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Active Packaging Influence on the Shelf Life of Milk Pomade Sweet – Sherbet

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***Abstract*—**The objective of the research was to evaluate the quality of milk pomade sweet – sherbet packed in different packaging materials (Multibarrier 60**,** met.BOPET/PE, Aluthen), by several packaging technologies – active and modified atmosphere (MAP) (consisting of 100% CO_2), and control – in air ambiance. Experiments were carried out at the Faculty of Food Technology of Latvia University of Agriculture. Samples were stored at the room temperature +21±1 °C. The physiochemical properties – weight losses, moisture, hardening, colour and changes in headspace atmosphere concentration (CO_2 and O_2) of packs were analysed before packaging and after 2, 4, 6, 8, 10 and 12 storage weeks.

***Keywords*—**packaging, shelf life, sherbet with crunchy peanut chip's

I. Introduction

CONFECTIONERY products, in comparison with other foods, are generally stable and have relatively long shelf-lives. The high level of sugar present in confectionery products makes them less prone to microbiological spoilage. Consequently, physical and chemical changes, which lead to a deterioration of texture, flavour, colour or odour of the product, are the main reasons of spoilage and thereby limiting the shelf lives of confectionery products. The shelf life stability of confectionery products, as in the case of all food products, is governed by their composition.

The confectionery industry is enormous. It ranges from small shops to branches of the largest companies in the food industry [1]. Mostly sugar confectionery has been developed over the centuries with increasing sophistication and it exists in countless formats with different degrees of sweetness, flavours and aromas, textures and mouthfeel. Sugar confectionery by definition is meant to include products that contain predominantly one form or another of the following sugars: sucrose (usually cane or beet sugar); dextrose (otherwise known as glucose, usually corn sugar); fructose (often referred to a fruit sugar) or lactose (otherwise known as milk sugar) [2; 3; 4; 5].

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Milk pomade sweets are one of the sugar confectionery products and usually contain sugar, glucose syrup, water, condensed milk; it may also contain nuts depending on product category. The shelf life of milk pomade sweets depend on several parameters including: storage temperature and humidity, availability of oxygen in the immediate environment, directly related to packaging material used, as well as the addition of other ingredients such as fats, nuts etc. [3; 6]. Milk pomade sweets could be characterised by moisture below 5% [3]. Milk sweets are usually a mixture of several ingredients, made according to a fairly complex recipe and in a short time. This may lead down to absorbtion of water from the atmosphere following prolonged exposure to ambient conditions, making the sweets soft and soggy [7], in that way packaging films with a high moisture barrier properties could be a common practice. In the second place, hardening is the main cause of quality deterioration of cookies and biscuits, included milk pomade sweets, which change from soft and pliable to firm and crumbly within a few days or even hours after their manufacturing.

Sherbet with crunchy peanut chips could be classified as milk pomade sweet. It is one of quite popular delicious sweets in Latvia [8]. Sherbet is recommended to keep cool and dry (+18 ± 3 °C). On the market place peanut sherbet for the time being could be found only in bulk carton transport packaging boxes by 5 to 10 kg in each. Freshly made sherbet is soft and savoury but after several days' storage at the open air gradually hardens, as it has been observed at the market place and laboratories, product loses eye appeal, taste and become not marketable. This problem limits the shelf life, so sherbet can be marketed only at the local market. As there is not sufficiently knowledge about behaviour of this unique product during the storage time, a preliminary investigation on the evolution of freshly manufactured sherbet texture, packed in various plastic films with several barrier properties was planed to carry out [9; 10]. The most common threats for confectionery products are oxygen and moisture. Oxidation is a critical degradation pathway for confectionery products and can lead to rancidity of nuts and nut oils as well as rancidity of natural vegetable oils, now frequently used to replace trans fats. Oxidation as well as results changes in flavour over time. Furthermore, moisture is a concern, leading to hydrolytic rancidity of saturated fats like cocoa butter and adversely affecting texture and mouthfeel. These threats become more acute when confectionery products need to be packaged for a longer duration of time because of extended distribution [11].

