Potravinarstvo, vol. 10, 2016, no. 1, p. 265-271
doi:10.5219/618
Received: 15 March 2016. Accepted: 2 May 2016.
Available online: 14 June 2016 at www.potravinarstvo.com

ISSN 1337-0960 (online)

INFLUENCE OF TYPE AND SHELF-LIFE ON TWO BRANDS COMPLEMENTARY FOOD IN COLOR, VITAMINS, AND SENSORY EVALUATION

Vladimír Sýkora, Hana Šulcerová, Michal Mihok, Roman Pytel

ABSTRACT
The aim of our study was to measure the color by system CIELAB, sensory analysis, and determination of vitamins in children vegetable complementary feeding (carrot, vegetable mix) with the option to extend shelf life from eighteen to twenty-one months. Complementary children food was obtained from private factory in the Czech Republic. In this research there were used only carrot and vegetable mix samples. To determine the color changes by system CIELAB and determination of vitamins, samples of mash were analyzed before filling into jars and sterilization, and then immediately after sterilization. Further analyzes were performed for twenty-one months, with run of every three months (p <0.05). The comparison of color CIELAB parameter L* (lightness) for two process steps: raw mash and sterilized mash; there were significant differences when processing (p <0.0001, r^2 = 0.9983). Mainly, the parameter L* (Lightness) showed statistically significant differences in carrot and garden mix (p <0.05). β-carotenes such as provitamin A, is in food of plant origin stable substance in the absence of air. Storing time had significant influence on contain of β-carotenes, the mean content during twenty-one months was 0.862 mg.100g^{-1} (p <0.05, r^2 = 0.2300). There were no significant differences in dark storing (p >0.05, r^2 = 0.1097). The sensory evaluation showed statistical differences in all descriptors (color saturation, uniformity of color, consistency and homogeneity) (p <0.05) in course of months of storage time and storage conditions (daylight-dark). The results can be recommended to manufacturers, extending the period of minimum shelf life of the required three months to twenty-one months due to instability as characteristics of color and textural properties which were obtained.

Keywords: carrot; vegetable; colorimetry; storing; baby food; sensory analysis; vitamins

INTRODUCTION
The period of transition from exclusive breastfeeding to family foods, referred to as complementary feeding, covers a child from 6 – 23 months of age. Complementary feeding embraces all solid and liquid foods other than breast milk or infant formula and follow-on formula **(ESPGHAN, 2008)**. Malnutrition in young children can be prevented by feeding them with enough nutritious and safe complementary foods. The Association of United Kingdom Dietitians (BDA) and its Department of Health (DH) guidelines recommend the introduction of complementary feeding at around six months **(BDA, 2013)**. Furthermore BDA guidelines correspond with WHO (World Health Organization) statement. Most infants are developmentally ready for other foods at about 6 months. During the period of complementary feeding, children are at high risk of undernutrition **(WHO, 2009)**.

Complementary foods are known as weaning foods, which are semi-solid or solid foods **(Bond et al., 2005)**. Complementary food should be thick enough so that it stays on a spoon and does not drop off. Generally, such food is thicker or more solid with more energy- and nutrient- rather dense than thin. Malnutrition is common problem in infants, between age of 6 – 8, 9 – 11, and 12 – 23 months should intake than 200, 300, and 550 kcal per day, respectively **(WHO, 2009; Bronský et al., 2014)**. Home complementary food can hold lower amount of energy than processed food, with unstable content of minerals and vitamins. Infants should be fed by some fortified food. Fortified food-based products meant to be added to other foods or eaten alone to improve macronutrient, micronutrient, and vitamin intake **(Thurnham, 2013)**. On the other hand, if commercially prepared foods are used to increase micronutrient intake, their packaging instructions should clearly show purpose of feeding (age, increasing of micro-, macronutrient, etc.).

In the Czech Republic and Germany, complementary feeding usually starts with a single vegetable mash, (mostly carrot), or single fruit puree. Especially, fresh vegetables and fruits offer a high potential of taste and flavor variety and therefore the opportunity to get used to the taste of vegetable and fruits early in life depending on the season. On the other hand, commercial complementary food products provide a broader range of taste, flavors, and texture **(Foterek, Hilbig and Alexy, 2015; Bronský et al. 2014; MZČR, 2015)**.

In the past, baby foods were carefully prepared at homes. However, modern lifestyles have led to the commercialization of ready-made complementary food. Currently commercial baby jars have become an important part of baby food due changes in lifestyle. People do not have enough time for homemade alternatives of baby food and they also tend to increase consumption of ready-cooked foods **(WHO, 2009; Mir-Marqués, 2015)**.

