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Investigation on using of sorbitol, isomalt and whey powder for producing chocolate muffin

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ABSTRACT:

In this study, physicochemical, textural and sensory properties of chocolate muffin cake were evaluated by substitution of sucrose with different levels of sorbitol and isomalt and flour with different levels of whey powder in the cake formulation and tests were done in three repeats. In this study, there were two stages, in the first stage, two levels of whey powder (30 and 40%) was used in the formulation and the different properties of produced cake were determined. According to obtained results from this stage, the level of 30%was selected as the best level. In the second stage, there were 5 substitution levels sugar with sorbitol and isomalt: 0% (A), 4% sorbitol+4% isomalt (A_1), 8% sorbitol+8% isomalt (A_2), 8% sorbitol+4% isomalt (A_3), and 4% sorbitol+8% isomalt (A_4). Experiments were performed in a factorial form in a completely randomized design. The results showed that the substitution of sorbitol and isomalt instead of sucrose has significant effect on the percentage of moisture and carbohydrate in muffin. By increasing the percentage of sorbitol and isomalt in cake formulation, it was discovered that the moisture product were increased meaningfully, but carbohydrate was decreased. The texture analysis of muffin treatments showed that the highest amount of hardness was in treatment of 8% sorbitol+8% isomalt (A_2). By increasing storage time, the amounts of hardness were increased Finally, sensory evaluation results of five muffin cake formulations indicated more acceptance of prepared treatment of 8% sorbitol+4% isomalt (A_3). Totally, prepared muffin by using 8% sorbitol+4% isomalt can be introduced as the best treatment.

Keywords:
Isomalt, Muffin, Sorbitol, Whey protein

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INTRODUCTION

Most bakery products can easily be enriched and fortified at low cost with proteins, various vitamins and minerals to meet the specific needs of the target groups and vulnerable sections of the population, who are under nourished and mal nourished (Indrani *et al.,* 2007).Whey proteins are utilized as an important functional ingredient in dairy, meat and bakery products. Today, whey protein is popular among athletes that this is apparently due to the antimicrobial activity, immune modulation, improved muscle strength and body composition and to prevent cardiovascular disease and osteoporosis, Whey has high concentrations of the amino acids such as leucine, isoleucine and valine (Kerasioti *et al.,* 2013).The functional properties of whey are solubility, connectivity and water absorption, improved viscosity, gel consistency adhesion, elasticity and emulsification. The sweet taste of muffin was provided by sucrose and it has important roles that include delay in gelatinized starch and thermal denaturation of proteins during cooking (Martínez-Cervera *et al.,* 2012). However, polyols such as sorbitol, isomalt, xylitol, maltitol and lactitol, are suitable for people with diabetes diet (Attia *et al.,* 1993). Removing energy-rich compounds such as sucrose and replace this compound is one way to produce healthy food for people with diabetes or those who suffer from weight problems (Baeva *et al.,* 2000). Lee and Oh, (2010) studied the effect of 50% replacement of sucrose by erythritol, sorbitol or xylitol on cake quality. They

Figure 1. Effect of whey powder on the moisture content of chocolate muffin

observed difference in thermal properties, viscosity, moisture content, specific volume, volume index, symmetry index, colour, microstructure, texture and sensory analysis.

In this study, physicochemical, textural and sensory properties of chocolate muffin cake were evaluated by substitution of sucrose with different levels of sorbitol and isomalt and flour with different levels of whey powder in the muffin formulation.

MATERIALS AND METHODS

This study was performed at two steps; the samples containing whey powder were prepared in the concentration of 30 and 40 percent, at the end of the first step, The sample contains 40% of whey powder was removed due to lack of good quality. In the second stage, the isomalt and sorbitol alcohol sweeteners in two levels, 4 and 8%were added to the sample containing 30% whey powder (Table 1). Method of Martinez-Cervera *et al.* (2014) was used to prepare chocolate muffin. Some

Table 1: Percentage of compounds in each treatments (samples)