Nowadays lot of scientists explore different ways how to reduce these threats of confectionery products and are looking for innovative solutions how to preserve quality and prolong shelf life [2; 3; 6; 10; 13; 14].

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The use of appropriate packaging is most important in maintaining the quality of the products and achieving the required shelf life.

Several strategies have been devised to exert a positive action over the packaged foodstuff, including retention of desirable molecules (i.e., aldehydes, oxygen) and release of substances (i.e., carbon dioxide, aromas). These new developments have been generally termed active packaging technologies [12]. Principal active packaging systems involve oxygen scavenging, moisture absorption, carbondioxide or ethanol generation, and finally antimicrobial systems [15; 16].

Some manufactures and researchers propose for confectionery use sorbent technology: oxygen-absorption and moisture regulation technology. Oxygen-absorbing technology can lower oxygen levels to protect products from rancidity and flavour loss while moisture regulation technology reduces moisture content within a package to levels that inhibit hydrolysis of fats and oils that degrades texture and eating qualities. Using sorbent technology enables confectionery products to preserve flavour and colour, maintain an appropriate texture and extend the shelf life.

Rapid removal of oxygen from the packaging immediately after manufacturing greatly retards the loss of colour, thus enhancing the visual appeal of the product. In addition, fat-based confections, particularly enrobed products, are vulnerable to moisture and temperature variations. This can lead to migration of sugar and occasionally other compounds to the surface resulting in "sugar bloom" frequently observed on chocolate after extended storage. Moisture regulation within the package can hold moisture at a low level to effectively prevent this from happening [11].

Mouthfeel, texture and eating qualities are adversely affected by loss of moisture. As all packaging materials are permeable to moisture to some extent, active packaging can balance moisture and compensate for moisture loss. Furthermore, moisture regulation can be combined with oxygen removal so that it is now possible to rapidly remove oxygen from a package while maintaining an optimal relative humidity within the package. This approach allows the confectioner to optimize or minimize the use of emulsifiers, surfactants and other such additives.

Molds are sometimes associated with spoilage of confectionery products. As a class, molds are obligate aerobes; that is, they absolutely require oxygen to emerge from the spore form to the vegetative form and to grow. Fortunately, with rapid removal of oxygen, it is possible to completely prevent the growth of mold and fungi. Also, as most confectionery is too low in moisture for mold to grow, permeability of the packaging and temperature variations that may be experienced during distribution become important concerns. Moisture regulation can serve to protect against condensation and subsequent mold growth within the package where storage and distribution are less than ideal [11].

Application of active packaging for confectionery products is still limited, because there is a lack of scientifically based data related to sugar confectionery quality changes.

The objective of this study was to determine quality and respective shelf-life of a delicious sweet – sherbet with crunchy peanut chips by using different packaging materials with diverse barrier properties in modified atmosphere (100% CO_2) packaging both by itself as well as with incorporated iron based oxygen scavenging sachets, and to compare the results with control packaging in Multibarrier film and air ambiance.

II. Materials And Methods

A. Experimental design

Experiments were carried out in the laboratories of Department of Food Technology, Latvia University of Agriculture. The object of the research was milk pomade sweet – sherbet with crunchy peanut chips, produced by stockholder Laima, Latvia. Ingredients of sherbet: sugar, peanuts (24%), condensed milk with sugar, water, glucose syrup, wafers (wheat flour, egg mass, baking agent (E500), emulsifier (soya lecithin), salt. Dimensions of one piece of sherbet in average was 40 x 40 x 8 mm, mass 30 ± 1g.

B. Packaging and storage of samples

The study involved preliminary preparation of different laminate pouches from Multibarrier 60, met.BOPET/PE and Aluthen. For shelf life determination both usual MAP conditions as well as oxygen scavenger commitment in the pouch was investigated. For reduced oxygen packaging (ROP) creation (O_2 – 0%) in pouches an iron based oxygen scavenger sachets of 100 cc obtained from Mitsubishi Gas Chemical Europe Ageless® were used. The samples were hermetically sealed by MULTIVAC C300 vacuum chamber machine and stored at the room temperature of +21.0±1 °C, (controlled by MINILog Gresinger electronic) and about 40% RH for 12 weeks under day and night conditions. A characteristic of materials used in experiments is shown in the Table I and structure of performed experiments – in Fig.1. The materials for experiments were selected with different water vapour transmutation rate and various thicknesses. Two pieces of sherbets were placed in each package. Size of each pouch was 80 x 120 mm, the total product mass in each package – 60±1 g. The results were reported as an average value of all determinations. Samples were analyzed before packaging (day 0) and after 2, 4, 6, 8, 10 and 12 storage weeks.

