



EFFECT OF PH REDUCTION IN THE COLOR OF CAKES

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ABSTRACT

Appearance is one of the sensory attribute that give first impression regarding a product to the consumers. Color plays a major role in determining the overall quality of the product. Cakes have wider consumer acceptance among bakery and confectionary products due to its characteristic color, texture and taste. Each and every ingredient in cakes have significant role in its overall quality. Acidic cakes like lemon cakes are unique with its taste and flavor. In this study, change in color of cakes were analyzed and tried to evaluate the effect of pH and sugar on color. Cakes were baked at similar processing conditions. Lemon juice and maltitol were added in different proportions by varying water and sucrose respectively along with flour, egg powder, baking powder and fat. Color of crust and crumb were evaluated on the second day of baking using colorimeter. A significant color difference was observed between samples. Crust color become darker and color intensity of crumb increased on increasing the amount of lemon juice. Maltitol doesn't contribute significantly to the browning reaction.

KEYWORD: Pound cake, Lemon juice, Maltitol, Color.**INTRODUCTION**

Cakes were generally classified as layer cakes, foam cakes, and pound cakes, based on the methods used to produce it (Miller, 2016). The main ingredients using for cake baking include all purpose flour, eggs, sugar and fat. Each ingredient contributes significantly to the characteristic properties of cakes. Sucrose reduction is gaining popularity in food industry due to the increase of lifestyle diseases like diabetes, obesity and teeth problems (Ortiz, 2016). Polyols or sugar alcohols are widely used in bakery products as sugar replacer due to its low energy compared to sucrose. Among polyols, maltitol is the most common as its sensory properties are similar to sucrose (Nourmohammadi and Peighamardoust, 2015; Struck *et al.*, 2014; Jia *et al.*, 2008). Use of polyols in formulation results in lighter colored baked products, as it is not

actively participating in Maillard reaction (Ronda *et al.*, 2005).

Color is an important attribute that give first impression to the customers regarding the product (DuBose *et al.*, 1980). Barbosa-Canovas *et al.*, 2009 defined color as, it is essentially a beam of light composed of irregularly distributed energy emitted at different wavelengths. Color properties of a food are depending upon their composition and structure (Barbosa-Canovas *et al.*, 2009). The variations in color can be observed during baking, if any changes in temperature occur. High temperature baking will leads to darker color and low temperature baking leads to pale color (Sani *et al.*, 2014). The browning of cakes take place due to non enzymatic browning reaction called Maillard reaction. The color values are expressed in L*, a*, b* (CIELAB) and each variable is described (McGuire, 1992) as shown in Table 1.

TABLE: Color values and descriptions (McGuire, 1992)

Color value	Definition	Description	+ indicates	- indicates
L*	L* sample minus L* standard	difference in lightness and darkness	lighter	darker
a*	a* sample minus a* standard	difference in red and green	redder	greener
b*	b* sample minus b* standard	difference in yellow and blue	yellower	bluer

Along with emulsification, foaming and coagulation (Bennion and Bamford, 1997), eggs also contributes to the sensory properties like color, taste, aeration and structure to the product (Cauvain, 2003). Fat gives soft, smooth and shiny outer layering to the baked cake along with its primary functions like aeration and tender structure formation (Wilderjans *et al.*, 2013). Citrus juice is also known for its health benefits. It is very effective for treating sore throats, other throat infections, cold, dental

care, tonsillitis and others. It contains lot of antioxidants, can prevent ageing and wrinkle formation. It is a good source of potassium; lemon provides relaxation from ionic imbalance symptoms like nausea, dizziness, mental stress, anxiety and depressions (Bharate and Bharate, 2014). Lemon contain high amount of citric acid (49.2g/kg) compared to other citrus fruits (Poerwono *et al.*, 2001).

In this study, the effect of pH reduction along with the interaction of each ingredient on the colour of baked cakes was evaluated.

MATERIALS & METHODS

The main ingredients used for baking of cake include type 45 wheat flour, whole egg powder, Corman fat, crystal sugar, maltitol powder, sodium bi carbonate, Sodium Acid Pyro Phosphate 10 (SAPP 10) and lemon juice.