In general, complementary foods are made of fruit, vegetable, and meat from different animals, such as pork **(Nebot et al., 2014)**, chicken, beef, rabbit, calf, turkey, or tuna meat. Complementary food is defined as all semi-solid, pureed or mashed foods. Commercial complementary food is defined as all industrially processed, pre-packed foods in the jars or packets. Homemade complementary food is defined as all home prepared semi-solid, pureed or mashed food **(Foterek, Hilbig and Alexy, 2015)**. Complementary food can be classified in couple of groups, for example according to nutrient content, color, shape, texture, and consistency **(Rodriguez-Oliveros, Bisogni, Frongillo, 2014)**.

In recent years, commercial complementary foods have become an important part of baby dairy food. An increasing number of mothers feed their infants by processed complementary food in jars or plastic pots. The assortment of products offered has grown significantly. The processed complementary food is standardized rather than homemade complementary food, mainly incontent of vitamins, minerals, proteins, lipids, and carbohydrates **(Foterek, Hilbig and Alexy, 2015)**. Despite the benefits of infant complementary food as a major source of food for infants, the presence of contaminants, such as heavy metals may pose health risks to children **(Pandelova et al., 2012)**. Infants are exposed to daily intake of established by PTWI (Provisional Tolerable Weekly Intake) receive in complementary food. In addition, the amount of contaminants as lead, mercury and others in the European Union basket of complementary food descended in last decades **(Agostoni, Brunser, 2007; EFSA, 2012a; EFSA, 2012b)**.

Commission Directive 2006/125/EC (as amended) "on processed cereal-based foods and baby foods for infants and young children" gives an account of essential composition for baby foods, for infants and young children like protein, fat, sodium, vitamins, and minerals. Further information about specific maximum residue of pesticides or metabolites of pesticides in processed complementary food is in the annex VI. In scientific field, there are studies about the content of minerals, vitamins, contaminants **(Melø et al., 2008; Carbonell-Barrachina, 2012; Pandelova et al. 2012, Juan et al., 2014; Mir-Marqués 2014)** further researches are focused on e.g. mycotoxins, tetracyclines, acryl-amid etc.

In children diets a major role play basic characteristics of raw material (texture, pigments, etc.) that react with electromagnetic radiation in the visible spectrumand give the response to evaluators **(Figura, Teixeira, 2007)**. In food products, it was found around 10,000 inhalants **(Berger, 1995)**. Functional element which predominates is the main indicator of intra- and intermolecular interactions in the food system and its amount, gives resulting values for appearance, color, aroma, taste, and texture **(McGorrin, 2006; Stępniewski, Grundas 2013)**. On the other hand, if it uses objective measurements, the result may not be the overall color effect, therefore, still uses classical sensory analysis **(Pomerancz, Meloan, 1994)**.

The aim of our study was to measure the color by system CIELAB, sensory analysis and determination of vitamins in children vegetable complementary feeding with the option to extend shelf life of 18 to 21 months.

MATERIAL AND METHODOLOGY

Material

Complementary children feeding were obtained from private factory in Czech Republic. In this research there were used two kinds as carrot and vegetable mix samples.
Composition of samples was:

Carrot: carrot (70%), water, rice flour, citric concentrate. Nutrition per 100 g: energy 180 kJ, 0.3g of fat, carbohydrates 0.1 g, and protein 4.5 g.

Vegetable mix: potato purée (water, spray potato flocs, emulsifier: mono- and diglycerides of fatty acids), water, garden pea, carrot, spinach, leek, vegetable oil, rice flour, citric concentrate. Total vegetable content is 64%. Nutrition per 100 g: energy 287 kJ, 2.2 g of fat, carbohydrates 10.4 g, protein 1.7 g.

Methodology

To determine the color changes by system CIELAB and determination of vitamins, samples were analyzed before filling into jars and sterilization, and then immediately after sterilization. Further analyzes were performed for 21 months every 3 months. Sensory analysis was performed immediately after production – sterilization, and then again 21 months, in a run of every 3 months. The last determining of all parameters were already 3 months after the expiry date of minimum shelf life.

Color

Color of the complementary food samples were determined as reflectance values based on the L*a*b* system (lightness, redness, yellowness) using a spectrophotometer CM-3500d (Konica Minolta, Osaka, Japan) containing an integrated spectral component, a D65 illuminator and a 10° observer. Samples were measured in Petri dish with flat surface at room temperature with SCE. The L*a*b* values were determined in duplicate; the average value from these three determinations was used in the statistical evaluation.