TABLE I
CHARACTERISTICS OF USED MATERIALS IN EXPERIMENTS

Sample Nr.	Packaging material	Composition	Thickness, μ m
1.	Multibarrier 60 HFP	Laminate, APA/TIE/PA/EVOH/PA/TIE/PE/PE, transparent	60±2
2.	met.BOPET/PE	Laminate	65±2
3.	Aluthen	Laminate	80±2

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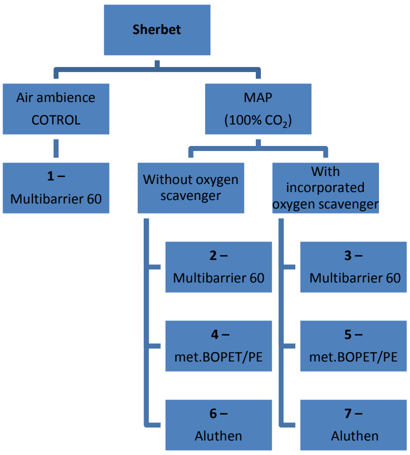

Fig. 1 Structure of performed experiments

Two pieces of sherbets were placed in each package. Size of each pouch was 80 x 120 mm, the total product mass in each package – 60 ± 1.0 g. The results were reported as averages of all determinations. Samples were analyzed before packaging (day 0) and after 2, 4, 6, 8, 10 and 12 storage weeks.

C. Physical analysis

The following mechanical and physical characteristics were analyzed:

- The dynamics of gas composition in a hermetically sealed package headspace during the storage time was measured as a percentage of oxygen and carbon dioxide by a gas analyser OXYBABY® V O_2/CO_2.
- Moisture content and accordant at the storage time was determined by using verified balance KERN (Germany) with precision ±0.001g; mass loss calculation (%) – were determined by weighing on the electronic scales.
- Hardness for freshly manufactured sherbet samples was determined as cutting force (in N) by using TA-XTplus Texture Analyser. Cutting force was determined for six small sherbet samples from each it piece. For the sample cutting force determination a special probe with knife edge for a cut test HDP/BSKBLADE SET WITH KNIFE was applied. The maximum cutting force (in N) was detected at the deformation rate 10 mm/s and distance 10 mm. The samples were cut right through, in order to check whether any different structural characteristics (peanut pieces) were present under the knife inside the product or on the surface. Samples for cutting were placed centrally under the knife edge. Plotting force (in N) versus storage time (in weeks), the hardness change of sherbet stored in each gas composition in the package as well as for each packaging material was calculated. The maximum cutting force (N) was used as an index for the cut test.

At each time of measurement, two identical packages for any treatment were randomly selected on sampling days (day 0) and after 2, 4, 6, 8, 10 and 12 storage weeks; six measurement repetitions of each sample were performed.

- The colour of sherbet samples was measured in CIE L*a*b* colour system using Tristimulus Colorimeter measured Hunter colour parameter changes: by Colour Tec PCM/PSM. Samples for colour measurement were placed in PP bag. Colour values were recorded as L* (lightness, 0 = black, 100 = white), a* (-a, greenness, +a, redness) and b* (-b, blueness, +b, yellowness) are two chromatic components which range from -120 to +120 [17]. The measurements were repeated on five randomly selected locations on each sample. Total colour difference (ΔE^*) of sherbets between initial value and after storage was calculated using the following equation 1:

$$\Delta E^* = \left[\left(L^* - L^*_{day0}\right)^2 + \left(a^* - a^*_{day0}\right)^2 + \left(b^* - b^*_{dayo}\right)^2 \right]^{1/2} \quad (1)$$

Where ΔE^* – total colour difference; L*, a* and b* are the lightness (L), greenness and (a) and blueness (b) values for the stored sherbet samples; and L_{day0}, a_{day0} and b_{day0} are the corresponding color values for sherbet samples at the beginning of experiment. The difference $L^* - L^*_{day0}$ is difference of lightness, $a^* - a^*_{day0}$ – difference of green and red colour and $b^* - b^*_{day0}$ – difference of blue and yellow colour.