Wheat flour of type 45 was supplied by Giraudineau (France) with 14.8% water content, 10.7% protein, 0.2% fat, 66.8% starch and 0.42% ash. Whole egg powder was supplied by Ovobio (France). It is composed of 48% protein, 38 % fat and less than 5% moisture. Corman fat which is a blend of rapeseed oil (70%) and anhydrous milk fat (30%) is a ready to use fat blend supplied by Corman (Belgium) was used. Crystal sugar was supplied by Tereos (France). Crystalline maltitol (MALTILITE P 200) was supplied by Tereos (France). Baking powder (sodium bicarbonate) and SAPP 10 (Sodium Acid Pyro Phosphate 10, leavening acid) used in this formulation was supplied by Budenheim. Hundred percentage fruit lemon juice is purchased from Lea Nature, Jardin Bio (France). The mean nutritional data per 100 mL of lemon juice contain 36 mg of citric acid, 1.7 g carbohydrates, 0.8g fat, 0.2 g saturated fat, 0 g protein and remaining water. The total energy per 100 ml is 133 kJ energy.

Experimental design was done with the help of Statgraphics Centurion XVII-X64 (France) with two factors, lemon juice and crystal sugar. All the dry ingredients and water for mixing were taken at room

temperature (22-24 degrees Celcius). Corman fat and lemon juice at 6- 8 degrees Celcius was used for mixing. The dry ingredients given in the formulation were weighed and sieved properly and mixed for a minute at the lowest speed in a Kitchen aid (St Joseph, Michigan USA, Heavy duty model 5KPM5) with whisk (mixing blade). Then water was added to this and again mixed for a minute at the same speed. Fat was blended into the mixture through three stages of mixing initially for one minute at lowest speed (speed 1; 30-37rpm), then for 2 minutes at medium speed (speed 6; 69-78 rpm), and at highest speed (speed 8; 82- 92 rpm) for 3 minutes. The batter prepared was poured into previously greased baking moulds (300 g in each) and kept for 20 minutes as resting period. Conventional baking was done in a preheated (180 degrees Celcius for an hour) lab model domestic oven at 180 degrees Celcius for 25 minutes.

RESULTS & DISCUSSION

Color changes in crust and crumb of different cakes were checked using Konica Minolta Colorimeter (CR- 400) in L*,a*,b* scales on the second day of baking. Baked cakes were covered using freezer bags to retain moisture and to avoid drying of crust. Figure 1 and Figure 2 showing the top view and cross- sectional view of samples respectively. Color change was significant in both crust and crumb of all the samples. As acidic content of cakes increases, crust is getting darker even without complete baking. Crumbs are more yellowish in acidic cakes. Decrease in L*and b* values of crust indicates the shift of crust color from lighter to darker (Fig. 3).



FIGURE 1. Top view of trial samples (C-LJ:S indicates the sample name with lemon juice and crystal sugar ratio 0:21, 2:23, 2:18, 7:21, 7:25, 7:17, 12:23, 12:18 and 14:21 respectively)



FIGURE 2. Crosssectional view of trial samples (C-LJ:S indicates the sample name with lemon juice and crystal sugar ratio 0:21, 2:23, 2:18, 7:21, 7:25, 7:17, 12:23, 12:18 and 14:21 respectively)