Determination of β-carotene

5 g of homogenous samples were placed to a vial with volume of 40 mL and added 10 mL of metanolic KOH solution (KOH p.a., Merck, Czech Republic; Methanol for HPLC, Merci, Czech Republic), shaked 60 min at 350 RPM in Vortex. Next, adding of 10 mL deionization water and 3 mL of hexan p.a. (Merck, Czech Republic), vial was placed into the shaker for 10 min and 350 RPM. To 5 mL of vial was moved the top surface of hexan take out by micropipette and evaporated in blow of nitrogenous. To vial there was added next 3 mL of hexan and placed to shaker for 10 min. Upper surface was placed out and put to previous 5 mL of hexan, the content of vial was dried by nitrogenous, this steps were used triplicate. Into vial there was added 0.5 mL of methanol and 0.5 mL of dichlormethan (Merck, Czech Republic), solution was mixed in Vortex. Ready samples were place for HPLC analysis. Standard of β-carotene for HPLC was solution of 20 mg β-carotene (Fluka, Czech Republic) in 10 mL of methanol and it was shaken in Vortex and calibration

curve was papered. For HPLC analysis Shimadzu set with column Exlipse XDB-C8, 50 x 4.6 mm, 1.8 μm, 55 °C was used, mobile phase methanol-water, gradient of methanol 0 min 90%, 2 min 90%, 3 min 95%, 6 min 100%, 13 min 100%, 14 min 90%, 15 min 90%, flow of mobile phase 0.8 $mL.min^{-1}$, analysis was resulted in 15 minutes. The volume of samples 20 μL, UV/VIS detector at 450 nm was measured. Results were obtained by programme Chemstation.

Sensory analysis

Sensory evaluation of two samples of complementary food was performed immediately after the production, and for storage with minimum durability of 18 months every 3 months and 3 months after the storage by 10 trained members in sensory laboratory equipped according to ISO 8589. Determination of color saturation, uniformity of color, homogeneity and consistency were evaluated using a continuous unstructurated scale (100 mm) without references. There were evaluated 4 descriptors: color saturation, uniformity of color, consistency and homogeneity.

Statistical evaluation

Panel data were collected by Excel and tested with one-way analysis of variance (ANOVA, Statistica 12) by means of Duncan's test (p <0.05) for multiple comparisons.

RESULTS AND DISCUSSION

When comparing color CIELAB parameter L* (lightness) for two process steps: raw mash and preserved mash; there were significant differences between them p <0.0001, r^2 = 0.9983. L* parameter of carrot mash showed direct decrease of lightness. On the other hand, parameter a* (redness) and b* (yellowness) were saturated in color p <0.0001, r^2 = 0.9995, and p <0.0001, r^2 = 0.9850, respectively. The samples garden mix appeared before heat treatment and after as color stable for human eye. However, the significant statistical differences were calculated for all CIELAB parameters L*a*b* p <0.05 they showed significant differences of processing raw mash compared preserved mash which was filled in to jars. Lightness tendency were decreasing in the parameter L* in both samples; regardless, redness and yellowness parameters a* and b* were more saturated after-processing in both cases.

Majority of vegetable-based complementary food is carrot and mixes of carrot with other vegetable and other products, these similary tendencies are in the Middle Europe such is Germany **(Mesch et al. 2014)**. Studied carrot samples were measured in following storing conditions: room temperature with daylight storing. The samples were observed in raw mash, after preservation and every 3 months to "use before" and furthermore 3 months for last measurement run. The main differences between raw and preserved mash were carried out previously, the advance measurement shows significant differences between storing periods. In most cases, in parameter L* there were calculated statistically significant differences p <0.05. The lightness has changed with advance storing, however, no significant trend was observed. Variability in lightness was observed in raw mash, over L* 52, but after

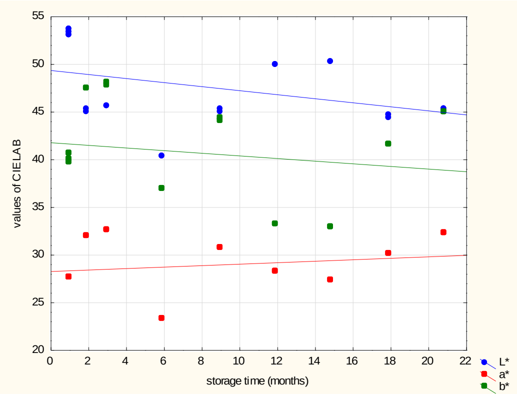

Figure 1 Monitoring changes color co-ordinates L*a*b* in relation to the length of storage in daylight for carrot samples.

heat treatment decreased to L* 44, for instance, high differences were measured during shelf-life (Figure 1).

Significant differences p <0.05 were observed in a* parameter. This parameter was relatively stable because the variation of a* was not as high as in L* parameter. The raw mash was less saturated before preservation, on the other hand saturation of a* parameter was variable in advanced storing. In redness parameter b* there were calculated significant difference in most cases. Regardless, for preservation and 3 months, 12 and 15 months, two pairs of homogenous groups p <0.05 were carried out. For instance, could be obtained non-significant data in food where the shelf-life is only one month **(Kročko et al., 2015)**.

