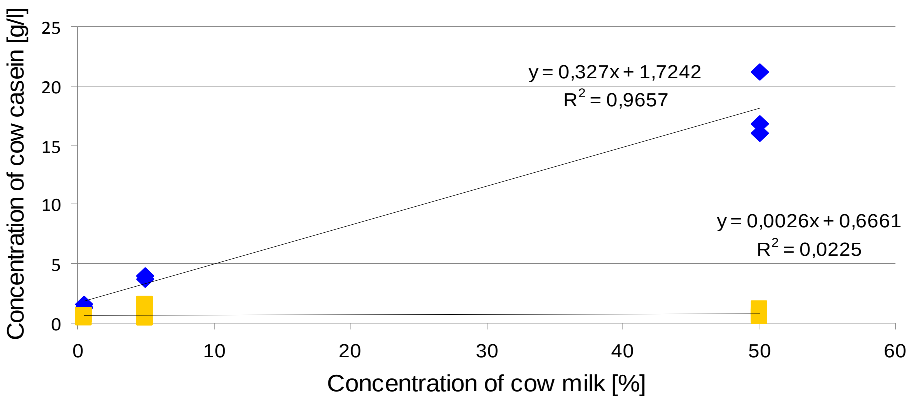

Figure 2
Trend of detected cow casein in milk and cheese [g/l]

CONCLUSION

Various mixtures of cow and sheep milk were analysed, leading to a reproducible calibration curve, which has been successfully employed in determining the percentage of cow milk fraudulently added to ewe milk in the production of ewe cheese. ELISA have been successfully applied to the detection of cow milk adulteration in sheep milk using a range of adulteration percentages (0.5 –50 %). Use of ELISA test is not adequate for routine surveillance of cheeses, especially for mixed cheeses, when the amount of milk from different species used for cheese making is unknown. Our experiments show that for better quality determination, especially of low concentrations, it is necessary to find an appropriate dilution for various concentrations of cow milk in the context with the way of its thermal treatment as well as further technological processing.

ACKNOWLEDGEMENT

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RHEOLOGICAL PARAMETERS OF FRUIT GUMS "HARIBO" GOLD BEARS

S.P. ZHELJAZKOV[2] E. VOZÁRY[1] G. ZSIVÁNOVITS[3]
G. EXNER[2] M.G. MARUDOVA-ZSIVÁNOVITS[2] Á. KRISÁN[1]
[1]Corvinus University of Budapest
Faculty of Food Sciences,
Str. Somlói 14-16, 1118 Budapest, Hungary
e-mail: eszter.vozary@uni-corvinus.hu
[2]Plovdiv University „P. Hilendarski"
Faculty of Physics
Str. Tzar Asen 24, 4000 Plovdiv, Bulgaria
e-mail: margo@uni-plovdiv.bg
[3] Canning Research Institute of Plovdiv

ABSTRACT

Mechanical hysteresis and force relaxation curves of "Haribo" gold bears consisting of glucose syrup, sucrose, gelatine, dextrose, citric acid, vegetable oils, fruit extracts, were measured with Stable Micro System TA-XT2 texture analyser. Loading-unloading curves were determined at room temperature with probe speed of 0.3, 0.5, 0.7, 0.9 and 1.1 mm/s, and in the temperature range from 5 °C up to 55 °C with 0.1 mm/s probe speed. The maximal deformation was 5 mm. The force-deformation curves had linear character up to about 1 mm deformation and at higher deformations the slope of the curves increased with the increasing of the deformation. The degree of elasticity defined as the ratio of unloading work to loading work decreased at temperatures lower than 20 °C and higher than 40 °C. The degree of elasticity decreased with the increasing of the probe speed. The measured force relaxation curves at constant 5 mm deformation were approached with a three elements generalized Maxwell-model. The relaxation time of all the three components decreased and the amplitude decreased for the two slower components and increased for the quickest component as the probe speed increased.

INTRODUCTION

It is easy to find connection of physical properties of gummy sweets with relative simple structure and the phase morphology of them (DeMars and Ziegler, 2001). Some suitable rheological parameters can represent the quality of such products (Ziegler and Rizvi, 1989). For example, the degree of fragmentation of food into particles is related to ratio of toughness (work needed to generate a unit of surface area during fracture) to the Young's modulus (E, normal stress/normal strain) (Lucas et al., 2004). Gelatine forming thermoreversible gel (Ledward, 1990) has melting point at about 35 °C (Johnston-Banks, 1990) and addition of sugar to gelatine increases the strength of its gels (Kasapis and Al-Marhoobi, 2003). During storage of high sugar content confectioneries the increase of temperature (above 40-45 °C) can cause structural collapse, welding and crystallization (caking) of the product.

