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RESEARCH ARTICLE

Effect of Packaging Material on Color Properties of Catsup Tomato Sauce

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ABSTRACT

Catsup and tomato sauce products currently are one of the most popular and commercially available table sauces particularly consumed by young people and families around the world in recent decades. In this study colorimetric properties of catsup sauce samples including L, a* and b* values in different packaging materials including PP, PE, PET, Glass and Sachet have been investigated during and after 180 days storage time at 22˚C (environmental temperature). Hunter Lab system has been used to evaluate the color values of sauce samples. According to obtained results of experimental measurements and sensory evaluations, PP and PE packaging materials affected significantly color properties of catsup sauce samples during and after the storage time that it because of interaction between packaging material and lycopene components in catsup sauce samples. Finally, According to consumer prefers to darker tomato and catsup sauce products, PP and PE are not suitable for packaging of catsup sauce production.*

Key Words:
Packaging Material; Color Properties; Catsup Tomato Sauce

INTRODUCTION

Tomato catsup, a sauce manufactured from ripe tomatoes, which is flavored with sugar, vinegar, salt and some additional spicy ingredients. It currently is one of the most popular, commercially available table sauces and particularly, young people and families with high consumption of `catsup-friendly` products such as hamburger, French fries and chicken wings represent the group of target consumers (Intelmann et al., 2005). Tomato as raw material for catsup sauce production contains bioactive and phytochemical components contribute to some health benefits (Tan et al., 2010). The high glucose

content and high dry matter content contributes to an increase in water activity on the level from 0.93 to 0.95. The amount of added vinegar results in 0.8 and 1.0% acetic acid in product (Lund et al., 2000). This product also has an extensive shelf-life time and with relatively heat treatments can be stored for one or more years at ambient temperature (Rajchl., 2010). The catsup is required to be a clear tomato color, smooth looking, without any blots with a consistency that is neither too waterish nor too compact so that it does not spur or separate the liquid part from the solid after shaking and then opening the bottle (Ranken et al., 1996). From the physical point of view, catsup is two-phase system in which solid particles of tomato pulp and added spices are dispersed in a colloidal continuous phase that consist of sugars, salts, organic acids, a fraction of soluble pectins, and other compounds of extract dissolved in water (Juszczak et al., 2012). The vibrant red color of tomato products such as catsup sauce is due to the presence of the carotenoid and lycopene. Beta-carotene may also contribute to the color profile (Barrett and Anthon, 2008).

Packaging is the tool that protects and contains products so that the environmental effect on the food in the package is minimized. Effective packaging is vital to the health and welfare of the consumer. The materials and methods used to package food have changed more in the recent decade than over the preceding 150 years (Gramiccioni et al., 1996). The quality, safety, and nutritional content of packed foods have not been thoroughly researched for certain newly packed foods. The desire for higher quality and safer food with a longer shelf-life led to increased interest in the interaction between foods and food packaging (Joshi et al., 2002). Color is an important quality feature of catsup sauces that affected during storage time by environmental conditions and packaging attributes significantly. Sensory evaluation of catsup sauces indicated that consumers preferred much redder sauce samples, so if packaging properties influences the color of catsup sauce acceptability of products should be changed (Intelmann et al., 2005). Baiano et al. (2005) represented a comparative study of the effects of varied packaging materials (including glass, polyethylene terephtalate [PET], PET added with an oxygen scavenger, and polypropylene [PP]) on the quality decay kinetics of a semi-preserved sauce. They suggested that the packages chosen for experiments can be used interchangeably. They found two exceptions were represented by lycopene content whose decrease was faster in PET and PP than in glass and PET containing the oxygen scavenger and the peroxide data which reached the highest values for PET containers. Patricio et al. (2007) found that packaging materials influenced organoleptic properties of sweet cream during the storage time. Monomer migration from material packaging contributes to significant effects on aroma, color and organoleptic characteristics of food (Arvanitoyannis and Bosnea, 2010). Polymer based packaging materials affect more than other kind of packaging materials in varied food flavor and color properties (Hotchkiss, 1997). Zygoura et al. (2004) reported that polymer based packaging led to increase in shelf-life of pasteurized milk in compared with other packaging materials. Also, the aim of the present study was to investigate the color properties of catsup sauce with different packaging materials and conditions during the storage time.