Carrot samples were stored in the dark and in room temperature and the measure runs were the same as carrot storing in the daylight. Significant differences (p <0.05) were calculated for these samples in most cases. However, in this kind of storing there were observed more homogenous groups in parameter L*. Similar tendencies in variability of parameter L* ware observed with advance storing (Figure 2). In comparison of two storing mode were investigated no high differences. The color stability was no stable with advance storing, but for dark storing were calculated more homogenous groups in all parameters L*a*b*.

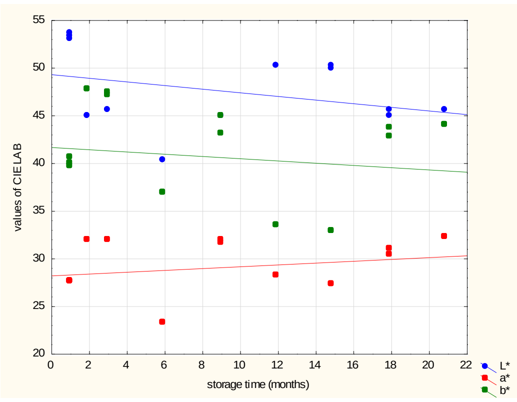

Figure 2 Monitoring changes color co-ordinates L*a*b* in relation to the length of storage in dark for the samples carrot.

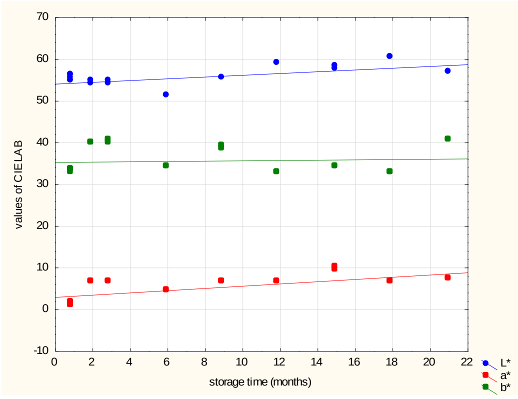

Figure 3 Monitoring changes color co-ordinates L*a*b* in relation to the length of storage in daylight for the samples vegetable mix.

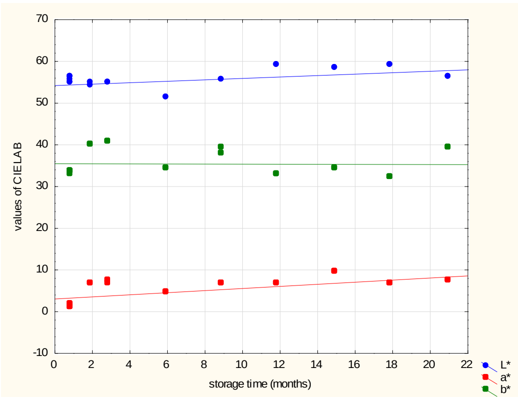

Figure 4 Monitoring changes color co-ordinates L*a*b* in relation to the length of storage in dark for the samples vegetable mix.

Furthermore, samples which called garden mix were investigated in same parameters as previous carrot mash. Lightness for daylight and dark storing had similar behavior, where lightness tendency in both were decreasing till 6 months and for the rest of runs were increasing (Figure 3 and Figure 4). On the other hand, for statistical analysis were calculated in most cases paramount significance differences p <0.05, except for preservation and 3th month and for raw and nine months for both types of storing. For instance, in dark were calculated next homogenous group for twelve and eighteen months.

For parameter a* (daylight storage) were calculated the most homogenous groups p <0.05 for preservation, 3, 9, 12, and 18 months. On the other hand, this trend was not investigated for dark storage, where were two main groups preserved, 9, and 21 months and 9, 21, and 3 months, respectively.

B-carotene

β-carotene such as provitamin A is in food of plant origin stable substance in the absence of air. During food preservation, it can isomerize to neocarotenes (still counting to vitamin A) which are less intensely colored **(Velíšek, 2014)**. It was not corresponded with our obtained data for carrot, because the color on redness axis a* was higher after preservation than before; and contain of *β*-carotene decrease from 0.186 to 0.015 mg.100g^{-1}, and the redness increase from L* 27 to 31, respectively. Storing time had significant influence to contain of β-carotenes, the mean content during 21 months was 0.862 mg.100g^{-1}, in the case of light storing there were calculated statistical differences p <0.05, r^2 = 0,2300. Samples of vegetable mix mean contains 0.135 mg.100g^{-1} of provitamin β-carotene and the statistically significant differences were calculated in light storing p <0.05, r^2 = 0.2300; on the other hand, no significant differences were obtained in dark storing p >0.05, r^2 = 0.1097. The obtain results shows nonsignificant connection between contain of β-carotene to redness parameter a* p <0.05.