E. Statistical analysis

The results were processed by mathematical and statistical methods. Statistics on completely randomized design were determined using the General Linear Model (GLM) procedure SPSS, version 16.00. Two-way analyses of variance ($p \leq 0.05$) were used to determine significance of differences between means of hardness, moisture and mass lose by different packaging materials.

II. Results And Discussion

The aim of this work was to assess the effect of modified atmosphere (MAP: 100% CO_2 both by itself as well as with incorporated iron based oxygen scavenging sachets) during the storage time on the hardening of sherbet with crunchy peanut chips samples affected by moisture losses in two different type foils and Multibarrier 60 film packaging and to compare the results with control packaging in Multibarrier 60 film and air ambiance.

The changes of carbon dioxide content during the all storage time in investigated samples without oxygen scavenger (sample 1; 2; 4; 6) and with incorporated O_2 scavenger, 100 cc (sample 3; 5; 7) are presented in Fig. 2. Significant differences in carbon dioxide (CO_2) content during the 12 weeks storage among all sherbet samples packed in different kinds of materials and oxygen scavenger were found ($p<0.05$), (Fig. 2). Experimentally we have observed that carbon dioxide content in samples without and with incorporated oxygen scavenger considerably differed ($p<0.05$). An interesting phenomenon we have observed analysing experimental data of head space composition in modified atmosphere (MAP 100% CO_2) with incorporated oxygen scavengers. In all investigated samples with incorporated oxygen scavengers the CO_2 contend after 2 weeks the pouches collapsed and a perfect vacuum established (Fig.2). This phenomenon can be explained with carbon dioxide dissolving in the sherbet.

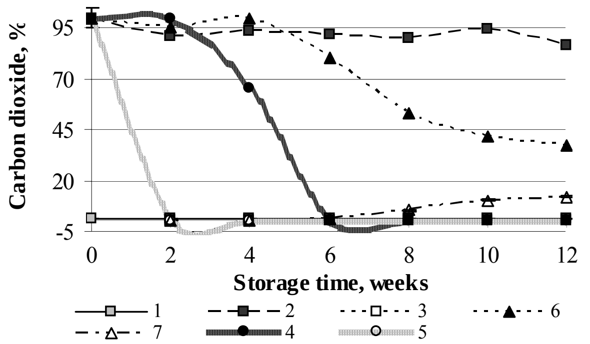

Fig. 2 The dynamics of carbon dioxide (CO_2) content in the headspace of package in during store

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

The monitoring of the change of O_2 composition is shown in Fig.3. In the sample 1 (Multibarier 60 bags, air ambience) the content of O_2 during all experiment period was disparate from packages in all other pouches ($p<0.05$), – it was similar like in the surrounding environment. In the packages made of Multibarrier 60 as well as of met.BOPET/PE without and with incorporated oxygen scavenger all storage time O_2 content stay close to zero. In return in the Aluthen pouches O_2 content increased from 0±0.0% till 14.2±0.5% to 13.3±0.8% during 12 weeks storage.