MATERIALS AND METHODS

Samples

Catsup sauce samples manufactured by Mahram Company at the same batch production with different packaging materials including Poly Ethylene (PE), Poly Propylene (PP), Poly Ethylene Terphetalate (PET), Sachet (single-use packaging with laminated from in to out PE, Aluminum, PE and Poly ester layers) and Glass were purchased directly from the

company. All catsup packages stored at 22 ℃ (environmental temperature) for 180 days and samples were taken at 15-day intervals for color analysis and finally for sensory evaluation.

Instrumental color analysis

Color characteristics of the catsup sauce samples were determined by measuring the L* a* and b* values using Hunter Lab (Color Flex, Hunter Associates Laboratory, Virginia, USA), according to the CIE Lab scale. The system provides the values of three color components: L* (black-white component, luminosity), a* (+red to –green component) and b* (+yellow to –blue component). Samples (15 ml) were pipette into a glass Petri dish (5 cm diameter). The sample was illuminated with artificial daylight (10 ° standard angle - D65 model) according to procedure provided by the manufacture. The color determination was conducted in four replications for each sample. Color values determined as a*/b* suggested to report for catsup sauce samples (Intelmann et al., 2005).

Figure 1 Effects of packaging material on a color value of catsup sauce during 180 days*

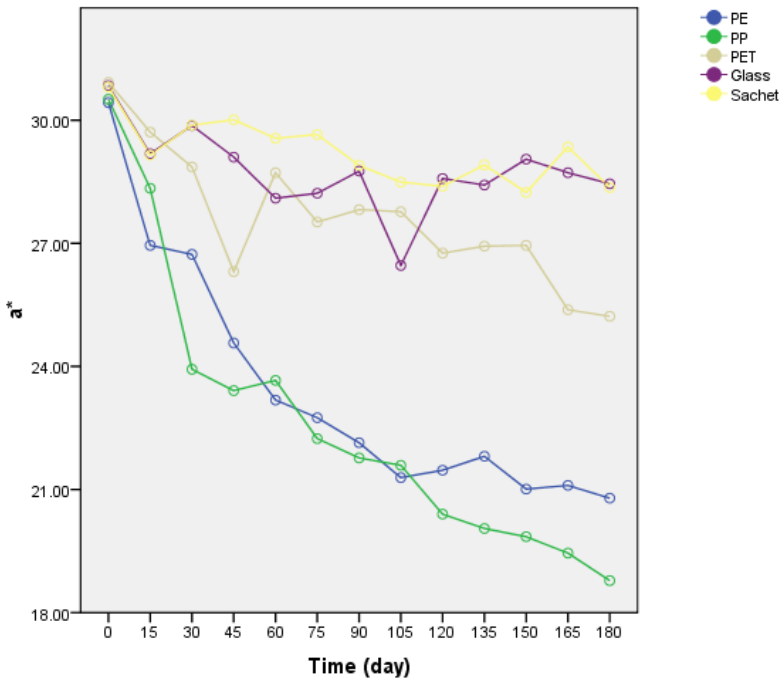


Figure 2.Effects of packaging material on b color value of catsup sauce during 180 days*