Sensory evaluation

After assessing the results of sensory analysis, it was found that the length and type of storage affect the color changes of children complementary food and is perceptible to the human senses.

Carrot: When the sensory analysis of samples carrot compared to the daylight-dark were in the first 9thmonths of storage found statistically significant differences between the samples. In the ninth month of storage (p <0.05), as well as in 15th (p <0.01), there was a change in the descriptor consistency.At 18th months, again there were no statistically significant differences between the samples stored in daylight and in darkness. In the last month of monitoring, three months after the expiry date of minimum durability, changes have occurred only in the descriptor uniformity of color (p <0.05). From the results we can conclude that storage of the product carrot is only minimally affected when exposed to daylight.

The relative proportions of the samples were stored in daylight for 21st months (Figure 5). At color saturation occurred two homogeneous groups were created. The biggest differences that separated the groups were between 12th and 15th months of storage. The inferior results were recorded in the 21st months of storage, so three months after the expiry date of minimum durability. This change was highly significant (p <0.0001, r^2 = 0.3978). At descriptor uniformity of color, occurred to separation of homogeneous groups between 12th and 15th months of storage. Again, a statistically significant difference between all groups was evaluated with the last assessment in the 21st months (p <0.0001, r^2 = 0.3892). For descriptors consistency and homogeneity, the results were very inconsistent and have failed to form strictly according to

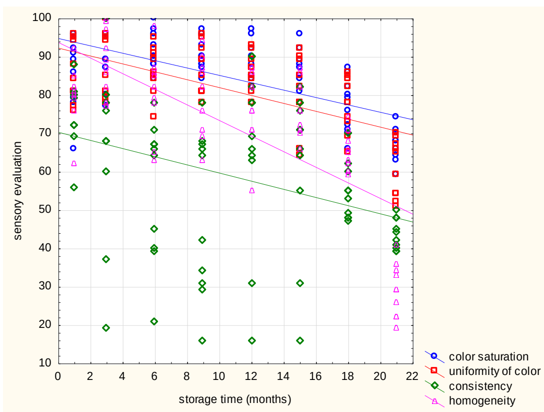

Figure 5 Dependence changes observed in sensory quality descriptors on the duration of storage of complementary food carrot for children in daylight.

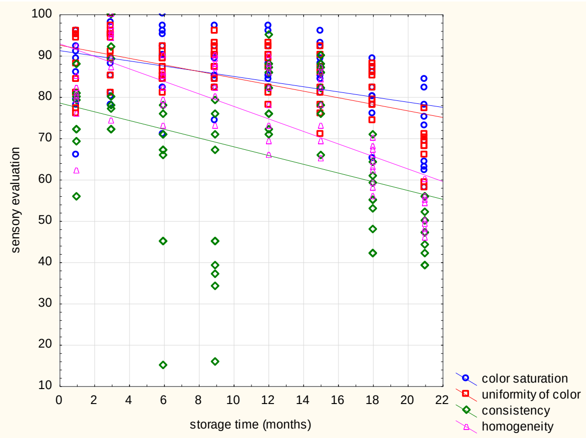

Figure 6 Dependence changes observed in sensory quality descriptors on the duration of storage of complementary food carrot for children in dark.

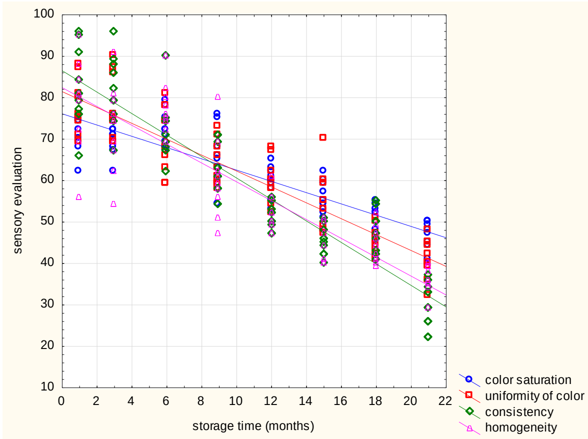

Figure 7 Dependence changes observed in sensory quality descriptors on the duration of storage of complementary food vegetable mix for children in daylight.

the length of storage. Even when descriptor consistency (p <0.001, r^2 = 0.1316) and a descriptor of homogeneity (p <0.0001, r^2 = 0.5027) showed a statistically significant difference, it can not be said that it was quite adequate to the storage time.