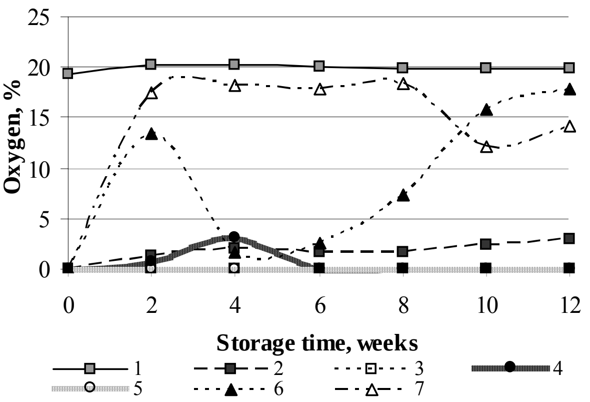

Fig. 3 The dynamics of oxygen (O_2) content in he headspace of package in during storage

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

The mass losses formed during the storage time are presented in Fig. 4. Experimentally we have observed that mass losses from the sherbet samples packed in Multibarier 60 pouches without and with incorporated oxygen scavenger considerably differed ($p<0.05$) from those packed in all another investigated film pouches both without and with oxygen scavenger.

Following these results, we can come to a conclusion that met.BOPET/PE and Aluthen film packaging without as well as with incorporated oxygen scavenger could be the best from investigated packaging materials for sherbet packaging and long-term storage.

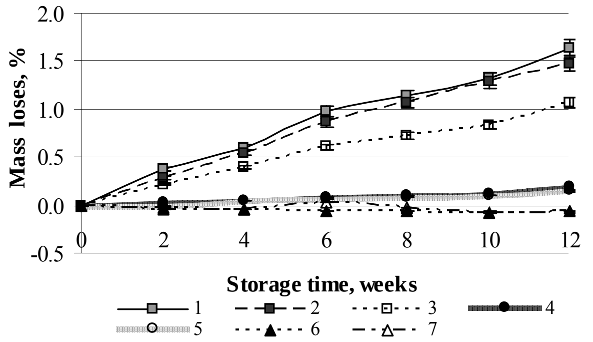

Fig. 4 Mass loses of samples after storage 12 weeks, %

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

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Initial moisture content of sherbet was 3.4±0.01 %. As we can see in Fig. 5. The moisture content decrease during 12 weeks storage changed. The moister content different change of samples are dependent on the packaging material various water vapour permeation through the material ($p<0.05$). In the all investigated sample pouches moisture content decreased average only one 0.1% to 1% during 12 weeks storage.

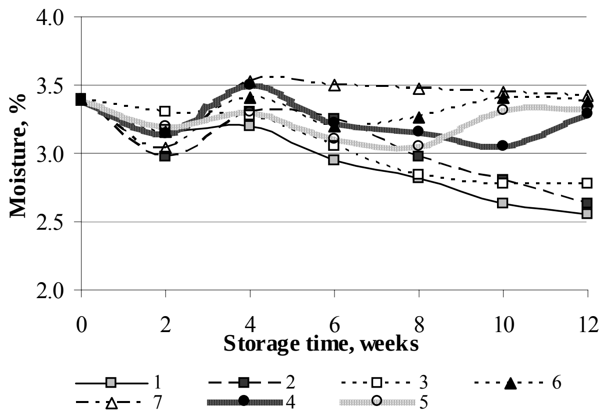

Fig. 5 The dynamics of moisture content of milk pomade sweets the storage

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

Texture changes of sherbet samples stored in various packaging materials and applying 100% CO_2 both by itself as well as with incorporated iron based oxygen scavenging sachet composition of MAP are presented in Fig. 6.

The hardening of sherbet has been observed irrespective of used packaging technology as well as by material type. The major reason can be water vapour migration through the packaging material and subsequent sucrose crystallisation, which promotes hardening. The initial cutting force of all samples at the beginning of experiment was determined 56.4±5.0 N. Mouth feel, texture and eating qualities are adversely affected by loss of moisture [11]. The mouthfeel of all tested samples during investigated storage time was observed as acceptable.