The main goal of the present study is to find an appropriate rheological model describing the stress-strain curve and the relaxation curve of fruit gums "Haribo" gold bears of various temperature.

MATERIALS AND METHODS

"HARIBO" gold bears consisting of glucose syrup, sucrose, gelatine, dextrose, citric acid, vegetable oils, fruit extracts (www.haribo.com) were measured by hysteresis and relaxation methods in temperature series, with Stable Micro Systems TA-XT2 penetrometer. The deformation speed was varied between 0.1 mm/s and 1.1 mm/s with steps of 0.2 mm/s. The diameter of the measure cylinder was 2 mm. For the hysteresis method the deformation was maximized to 5 mm. The load-unload curves were determined in temperature range from 5 °C up to 55 °C. The bears were held in a laboratory oven "Venticell", or in a refrigerator. During the measurements the bears were in a thermally isolated box and their temperature was measured with a termistor. The force relaxation under 5 mm constant deformation was followed 300 s time duration at room temperature only. The Young's modulus was calculated as the slope of the linear part of the loading section in the hysteresis test. The hysteresis work was integrated from the area between the loading and unloading section. The degree of elasticity is defined as the ratio of unloading work to loading work. The measured relaxation curves were approached with three elements generalized Maxwell model

$$F(t) = F_o + F_1 e^{-\frac{t}{T_1}} + F_2 e^{-\frac{t}{T_2}} + F_3 e^{-\frac{t}{T_3}} \qquad (1)$$

with successive-residual method (Sitkei, 1986). F_o is the equilibrium force, F_1, F_2 and F_3 contain the elastic modulus of each Maxwell elements, and the T_1, T_2 and T_3 are the relaxation times of Maxwell elements.

RESULTS AND DISCUSSION

The stress-strain curves have linear character at low deformation about up to 1 mm and at higher deformations the slope of curves is increasing with increasing deformation (Figure 1.A). In the linear region the structure remains intact and in the region of increasing slope there are micro cracks in gel structure (Foegeding, 2007). The increasing probe speed resulted in increasing slope in both linear and non-linear viscoelastic regions. While the loading work greatly, the unload work little increases with increasing test speed (Figure 1.A), therefore the ratio of unload work to load work – the degree of elasticity – is decreasing. This observation also confirms the presence of micro crack in non-linear viscoelastic region.

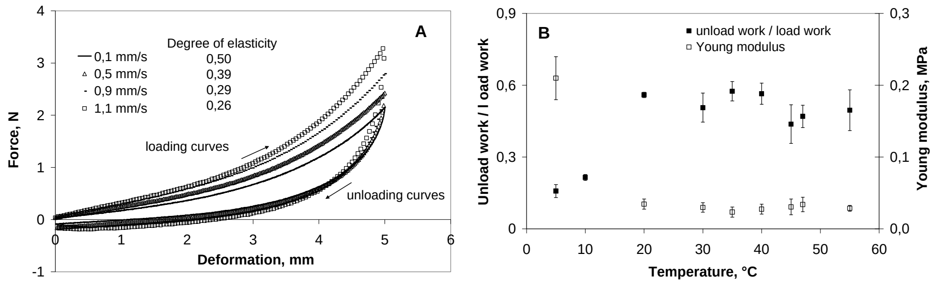

Figure 1.

A. The loading and unloading stress-strain curves at various test speed.
B. The Young modulus and the degree of elasticity at various temperatures.

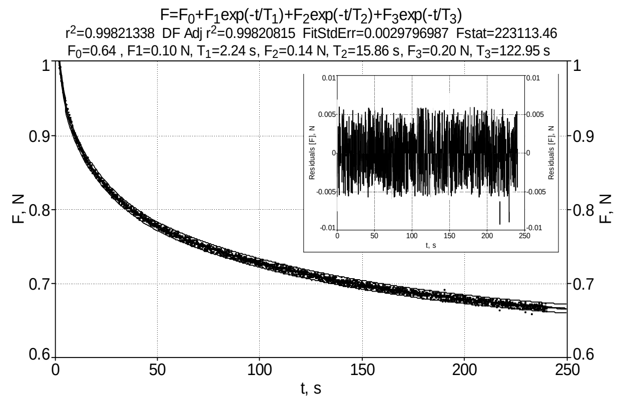

Figure 2.