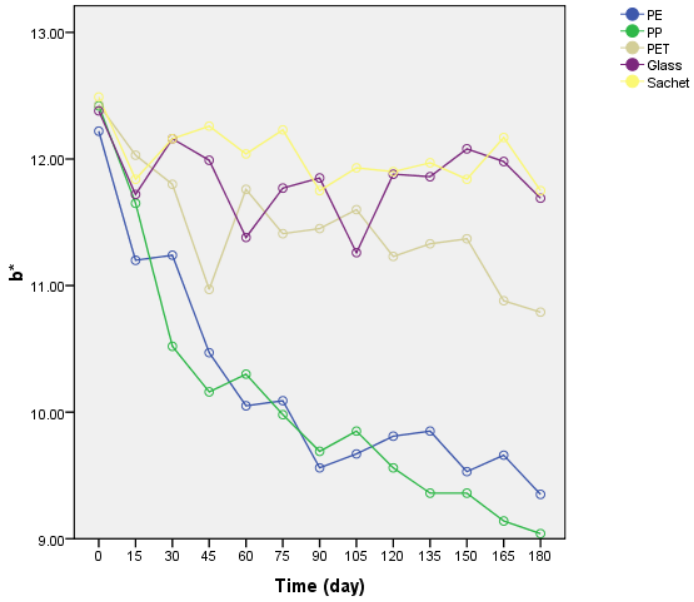
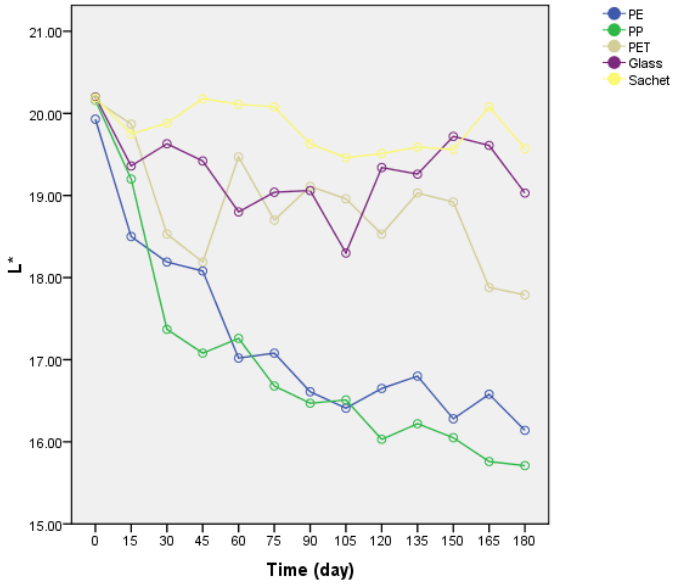


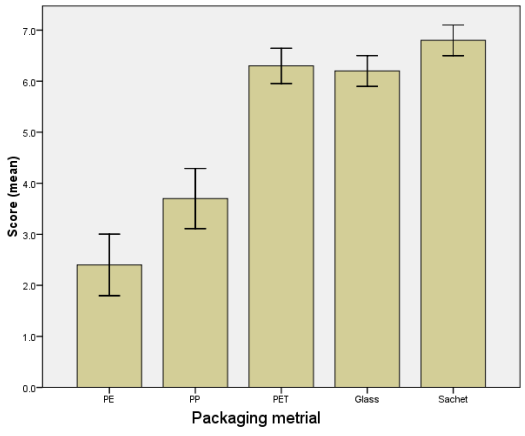
Figure 3.Effects of packaging material on L color value of catsup sauce during 180 days*



Sensory evaluation

After 180 days storage, all catsup samples were analyzed with hedonic scoring color evaluation. Sensory evaluation of color for catsup samples was carried out by means of a panel of 24 trained panelists. The tests were carried out under daylight simulating illumination in a sensory laboratory against a white background. The samples were encoded with three-digit random numbers and presented in open transparent petri dishes of 65 mm diameter in random order. A 7-point hedonic scale including both the number and verbal scores was provided to the panelists (Sharoba et al., 2005). The scores were; Like extremely (7), Like very much (6), Like moderately (5), Neither like nor dislike (4), Dislike moderately (3), Dislike very much (2), Dislike extremely (1). A section for the panelist`s comment was presented in the evaluation sheet. Consistency is associated to the viscosity perceived by the panelists. Mean scores for each attribute were calculated for comparison of the samples.