Compounds(%)	Control	A	B	A_1	A_2	A_3	A_4
Flour	32.72	32.72	19.632	22.904	22.904	22.904	22.904
Cocoa powder	6.54	6.54	6.54	6.54	6.54	6.54	6.54
Baking powder	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Egg	10.47	10.47	10.47	10.47	10.47	10.47	10.47
Sugar	15.7	15.7	15.7	14.44	13.188	13.188	13.188
Oil	7.85	7.85	7.85	7.85	7.85	7.85	7.85
Milk	26.17	26.17	26.17	26.17	26.17	26.17	26.17
Whey powder	0	9.816	13.08	9.816	9.816	9.816	9.816
Sorbitol	0	0	0	0.628	1.256	1.256	0.628
Isomalt	0	0	0	0.628	1.256	0.628	1.256

A: cake containing 30% whey; B: cake containing 40% whey; A_1: 4% sorbitol + 4% isomalt; A_2: 8%sorbitol + 8% isomalt; A_3: 8% sorbitol + 4% isomalt; A_4: 4% sorbitol + 8% isomalt

Fig 2. Effect of whey powder on the pH of chocolate muffin

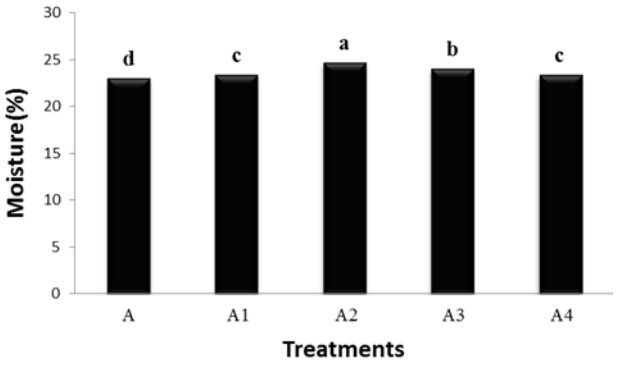

Figure 4. Effect of treatments on the moisture content of chocolate muffin

properties were studied including chemical experiments, rheological and organoleptic tests. The experiment was conducted as completely randomized design with seven treatments and three replications; also Duncan test was applied for means comparison at 5% statistical level.

RESULTS AND DISCUSSION

Effect of whey powder on the moisture

Figure 1 shows that treatments had significant effect on moisture% and control had highest value of moisture. By increasing the percentage of whey powder in the cake formulation, it was discovered that the moisture was decreased meaningfully. Whey protein is soluble in water and hence cannot be connected with large amounts of water, so it seems that the reduction of the moisture content with increasing levels of replacement is, related to this property (Boye *et al.,* 1995). Our result was in accordance with the results of Arunepanlop *et al.* (1996) that with the increasing of whey protein isolate percentage in angel cake, moisture decreased significantly.

Effect of whey powder on the pH

According to the Figure 2, 6.51 -6.70 values were observed by whey application, whereas control and 40% whey powder treatments showed lowest (6.51) and highest (6.91) means, respectively. The reason is probably, pH of whey (approximately 7) was higher than the muffin pH and whey addition to cake increases the pH.

Effect of whey powder on the protein

Application of whey powder had significant effect on protein%, so by increasing the percentage of whey powder in cake formulation, it was founded that the protein percentage was increased meaningfully (Fig ure 3) since whey protein is at least 25%, whey enhances the protein percentage (Aryana *et al.,* 2002). Our result was in accordance to the results of Munaza *et al.* (2012) that with the increasing of whey percentage in biscuits, protein increased significantly.