A typical approach of measured relaxation curve with three element generalized Maxwell model at 5 mm deformation, at temperature of 22 °C. In the insert the residuals can be seen.

At low temperatures the increasing Young modulus (Hayashi 1983) can show on more elastic character of gelatine gel according to gelation processes (Walkenstrom, 1994), but the decrease of degree of elasticity can reflect considerable increase of viscosity (Figure 1.B). The degree of elasticity is the highest at temperature interval 20-40°C. Further increase of the temperature leads to a decrease in the degree of elasticity. Three-dimentional network forms at temperatures below 30°C, when gelatin crystallization is realized (Zandi, 2007). The segmental mobility of the gelatine molecules is small at temperatures lower than the crystallizatrion temperature and thefore the values of the Young's moduls are higher. The temperature increase leads to more intensive segmental motion expressed in higher degree of elasticity and lower values of the Young's modulus.

It was found that the 3 element Maxwell model fits enough well to the measured relaxation and the residuals are uniform distributed (Figure 2.).

Table 1.
The parameters and their standard deviation of generalized Maxwell model, as a result of successive-residual approaching method. The relaxation of force was followed 300 s at constant, 5 mm, deformation reaching with probe of various speed.

Speed of probe, mm/s	**Fo** N	**F1** N	**T1** s	**F2** N	**T2** s	**F3** N	**T3** s
0,1	0,90±0,021	0,21±0,051	3,24±0,625	0,27±0,057	20,5±2,25	0,32±0,012	160±25,2
0,3	0,74±0,102	0,24±0,053	2,57±0,552	0,22±0,031	16,0±0,73	0,30±0,045	138±8,2
0,5	0,71±0,082	0,31±0,045	3,36±0,331	0,21±0,030	20,6±2,50	0,22±0,033	162±20,6
0,7	0,77±0,075	0,35±0,053	2,69±0,246	0,26±0,023	16,9±0,66	0,26±0,015	140±1,5
0,9	0,72±0,065	0,32±0,034	2,03±0,125	0,24±0,032	15,5±0,37	0,25±0,015	140±2,6
1,1	0,74±0,051	0,33±0,015	2,44±0,036	0,24±0,025	17,9±1,06	0,24±0,024	145±5,8

All relaxation time, F_2, F_3 parameters show slightly decreasing tendency with increasing speed of probe and only F_1 parameter connecting with the modulus of elasticity of the first (the quickest) component increased as the probe speed increased. The observation time – the time requiring to reach the 5 mm deformation – is varied from 4,5 s up to 50 s depending on the probe speed from 1,1 mm/s to 0,1 mm/s. For the first component the ratio of relaxation time to observation time (Deborah number) (Figura and Teixeira, 2007) is increasing from very low value up to about one, and the elastic character can become more expressed. The Deborah number is less than one for the first component and greater than one for the second and third components, so the first component can show mainly viscous properties and the second and third components show more elastic character.

CONCLUSION

The rheological properties of gummy bears can be described with parameters of generalized Maxwell model. In the experiment it is important to choose the appropriate observation time for investigation the viscoelastic properties. The optimal temperature range for storage of gummy bears is 20-40 °C.

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Péter Závodszky
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DIFFERENT APPROACHES FOR COFFEE BEAN SHAPE AND CONTOUR DETERMINATION

L. Severa
Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic,
severa@mendelu.cz

ABSTRACT

Selected Arabica (*Coffea arabica L.*) coffee beans (13 different types from 13 different countries) were monitored and variability of their shape and size was analysed. The basic analysis was based on evaluation of main dimensions. Several tools were employed for performing of the objectives – determination of main dimensions ratios, determination of sphericity (parameter for the calculation of processing and handling operations), calculation of shape variability using elliptic Fourier descriptors, and calculation of curvature radius. All three approaches proven significant differences among individual coffee samples. The least variable bean parameter was bean depth with a coefficient of variation 0.05, followed by bean width with a coefficient of variation of 0.18, and bean length with a coefficient of variation of 0.85. The experiments improved previous findings concerning the relationship between length, width, and depth of Arabica beans. Sphericity also ranged and its value can be used for the design and evaluation of processing and handling operations. Reconstructed shapes (by use of Fourier descriptors) indicated that the first principal component (which represents the length-to-width ratio) is a suitable measure of the total shape variation (70.87 to 74.64 % of the total shape variation).