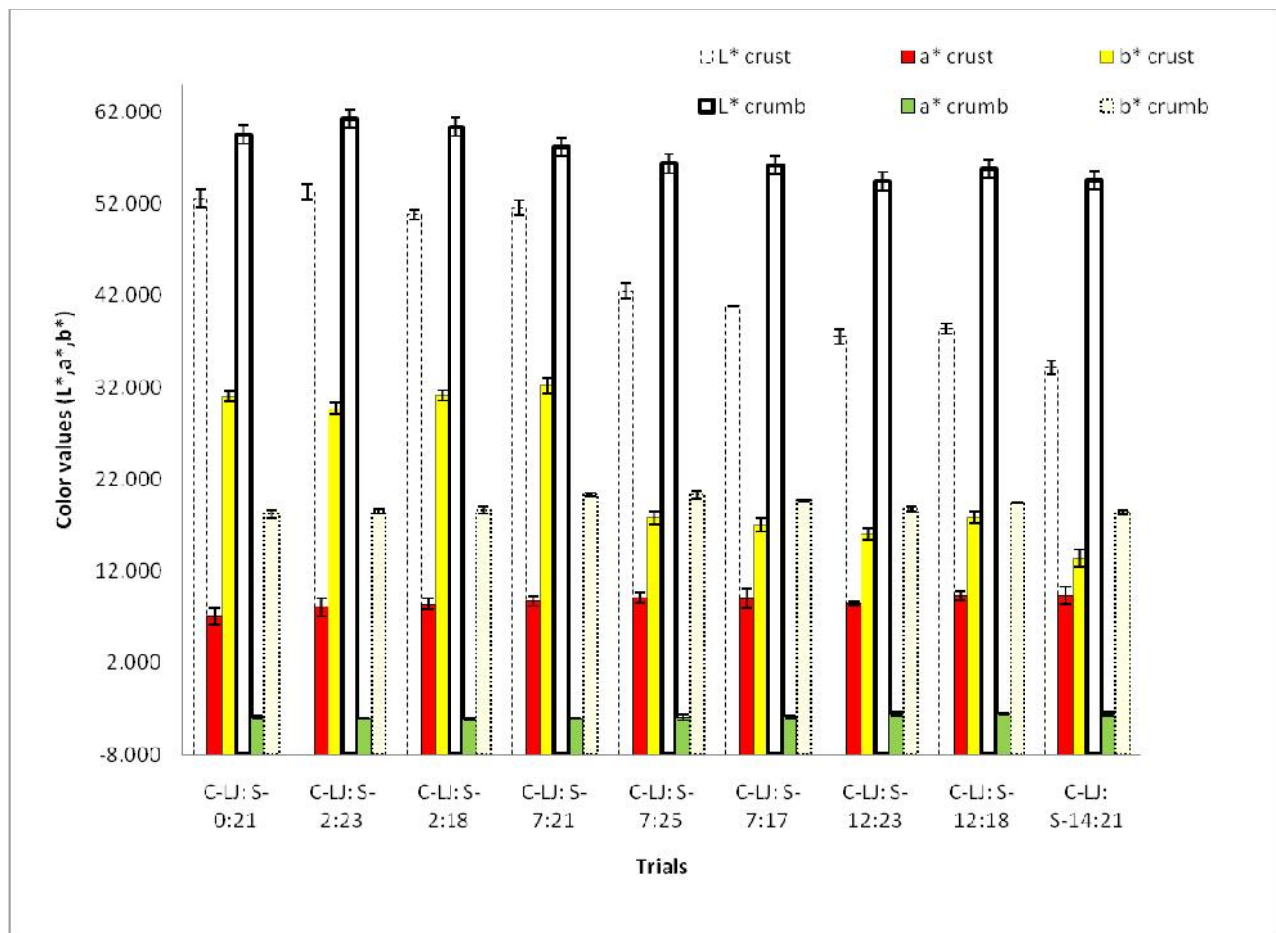


FIGURE 3: Changes in color of crust and crumb of samples (C-LJ:S indicates the sample name with lemon juice and crystal sugar ratio 0:21, 2:23, 2:18, 7:21, 7:25, 7:17, 12:23, 12:18 and 14:21 respectively)

For L* value of crumb, it was found to be decreasing. It clearly indicates that crumb also getting darker in color

compared to control (cake without lemon juice). The increase in the color intensity of crumb to yellowish shade

may due to the addition of yellow color lemon juice to the formulation. The batter also found to be more yellowish as the amount of lemon juice in the batter system increases. Browning of cakes is due to the maillard reaction of sugars on heating. This reaction get accelerates in the presence of acids. Acids in cake increases hydrolysis of sugars and it leads to produce reducing sugar. The reducing sugars react with proteins leads to more browning. Increase in intensity of crumb color may due to the denser structure of the cakes. Even though the sucrose in cake was reduced with maltitol, it was not completely replaced. So the remaining sugar can take part in maillard reaction and it can be catalysed by the acid present in the cakes. The change in color was evident. The color of acidic cakes was changing even after 15 minutes of baking. Color of cake cannot be taken as an indicator of completion of baking in the case of acidic cakes. Baking the cakes more than 25-30 minutes will result in charring of the crust.

CONCLUSION

It was concluded that the addition of lemon juice plays a significant role in changing the color of cake. Color of cake changed from golden brown to dark brown. L*, a* and b* of crust was decreased from 52.6 to 34.183, 7.06 to 9.35 and 30.987 to 13.410 respectively and L* of crumb was decreased from 59.55 to 54.583. There was no significant changes in a* and b* values of crumb. Baking at low temperature is recommendable for high acid cakes. Replacing sucrose with maltitol can also be a good solution to reduce darkening of crust. But it may affect other sensory characteristics of cakes.

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