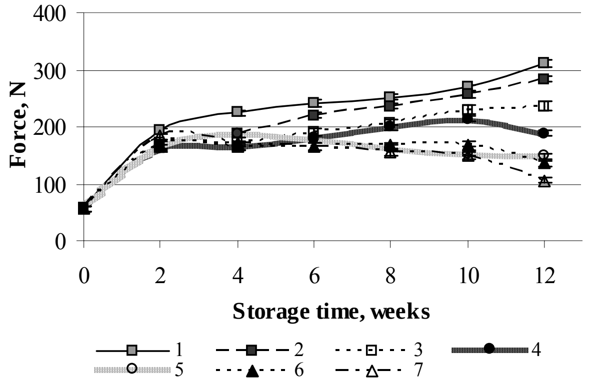

Fig. 6 The dynamics of texture changes of milk pomade sweets during storage

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

The hardness of all samples during first two storage weeks has increased noticeably from initial cutting force level 56.4±5.0 N up to maximum in Multibarrier 60 in air ambiance 199±5.0, whilst in all packaging in MAP the increase was less – on average only up to 160±5.0 N, which characterize any influence of CO_2 ambiance and incorporated oxygen scavenger as well. During the storage from two up to 12 weeks the hardening of all samples packed in Multibarrier 60 gradually continue to increase, especially that was observed in Multibarrier 60 in air ambiance (control) where the cutting force level reached the highest point – as far as 311±5.0 N, at the same time the influence of oxygen scavenger have been observed – characterizing by increase of sherbet hardness in Multibarrier 60 and MAP packaging with incorporated oxygen scavenger less – up to 235±5.0 N, but without scavenger the increase was a little higher – not over 280.0±5.0 N, what for all that is less tan in air ambiance packaging. The changes in hardening of sherbet samples within two up to 12 weeks in met.BOPET/PE pouches (100% CO_2) were insignificant, at the same time and same material with incorporated oxygen scavenger the hardness even slightly decreased from 160±5.0 N up to 150±5.0 N. The best results concerning the hardening showed packaging in Aluthen with incorporated oxygen scavenger, where the sample hardness after 12 weeks storage was 105±5.0 N, and among all tasted samples the best mouthfeel was accepted.

Colour is an important attribute because it is usually the first property the consumer observes. The Hunter (L, a, b) values were measured in order to describe the colour changes of fresh and sherbet during storage up to 12 weeks (Fig. 7 – 9).

The initial Hunter L, a, b values of sherbet samples were determined to be 64.43, 2.59 and 16.48, respectively. The total color difference (Δ E*) has been calculated using equation (1).

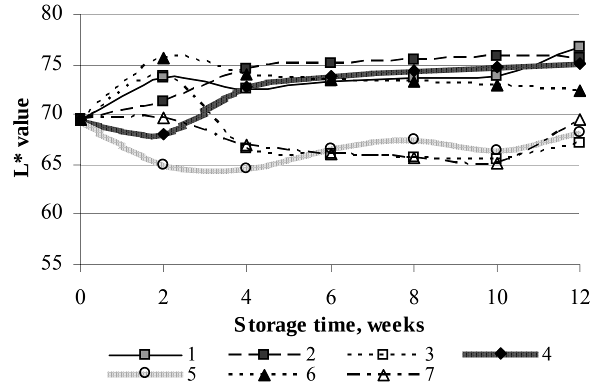

Fig. 7 The changes of milk pomade sweet L* values during the storage time

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

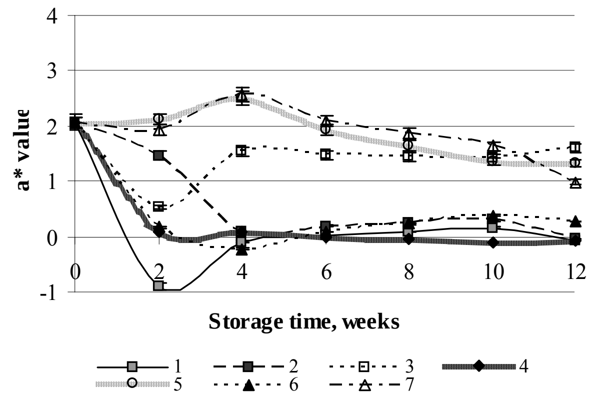

Fig. 8 The changes of milk pomade sweet a* values during the storage time

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

Non-enzymatic browning (NEB) might have influence the variations in the colour (L, a, b). As it has been observed, several factors like temperature, moisture, carbonyl compounds, fatty acids, O_2 presence and sugars have been reported to be a responsible for causing non-enzymatic browning in stored foods. Non-enzymatic, or oxidative, browning is a chemical process that produces a brown color in foods without the activity of enzymes.