INTRODUCTION

The quality of coffee beans is partly determined by their size and shape (Banks et al, 1999). Shape and size of coffee berries and beans depend on many factors such as geographical zone (Freitas and Mosca, 1999), coffee variety (Ghosh and Gacanja, 1970), and planting conditions (Muschler, 2001). The first statistical review of coffee bean shape was performed by Wormer (1966). Knowledge of coffee bean is critical, e.g. for designing manipulation, handling, and processing devices. The evaluation of the coffee grain shape is relatively difficult owing to its complexity. Calculation of the bean sphericity with the use of a simple approach is one of the objectives of this work. It can be consequently used for comparison with the shape variability of different coffee types (quantified by use of Fourier descriptors) and for comparison with bean curvature radius.

MATERIAL AND METHODS

Coffee samples

Arabica coffee beans (roasted) were used for performed analyses. Coffees were produced in Brazil [B], Colombia [C], Costa Rica [CR], Ethiopia [E], Guatemala [G], Honduras [H], Indonesia [I], Kenya [K], Mexico [M], Panama [P], Papua New Guinea [P-NG], Peru [PE], and Tanzania [T]. The abbreviations in square brackets indicate the coffee type and it is used in the text hereinafter. The beans were ordered from a commercial distribution network in the Czech Republic.

Quantitative measurement of the bean weight and dimensions

Dimensions in the main axes (D1, D4, D7 – see Figure 1) were measured using a SOMET digital calliper (Germany). The remaining dimensions (D2, D3, D5, D6 – see Figure 1) were determined from digital images using Corel DRAW X3 (Corel Corporation, USA).

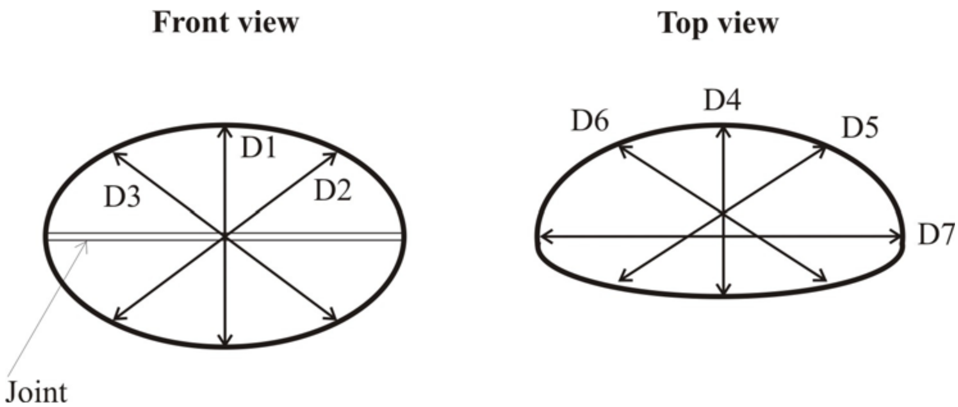

Figure 1
Illustration of measuring sides for coffee beans

Calculation of sphericity

The sphericity was calculated using Equation 1, derived by Bayram (2005).

$$\phi_s = \frac{\sum \left(D_i - \overline{D}\right)^2}{\left(\overline{D}N\right)^2} , \quad (1)$$

where ϕ_s denotes sphericity, D_i is any measured dimension, $\overline{D}$ is average dimension or equivalent diameter, and N is the number of measurements. In the given model, an equivalent or nominal diameter for irregularly shaped materials is accepted as the average dimension to obtain an equivalent sphere. Differences between average diameter and actual measured dimensions are determined with the sum of square of differences. When this difference is divided by the square of the product of the average diameter and number of measurements, it gives a fraction for the approach of the slope to an equivalent sphere, i.e. sphericity. An increase in N increases the accuracy.