For samples stored in the dark (Figure 6), it was found that the color saturation created two homogeneous groups, from1st to 15th, respectively 18th month, with a fluctuation in the sixth month. Evaluation of the 21st month was quite different from the others (p <0.0001, r^2 = 0.1989). The same tendency was observed also in the descriptor uniformity of color (p <0.0001, r^2 = 0.3657), consistency (p <0.001, r^2 = 0.1393), and homogeneity (p <0.0001, r^2 = 0.5387). In the last mentioned descriptor a significant improvement occurred in the 3rd month, not only when stored in the dark, but also in the light.

Vegetable mix: By comparing storage at daylight-dark there was found no influence on color change after 3 months. Changes occurred at the rising trend in following months. After 6 months of storage there were changes (p <0.05) in the descriptor uniformity of color and after 9 months there were noticeable changes in color saturation (p <0.05) and uniformity of color (p <0.01). After 12 months of storage, there were found statistically significant differences between samples (p <0.01) for all measured descriptors –color saturation, uniformity of color, consistency, and. Fifteen months of storage significantly influenced the evaluation. There were found statistically significant differences between light and dark with descriptors color saturation (p <0.01), the uniformity of color (p <0.001) and homogeneity (p <0.001). When assessing influence of storage at samples after 18 and 21 months, there were statistically significant differences at all investigated descriptors (p <0.05). For descriptors of color uniformity in the 18th month and color saturation descriptors, consistency and homogeneity was detected very high, with statistical significance difference (p <0.001) between the samples stored in the light and in the dark.

In the samples storage by 21 months in daylight were found relatively significant differences (p <0.0001). There was a significant decline in sensory quality, particularly towards the end of the storage period (Figure 7). At descriptor color saturation (r^2 = 0.7872), there were created two homogeneous groups, one to 6 months of storage, and the second one from 9th to 21th months of storage. The most significant changes in sensory quality of descriptor for color saturation were between 6th to 9thmonths of storage. Further significant degradation of color saturation occurred between 18th and 21thmonths of storage. At descriptor uniformity of color there were established two homogenous groups, one from 1st to 15th months storage; and the second one from18th to 21stmonths. The most important changes were at 6th months and then between 15th and 18th months (r^2 = 0.8213). For consistency there was found the largest difference between 9th and 12th months, leading to their deterioration (r^2 = 0.8603). Significant changes also occurred in the descriptor of homogenity (r^2 = 0.7732). Two separate homogeneous groups were obtained and separated by 6thto 9th months. The biggest changes were occurred between 9th and 12th months of storage. At two last mentioned descriptors the samples had only low sensory evaluation after 21 months of storage.

Samples storage in the dark there were found significant differences (p <0.0001) between months again (Figure 8). Differences during storage time were not so significant such as during storage in the daylight. At descriptor color

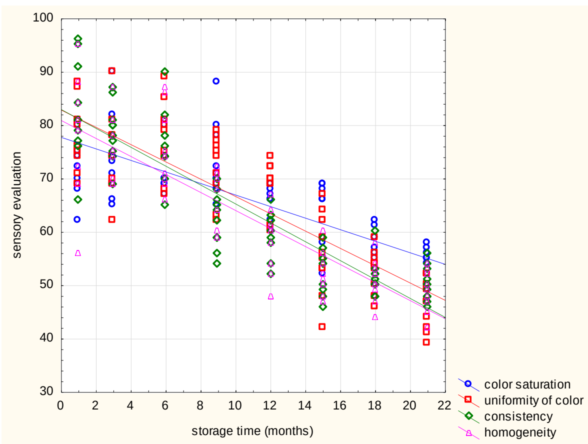

Figure 8 Dependence changes observed in sensory quality descriptors on the duration of storage of complementary food vegetable mix for children in dark.

saturation there were found two homogeneous groups, and the most significant changes occurred between 12th and 15th months of storage (r^2 = 0.5974). In another reference descriptor uniformity of color, the most significant changes were between 9th and 12th months and 12th and 15th months of storage. The 21st month exceeded by its value to other phases of evaluation (r^2 = 0.7179). Descriptor consistency recorded the most significant deterioration in sensory quality between the 12th and 15th month (r^2 = 0.7915). However, very important sensory quality deterioration was also in the 9th month. The same evaluation is also evident in the descriptor homogeneity (r^2 = 0.7552).

Generally, the color of complementary food has not so much investigated; some papers were issued **(Palazón et al., 2009)**. The objective measurement of color is not so common but sensory evaluation is wide used. In last decade, the scope of researches is on food safety and product quality such as: content of vitamins, minerals, etc. **(Bosh et al., 2013; Mir-Marqués et al., 2015; Melø et al., 2008; Mesh et al., 2014)**. Sensory quality and changes in the descriptor are affected by materials, processing, and foodstuffs **(Trejo Arayaa et al., 2009; Berger et al., 2008)**.