One of two main forms of non-enzymatic browning is caramelize of sugars, what is a function of water activity.

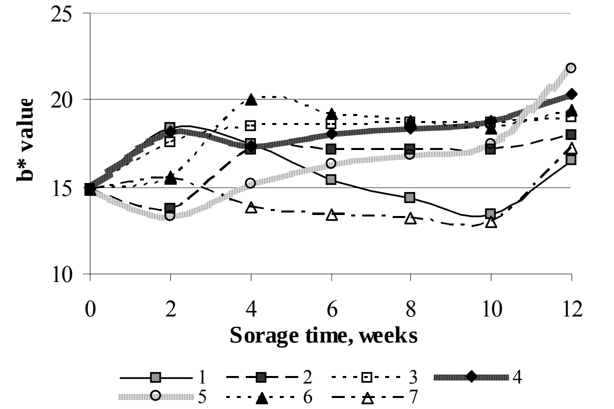

Fig. 9 The changes of milk pomade sweets b* values during the storage time

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

During storage, in experiments there was observed an insignificant changes in lightness of sherbet samples stored in Multibarrier 60 film and two Al foil laminates in MAP (100% CO2) both by itself as well as with incorporated iron based oxygen scavenging sachets. Though, comparatively samples packed in Aluthen both without and with oxygen scavenger samples become slightly lighter, whereas all samples in Multibarrier 60 and in met.BOPET/PE (100% CO2) – somewhat darker. Satisfactory good retention of sherbet colour was observed for samples packed in all investigated packaging materials as by itself as well as wit oxygen scavenger. The influence of packaging materials on the total colour difference ΔE^* of sherbet is shown on the Fig. 10. As can be seen, during storage a commonly colour change ΔE^* occurs during storage due to some physical properties as sugar crystallization took place. The less total colour difference was observed of samples packed in met.BOPET/PE and Aluthen pouches (100% CO_2) with oxygen scavenger, conforming to good application of that packaging style in satisfactory hardness retention during 12 storage weeks.

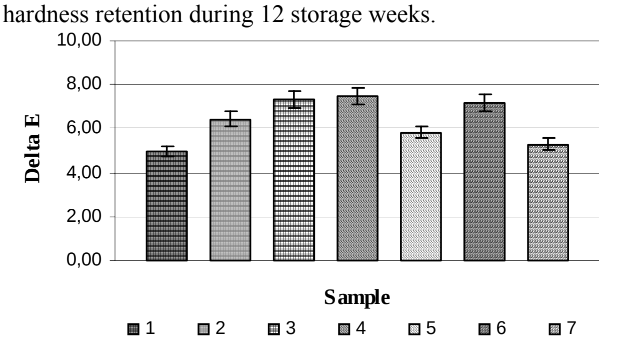

Fig. 10 The influence of packaging material on the total colour difference ΔE^* of Sherbet samples after 12 weeks storage

1 – Multibrier 60 pouches (air ambiance); 2 – Multibrier 60 pouches (MAP 100% CO_2); 3 – Multibrier 60 pouches (MAP 100% CO_2) +O_2 scavenger, 100 cc; 4 – met.BOPET/PE pouches (100% CO_2); 5 – met.BOPET/PE pouches (100% CO_2) +O_2 scavenger, 100 cc; 6 – Aluthen pouches (100% CO_2); 7 – Aluthen pouches (100% CO_2) +O_2 scavenger, 100 cc.

IV. Conclusions

As a conclusion the obtained results can be summarized that all investigated packaging materials are applicable for sherbet packaging, among them met.BOPET/PE and Aluthen considered as the best.

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References

[1] O. L.A. Quinton, J.F. Kennedy, "Book review: The Science of Sugar Confectionery - W.P. Edwards, The Royal Society of Chemistry, 2000", Carbohydrate Polymers, vol. 47, Issue 1, pp. 88-89, 2002.

[2] R. Ergun, R. Lietha, R.W. Hartel, "Moisture and Shelf Life in Sugar Confections", Critical Reviews in Food Science and Nutrition, vol. 50, Issue 2, pp. 162-192, 2010.