Coffee bean shape variation evaluated by use of elliptic Fourier analyses

The image analysis software Shape (Iwata and Ukai, 2002) was used to perform the analysis. The closed contours of the beans were obtained through binary images with appropriate thresholds and were described by a chain–code. The same or similar method was used for the chicken egg shape analysis (Havlíček et al., 2008), hazelnut shape analysis (Menesatti et al., 2008), or e.g. sperm head shape analysis (Severa et al., 2010). The coefficients of elliptic Fourier descriptors that were normalized to avoid variations related to the size, rotation, and starting point of the contour traces were then calculated from the chain–code. To summarize the information contained in the coefficients of the Fourier descriptors, the principal components analysis based on a variance–covariance matrix of the coefficients was performed. The scores of the components were used in subsequent analysis as the bean shape characteristic.

Determination of curvature radius

The contours of single projections can be accurately described in a user-defined Cartesian coordinate system. The shape of the grain counter can be described using the polar coordinates *r, φ*. The most effective function describing this dependence is given by the Fourier approach:

$$r(\varphi) = a_o + \sum_{i=0}^{\infty} a_i \cos\left(2\pi \frac{\varphi}{c_i}\right) + b_i \sin\left(2\pi \frac{\varphi}{c_i}\right) \tag{2}$$

Another approximation can be given by the polynomial fit:

$$r(\varphi) = \sum_{i=1}^{n} p_i \varphi^{n+1-i} \tag{3}$$

If we denote $x(\varphi) = f(\varphi), y(\varphi) = g(\varphi)$, the curvature radius is given by well-known relation:

$$R = \frac{\left(\dot{f}^2 + \dot{g}^2\right)^{\frac{3}{2}}}{\left(\dot{f}\ddot{g} - \ddot{f}\dot{g}\right)}, \tag{4}$$

where dot denotes the derivation with respect to *φ*.

RESULTS AND DISCUSSION

The bean width (D1) ranged from 7.56 mm (E) to 9.76 mm (M), the bean depth (D4) from 4.50 mm (CR) to 5.07 mm (K), and bean length (D7) from 10.36 mm (P-NG) to 14.90 mm (M). Generally, the least variable bean parameter was bean depth (D4) with a coefficient of variation of 0.05, followed by bean width (D1) (CV = 0.18), and bean length (D7) (CV = 0.85). The coefficient of correlation for the ratios of length/width ranged from 0.301 (C) to 0.787 (CR), length/depth from 0.376 (P) to 0.924 (P-NG), and width/depth from 0.461 (H) to 0.813 (P-NG). The values of correlation coefficients are listed in Table 1.

Table 1: Correlation (r) for length/width, length/depth and width/depth ratios

Coffee brand	r - length/width	r - length/depth	r - depth/width
B	0.621	0.744	0.690
C	0.301	0.468	0.478
CR	0.787	0.659	0.731
E	0.679	0.670	0.572
G	0.512	0.624	0.561
H	0.581	0.516	0.461
I	0.394	0.548	0.619
K	0.512	0.694	0.699
M	0.378	0.635	0.497
P	0.541	0.376	0.593
P-NG	0.864	0.924	0.813
PE	0.404	0.717	0.751
T	0.421	0.413	0.531

Sphericity

The values of Arabica bean sphericity (including standard deviation values) are listed in Table 2. The average value of sphericity ranged from 0.006536 to 0.009452 for K, M, respectively. A statistically significant difference at $\alpha = 0.05$ for average sphericity values for 100 samples was found for all coffee types. Due to important problems in available measurement and calculation methods to determine exact volume and surface area for granular materials, Equation 1 can be used easily for solid mechanics and handling operations to determine the sphericity of coffee beans.

Table 2: Mean and s.d. values of calculated sphericity. Superscript letter indicates a statistically significant difference at $\alpha = 0.05$ for average sphericity values for 100 samples.

Coffee brand	mean ϕ_s
B	$0.007510^{a} \pm 0.000842$
C	$0.007222^{a} \pm 0.001386$
CR	$0.007313^{a} \pm 0.000993$
E	$0.007182^{a} \pm 0.001413$
G	$0.006718^{a} \pm 0.000894$
H	$0.007166^{a} \pm 0.001244$
I	$0.008073^{a} \pm 0.001236$
K	$0.006536^{a} \pm 0.001087$
M	$0.009452^{a} \pm 0.001209$
P	$0.008424^{a} \pm 0.001340$
P-NG	$0.007081^{a} \pm 0.000751$
PE	$0.006782^{a} \pm 0.001001$
T	$0.007269^{a} \pm 0.001309$