Figure 4. Sensory evaluation of color quality of catsup sauce after 180 days in different packaging materials



Statistical analysis

All calculations were carried out in duplicate and all experimental measurements were done in triplicate for each 15-mL sample. Data (obtained after 180 days storage and in sensory evaluation) were statistically evaluated by one-way analysis of variance (ANOVA) procedure using Duncan`s multiple range test while significance was defined as $p < 0.05$. All statistical analyses were conducted using the software SPSS (v. 17, Chicago IL, USA).

Table1 Effects of packaging material on L, a* and b* color values of catsup sauce after 180 days*

	L*	a*	b*
PE	16.14^{b}	20.78^{b}	9.35^{b}
PP	15.70^{a}	18.81^{a}	9.04^{a}
PET	17.78^{c}	25.20^{c}	10.77^{c}
Glass	19.04^{d}	28.47^{d}	11.68^{d}
Sachet	19.57^{e}	28.37^{e}	11.75^{e}

RESULTS AND DISCUSSION

Effects of packaging material including Poly Ethylene (PE), Poly Propylene (PP), Poly Ethylene Terphetalate (PET), Sachet (single-use packaging with PP for internal layer) and Glass on L*, a* and b* color values of catsup sauce have shown in Fig 1, 2 and 3. All color values were changed similarly in same times. As it demonstrated in Figs 1-3, glass and sachet packaging had no significant effect on color values of catsup sauce during and after 180 days storage time but this result can not be obtained for PET, PE and PP packaging materials. There are significant effects on color values of catsup sauce during and after storage time for PET, PP and PE packaging materials. Baiano et al (2005) also found that PET, PP and PE packaging materials had significant effects on colorimetric characteristics and lycopene assay of tomato sauce but glass containers did not affect properties of tomato sauce samples. Lycopene is major pigment component in tomato products such as sauce and catsup. Packaging materials such

as PET, PP and PE have a considerable influence on lycopene pigments in catsup and tomato sauce so colorimetric properties can be affected by these packaging materials during the storage time. Glass container is excluded between mentioned plastic packaging materials (Baiano et al., 2005).

Other foods also are influenced by plastic packaging material. Brasava et al in the year 2013 investigated effects of plastic and aluminum packaging material on colorimetric characteristics of potato chips samples and they found that plastic packaging affect on color values properties of potato chips samples significantly. Even tough color properties are the most important characteristics in the consumption acceptability and commercial availability so the color changing in storage time is not favorable to consumers (Intelmann et al. 2005). Sensory evaluation of color quality and acceptability of catsup sauce after 180 days in different packaging materials have shown in Fig 4. According to it, sensory evaluation in color properties of samples demonstrated that PE and PP packaging materials affected the color quality of catsup sauce samples significantly so that confirmed the results obtained by hunter Lab experiments (Brasava et al., 2013). ANOVA analysis of L*, a* and b* color values of catsup sauce samples affected by different packaging materials also have shown in Table 1 that demonstrated significant different in L*, a* and b* color values affected by all packaging material groups. Color value changes exist in all samples but they were more in PE, PP and PET packaging material samples. Consumers also prefer darker (higher lycopene contents) for tomato and catsup sauce products so according to colorimetric properties of sauce samples PP and PE packaging materials are not suitable for tomato sauce products in high storage time.

CONCLUSION

Colorimetric properties of catsup sauce samples including L*, a* and b* values measured by Hunter Lab system in different packaging materials including PP, PE, PET, Glass and Sachet have been investigated in this study during and after 180 days storage time at 22° C (environmental temperature) . According to obtained results of experimental measurements and sensory evaluations, PP and PE packaging materials affected significantly color properties of catsup sauce samples because of interaction between packaging material and lycopene components in catsup sauce samples. According to results consumer prefers to darker tomato and catsup sauce products, PP and PE are not suitable for packaging of catsup sauce production.

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