CONCLUSION

There were found significant differences in all monitored descriptors by sensory evaluation in storage time for samples in daylight and dark in 21 months. The samples were evaluated every 3 months. The paramount statistically differences were carried out in daylight storage and in last third of sensory evaluation in all descriptors from 15th to 21st months. The obtained data shows the same results as a CIELAB. The samples from dark were more stable than daylight storage. On the other hand, the storage time had significant influence to complementary food in both storing conditions. β-carotene was affected by storage time and there was found significant differences. Sensory analysis plays an important role in the selection of food in general, but especially for infant food. From the results of objective measurement, were found that the color and storage conditions (light/dark) statistically varied over time. However, consumer preferred changes obtained by sensory analysis to select and purchase food before changes detected by measuring CIELAB.

REFERENCES

Agostoni, C., Brunser, O., 2007. *Issues in complementary feeding*. Basel: Nestlé Nutrition workshop series, Karger. ISBN: 978–3–8055–8283–4.

Agostoni, C., Decsi, T., Fewtrell, M., Goulet, O., Kolacek, S., Koletzko, B., Michaelsen, K., Moreno, L., Puntis, J., Rigo, J., Shamir, R., Szajewska, H., Turck, D., van Goudoever, J. (2008). Complementary Feeding: A Commentary by the ESPGHAN Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition*, vol. 4, no. 1, p. 99-110. http://dx.doi.org/10.1097/01.mpg.0000304464.60788.bd PMid:18162844

Berger, R. G. 1995. *Aroma biotechnology*, Berlin: Springer-Verlag. ISBN 978-3-642-79373-8. http://dx.doi.org/10.1002/food.19960400130

Berger, M., Küchler, T., Maaßen, A., Busch-Stockfisch, M., Steinhart, H. 2008. Correlations of carotene with sensory attributes in capot sunder differents to rage conditions. *Food Chemistry*. vol. 106, no. 1, p. 235-240.

BDA. 2015. Complementary Feeding: Introduction of Solid Food to an Infants Diet. [online] s.a. [cit.2016-01-16] Available at: https://www.bda.uk.com/publications/professional/complementary_feeding_weaning, The British Dietetic Association.

Bond, B., Fernandez, D., Van der Jagt, D., Williams, M., Huang, Y., Chuang, L., Millson, M., Andrews, R., Glew, R. 2005. Fatty acid, amino acid and trace mineral analysis of three complementary foods from Jos, Nigeria. *Journal of Food Composition and Analysis*, vol. 18, no. 7, p. 675-690.

Bronský, J., Bělohlávková, S., Burianová, I., Frühauf, P., Fuchs, M., Kotalová, R., Malý, J., Mydlilová, A., Nevoral, J., Pozler, O., Sýkora, J. 2004. Doporučení pracovní skupiny dětské gastroenterology a výživy ČPS pro výživu kojenců a batolat (Recommendation of Working Group of Pediatric Gastroenterology and Nutrition CPS for infants and toddlers). *Česko-Slovenská Pedaitrie*, vol. 69, suppl. 1, p. 1-48.

Carbonell-Barrachina, Á., Wu, X., Ramírez-Gandolfo, A., Norton, G., Burló, F., Deacon, C., Meharg, A. 2012. Inorganic arsenic contents in rice-based infant foods from Spain, UK, China and USA. *Environmental Pollution*, vol. 163, p. 77-83. http://dx.doi.org/10.1016/j.foodchem.2014.11.078

Foterek, K., Hilbig, A., Alexy, U. 2015. Associations between commercial complementary food consumption and fruit and vegetable intake in children. Results of the DONALD study. *Appetite*, vol. 85, p. 84-90.

EFSA, 2012a. Scientific Opinion on the risk for public health related to the presence of mercury and methylmercury in food [online] s.a. [cit.2015-01-16] Available at: http://www.efsa.europa.eu/en/efsajournal/pub/2985.htm

EFSA, 2012b. Lead dietary exposure in the European population [online] s.a. [cit.2015-01-16] Available at: http://www.efsa.europa.eu/en/efsajournal/pub/2831.htm

Figura, L., Teixeira, A. 2007. *Food physics physical properties - measurement and application*. Berlin: Springer Berlin Heidelberg. ISBN 9783540341949.