Shape variability quantified by Fourier descriptors

Image analysis was used for comparative analyses of coffee bean shape variability. Principal components of elliptic Fourier descriptors were employed. The mean bean shape (for each lot) was drawn using the mean values of the standardized Fourier coefficients. The first four principal components provide a good summary of the data, accounting for almost 100 % of the total variance. The first component represents the length-to-width ratio, the second component represents the position of the centre of gravity, the third component represents curvature, and the fourth component substitutes the degree of roundness. An example (coffee B) of a complete set of principal contribution components is given in Table 3. The influence of the first and most important component (length-to-width ratio) ranges from 70.87 to 74.64 for E, I, respectively.

Table 3: Contributions of individual principal components – coffee B.

Component	**Proportion (%)**	**Cumulative (%)**	**Indicator**
1	71.23	71.23	shape index
2	21.05	92.28	position of the center of gravity
3	1.31	93.59	curvature
4	0.91	94.50	degree of roundness

Since mean values of single components of individual coffee types are known or can be determined by the above-described method, unusual detected values can show the defective state of a coffee bean and can serve as a tool for the definition of specific irregularities. This study demonstrates the potential of modern techniques using shape-based methods on digital images to achieve high efficiency performance in fruit/beans/seeds grading and classification.

Curvature Radius

The function described by Equation 3 has been used for evaluation of the grain shape, as described in the previous section. A selected "average-like" coffee bean from each coffee type was used for sample calculation.

It was found that the correlation coefficient between measured and computed grain profiles ranges from 0.9680 to 0.9987 for M and T coffee, respectively. The knowledge of the equation describing the grain contour is necessary namely for the numerical simulation of grain behaviour under different mechanical loading, for numerical simulation of different heat treatment, and also for the determination of radius of curvature R. The values of the curvature radius calculated by use of Equation 4 can be plotted (and listed) for any coffee grain as can be seen in the sample picture - Figure 2, where half of the grain C is shown.

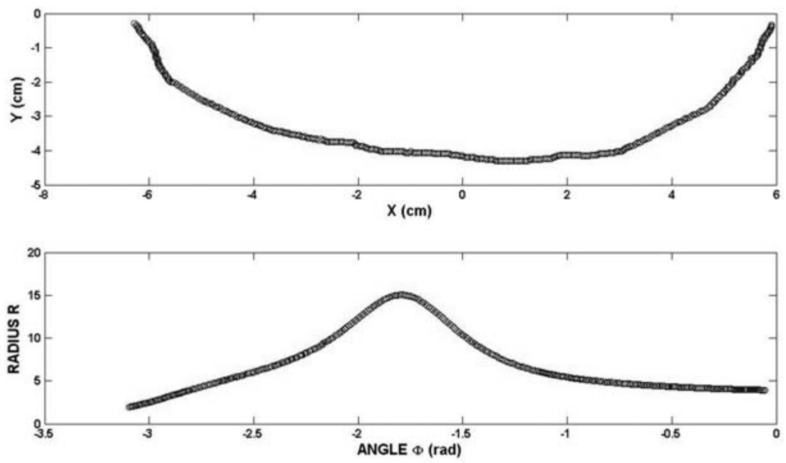

Figure 2
Example of curvature radius behaviour - C coffee grain (half-display).

CONCLUSIONS

The research revealed that all main dimensions, particularly length (D7), width (D1), and depth (D4) have changed for individual coffee types. The least variable bean parameter was bean depth (D4) with a coefficient of variation 0.05, followed by bean width (D1) with a coefficient of variation of 0.18, and bean length (D7) with a coefficient of variation of 0.85. The experiments partially confirmed partially improved previous findings concerning the relationship between length (D7), width (D1), and depth (D4) of Arabica beans. The only significant difference was revealed for the length/depth (D7/D4) ratio – presented values are higher than those in previous works. The coefficient of correlation for the length/width ratios ranged between 0.301 (C) and 0.787 (CR), for length/depth ratios between 0.376 (P) and 0.924 (P-24), and for width/depth ratios between 0.461 (H) and 0.813 (P-NG).
Another value which was monitored was sphericity. It was calculated according to procedure described by Bayram (2005) and ranged from 0.006536 to 0.009452 for K, M, respectively. The possibility of simple quantification of this parameter provides a large advantage for the design and evaluation of solid mechanics and handling operations. The highest value of sphericity was calculated for the same coffee type, where the highest values of D1 and D7 dimensions, and volume were found.
Quantification of coffee shape variability was performed by means of elliptic Fourier descriptors. Reconstructed shapes indicated that the first principal component (which represents the length-to-width ratio) is a very good measure of the total shape variation. It represents 70.87 to 74.64 % (for E and I coffee, respectively) of the total shape variation in case of the front view.
Numerical simulation of the coffee grain behaviour under different mechanical loading, heat treatment, and determination of curvature radius R can be supported by proposed mathematical formulas describing grain contour with a satisfying correlation coefficient between experimental and computed data ranging from $r^2 = 0.9680$ to 0.9987.