[3] T. Labuza, K.Roe, C. Payne, F. Panda, "Storage Stability of Food Systems: Influence of State Changes during Drying and Storage. (Published Conference Proceedings style)," in 14th International Drying Symposium, IDS 2004, Säo Paulo, Brazil, 2004, vol. A, pp. 48–68.

[4] A. Zumbé, A. Lee, D. "Storey, Polyols in confectionery: the route to sugar-free, reduced sugar and reduced calorie confectionery", British Journal of Nutrition, vol. 85, pp. 31-45, 2001.

[5] G. Barbiroli, P. Mazzaracchio, "Classification and standardization of bakery products and flour confectionery in relation to quality and technological progress", Food Control, vol. 5, Issue 1, pp. 33-38, 1994.

[6] A. Raisi, A. Aroujalian, "Reduction of the glucose syrup browning rate by the use of modified atmosphere packaging", Journal of Food Engineering, vol. 80, Issue 1, pp. 370–373, 2007.

[7] D. Manley, "Ingredients (Book style with paper title and editor)" in: Biscuit, cookie and cracker manufacturing manuals, Manual 1. D. Manley, Ed. Cambridge, UK: Woodhad Publishing Limited, 1998, pp. 5.

[8] LTD Laima, Product catalogue, 2006–2007. Available : http://www.laima.lv/files/catalogue2006-2007.pdf.

[9] E. Vorma, S. Muizniece-Brasava, L. Dukalska, "Effect of packaging materials and technologies on the milk pomade sweet sherbet with crunchy peanut chip's colour at the shelf life", Journal of International Scientific Publications: Materials, Methods & Technologies, volume 4, CD pp. 233–243, 2010.

[10] E. Vorma, S. Muizniece-Brasava, L. Dukalska, J. Skalbe, "Shelf Life Extension of Milk Pomade Sweet – Sherbet with Crunchy Peanut Chips by MAP in Various Packaging Materials", World Academy of Science, Engineering and Technology, Issue 65, pp. 1014-1020, 2010.

[11] R. Sabdo. , (2009, December 1). Active Packaging in the Confectionery Industry, Multisorb Technologies, Buffalo, N.Y., Available: http://www.snackandbakery.com/Articles /White_Papers/ BNP_GUID_9-5-2006_A_100000000000 00708972.

[12] A. Lopez-Rubio, E. Almenar, P. Hernandez-Munoz, J.M. Lagaron, R. Catala, R. Gavara. "Overview of Active Polymer-Based Packaging Technologies for Food Applications", Food Reviews International, vol. 20, No. 4, pp. 357–387, 2004.

[13] D. Restuccia, U.G. Spizzirri, O.I. Parisi, G. Cirillo, M. Curcio, F. Iemma, F. Puoci, G. Vinci, N. Picci, "New EU regulation aspects and global market of active and intelligent packaging for food industry applications", Food Control, vol. 21, No.11, pp. 1425–1435, 2010.

[14] C. López-Carballo, R. Catalá, D. Gavara, P. Hernįndez-Mući, "Food applications of active packaging EVOH films containing cyclodextrins for the preferential scavenging of undesirable compounds", Journal of Food Engineering, vol. 104, Issue 3, pp. 380–386, 2011.

[15] S.F. Mexis, A.V. Badeka, K.A. Riganakos, M.G. Kontominas, "Effect of active and modified atmosphere packaging on quality retention of dark chocolate with hazelnuts", Innovative Food Science and Emerging Technologies, vol. 11, Issue 1, pp. 177–186, 2010.

[16] S. Muizniece-Brasava, L. Dukalska, "Consumer awareness of an attitude to biodegradable polymer packaging materials and their implementation in the Latvian market", CHEMINĖ TECHNOLOGIJA, No. 3 (52), pp. 5-11, 2009.

[17] S.E. Papadakis, S. Abudal-Malek, R.E. Kamden., K.L. Yam, "A Versatile and Inexpensive Techniques for Measuring Colour of Foods", Food Technology, vol. 54, No. 12, pp. 48-51, 2000.

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