Juan, C., Raiola, A., Mañes, J., Ritieni, A. 2014. Presence of mycotoxin in commercial infant formulas and baby fous from Italian market. *Food Control*, vol. 39, p. 227-236. http://dx.doi.org/10.1016/j.foodcont.2013.10.036

Kročko, M., Ďurík, M., Bučko, O., Tkáčová, J., Čanigová, M., Ducková, V. 2015. Effect of rosemary in combination with yeast extract on microbiology quality, oxidative stability and color of non-fermented cooked salami "Inovec". *Potravinarstvo*, vol. 9, no. 1, p. 160-165. http://dx.doi.org/doi:10.5219/464

McGorrin, R., J. 2006. Food Analysis Techniques: Introduction. In *Encyclopedia of Analytical Chemistry*. http://dx.doi.org/10.1002/9780470027318.a1001

Ministerstvo zdravotnictví České Republiky, Pracovní skupina Ministersva zdravotnictví. Doporučení k zavádění komplementární výživy příkrmu u kojenců (The Ministry of Health of the Czech Republic, The working group of the Ministry of Health. Recommendations for the introduction of complementary feeding supplementary food in infants), 2013. [online] s.a. [cit. 2015-01-08] Available at: http://www.mzcr.cz

Mir-Marqués, A., González-Masó, A., Cervera, M., de la Guardia, M. 2015. Mineral profile of Spanish commercial baby food. *Food Chemistry*, vol. 172, p. 238-244. http://dx.doi.org/10.1016/j.foodchem.2014.09.074

Nebot, C., Guarddon, M., Seco, F., Iglesias, A., Miranda, J., Franco, C., Cepeda, A. 2014. Monitoring the presence of residues of tetracyclines in baby food samples by HPLC-MS/MS. *Food Control*, vol. 46, p. 495-501. http://dx.doi.org/10.1016/j.foodcont.2014.05.042

Rodriguez-Oliveros, M., Bisogni, C., Frongillo, E. 2014. Knowledge about food classification systems and value attributes provides insight for understanding complementary food choices in Mexican working mothers. *Appetite*, vol. 83, p. 144-152. http://dx.doi.org/10.1016/j.appet.2014.08.022

Melø, R., Gellein, K., Evje, L., Syversen, T., 2008. Minerals and traceelements in commercial infant food. *Food and Chemical Toxicology*, vol. 46, no. 10, p. 3339-3342.

Mesch, C., M., Stimming, M., Foterek, K., Hilbig, A., Ute, A., Kersting, M., Libuda, L. 2014. Food variety in commercial and homemade complementary meals for infants in Germany. Market survey and dietary practice. *Appetite*, vol. 76, p. 113-119.

Palazón, M., A., Pérez-Conesa, D., Abellán, P., ROS, G., Romero, F., Vidal, M., L. 2009. Determination of shelf-life of homogenized apple-based beikost storage at different temperatures using Weibull hazard model. *LWT - Food Science and Technology*, vol. 42, no. 1, p. 319-326. http://dx.doi.org/10.1016/j.lwt.2008.03.011

Pandelova, M., Lopez, W., L., Michalke, B., Schramm, K.-W. 2012. Ca, Cd, Cu, Fe, Hg, Mn, Ni, Pb, Se, and Zn contents in baby foods from the EU market: Comparison of assessed infant intakes with the present safety limits for minerals and trace elements. *Journal of Food Composition and Analysis*, vol. 27, no. 2, p. 120-127. http://dx.doi.org/10.1016/j.jfca.2012.04.011

Pomeranz, Y., Meloan C., E. 1994. *Food analysis: theory and practice*. 3rd ed. New York: Chapman and Hall, 778 p. ISBN 0412065916.

Stepniewski, A., Grundas, S., 2013. *Advances in agrophysical resear*ch. Rijeka: InTech. 408 p. ISBN 978-953-51-1184-9 http://dx.doi.org/10.5772/52372

Thurnham, D. I., 2013. Adequate Nutrient Intakes for Infancy. [onlline] s.a. [cit.2015-08-06] Available at: http://www.sightandlife.org

VELÍŠEK, J. 2014. The chemistry of food. Chichester, England: Wiley. 1124 p. ISBN 978-1-118-38381-0.

WHO, 2009. Infant and young child feeding: model chapter for textbooks for medical students and allied health professionals. Geneva: World Health Organization. 99 p. ISBN 9789241597494.

Acknowledgments:

The research was donated by Intenal Grant Agency of AF MENDELU IP 9/2013.

Contact address:

Vladimír Sýkora, Mendel Universtiy in Brno, Czech Republic, Faculty of AgriSciences, Department of Food Technology, Zemědělská 1, 613 00 Brno, E-mail: vladimir.sykora@mendelu.cz.

Hana Šulcerová, Mendel Universtiy in Brno, Czech Republic, Faculty of AgriSciences, Department of Food Technology, Zemědělská 1, 613 00 Brno, E-mail: hana.sulcerova@mendelu.cz.

Michal Mihok, Mikrofarma, s.r.o., Udolni 567/33, 602 00 Brno, Czech Republic, E-mail: michal.mihok@mikrofarma.cz.

Roman Pytel, Mendel Universtiy in Brno, Czech Republic, Faculty of AgriSciences, Department of Food Technology, Zemědělská 1, 613 00 Brno, E-mail: roman.pytel@mendelu.cz.