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INVESTIGATION OF CHIO CHIPS PRODUCTS
Part I.

COMPARATIVE SENSORY EVALUATION OF DIFFERENT CHIO CHIPS PRODUCTS

A.S. Szabo, P. Tolnay
Department of Food Chemistry and Nutrition
Faculty of Food Science, Corvinus University, Budapest,
H-1118, Budapest, Somlói út 14-16, Hungary,
(andras.szabo@uni-corvinus.hu) (pal.tolnay@uni-corvinus.hu)
G. Agyai-Szabo
Chio Hungary Ltd, Budapest
(szabog@chio.hu)

ABSTRACT

Many measurements were carried out - sensory, analytical and other ones – for investigation of Chio chips products. In this part of the article information is given about the sensory evaluation of products. The results - high level sensory properties – were analysed with Student t-test and Kramer-method.

INTRODUCTION

In the last years all over the world a lot of unfair information has been given in the media – concerning the need of healthy nutrition, as well – about the consumption of chips products, proposing that these products are not perfect and mainly unhealthy. The reason is e.g. the too high energy and fat content and presence of toxic or unhealthy components (e.g. salt, acrylamide, glycidamide, trans fatty acids) in the chips products.
Based on the commission of Chio Hungary Ltd. numerous measurements were carried out at the Department of Food Chemistry and Nutrition – in cooperation with other departments and research institutes - concerning the sensory, packaging, analytical and microbiological parameters and storability of different Chio products. In this paper information is given about the comparative sensory evaluation of 2 Chio products (salted chips and flavoured with onion and sour cream ones). Later (in part II) we try to give objective information also about the healthy status of chips products. Let us mention that these products are produced using high level of technology and excellent quality regulation and control systems (ISF, HACCP) with very good sensory properties.

RESULTS AND DISCUSSION

The measurements were carried out in 2007, using the 20 and 100 scores system with 28 panellists, all having the necessary level of knowledge in organoleptic qualification of foodstuffs. The results for comparison were analysed with Student t-test and method of Kramer.
Using the 100 scores system in case of salted chip products the average value was 86.5 (standard deviation 6.3), for products with onion and sour cream the average one was 88.4 (standard deviation 7.3). In the 20 scores system we got as average 15.8 (standard deviation 1.9) in case of salted chips, and 16.4 (standard deviation 2.3) in case of onion-sour cream flavoured products. For both products a relative strong correlation (correlation coefficients 0.6574 and 0.7558) was determined between the results of the 20 and 100 scores systems, but based on the t-test there was no significant difference between the salted and onion-sour cream flavoured products. Anyway, all samples were evaluated as products with very good sensory properties.
Using the Kramer method – in this case on the base of total scores given for the products by the individual panellists the ranking points (1 or 2) will be summarized – in both systems the total ranking scores were 36.5 for the products with onion and sour cream flavour and 47.5 scores for the salted samples. This is a significant difference, so to the opinion of the panellists the organoleptic quality of the investigated chips samples with onion and sour cream flavour was higher than in case of salted chips samples.
Finally, we would like to mention that the average chips consumption in Hungary is only 0.4-0.5 kg/year/capita – based on the food consumption structure of hungarian population.

LIST OF SCIENTIFIC PAPERS AND LECTURES, 1993-2002

The first decade (1973-1982) was published in the 2007 issue of Journal of Food Physics, the second one (1983-1992) in 2009. This issue is the third one, registering the period 1993-2002. Although in considerable part of my publications I am the only author, but during my scientific activity I had a lot of coworkers, and there are more than 200 coauthors in the publications. So You can find a list in alphabetical order, showing the names of my coauthors for this 10 years period. I am grateful for their activity and help.

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