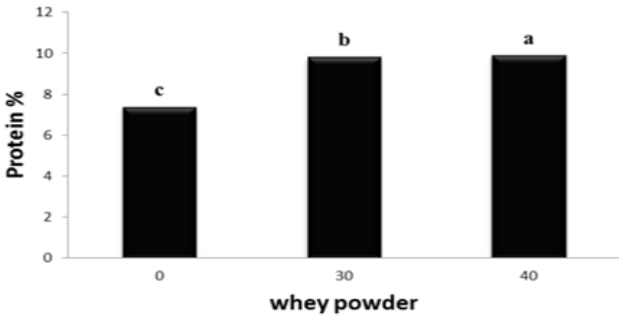

Figure 3. Effect of whey powder on protein percentage of chocolate muffin

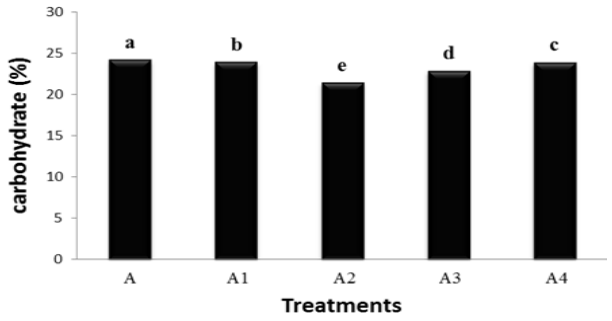

Figure 5. Effect of treatments on the carbohydrate of chocolate muffin

Table 2: Comparison means for Hardness

	Samples	After 1 day	After 2 days	After 10 days
Hardness values (N)	Control	$8.15 \pm 2^{C,a}$	$8.53 \pm 1.41^{B,a}$	$11.32 \pm 1.04^{A,a}$
	A	$4.34 \pm 0.34^{B,b}$	$3.67 \pm 0.03^{C,c}$	$7.33 \pm 0.14^{A,b}$
	B	$3.36 \pm 0.52^{C,c}$	$4.24 \pm 0.33^{B,b}$	$7.8 \pm 0.67^{A,c}$

A: Cake containing 30% whey; B: Cake containing 40% whey Capital alphabets and lowercase alphabets indicate a significant difference between the values in days and samples, respectively.

Effect of whey powder on the texture

According to table 2, it was found that treatments had significant effects on hardness. At the first day, by increasing the percentage of whey powder in cake formulation, the hardness was decreased significantly but by increasing the storage time, hardness was increased significantly and highest value was observed by control and after 10 days. It seems that, the possibility of gas expansion was provided in the pore structure during baking cake and the larger pores caused in the product (Boye *et al.,* 1995). Our result was in order to the results of Arunepanlop *et al.* (1996) that with the increasing of whey protein isolate percentage in angel cake, hardness decreased significantly.

Effect of whey powder on the sensory properties

The results of sensory properties were mentioned at Table 3, according to the analysis of results, there were no significant differences between the control and 30% whey. But there were significant difference between the control and 30% with 40%.Munaza *et al.* (2012) reported that whey replacement had positive effect on total acceptance.

Effect of polyols on the moisture

Lowest moisture was observed at control (23%) and by increasing substitution, the moisture was increased significantly and 8% sorbitol + 8%isomalt (24.65%) had highest means (Figure 4). Because increasing of moisture can be attributed to presence of sugar alcohols sorbitol and isomalt in the formulation of cake, as sugar alcohols having hydroxyl groups tend to hold water in their buildings (Akesowan, 2009). Also, sugar increases the starch gelatinization temperature and protein denaturation, it helps to remove moisture from the product. Thus reducing the amount of sugar increases moisture in the product (Kocer *et al.,* 2007). In this regard, Pareyt *et al.* (2009) and Zoulias *et al.* (2000) reported similar results.

Effect of polyols on the carbohydrate

Also it was founded that sorbitol and isomalt substitution had significant effect on carbohydrate, A treatment (control) showed highest value (24%) and A_2 treatments (8% sorbitol + 8%isomalt) had lowest means (21%) (Figure 5). A reduction in carbohydrates can be attributed to a decrease in sucrose. The results of this study correspond closely with the study by Lin *et al.* (2010) and Akesowan, (2009) findings.

Effect of polyols on the texture

According to table 4 and hardness, on the first day of cooking, there was no significant effect between samples except A_2 treatments (8% sorbitol + 8% isomalt) ($P>0.05$). In the case of A (control) and A_2 (8% sorbitol + 8% isomalt), there were no significant effect at the first

Table 3: Organoleptic properties of the samples analyzed

Parameters/samples	B	A	Control
Texture	2.80 ± 0.79 b	4.20 ± 0.79 a	4.40 ± 0.84 a
Taste	3.70 ± 0.82 b	4.50 ± 0.53 a	4.40 ± 0.84 a
Color	3.20 ± 0.79 b	3.90 ± 0.74 a	3.50 ± 0.53 ab
Redolent	4.30 ± 0.48 b	4.80 ± 0.42 a	4.60 ± 0.52 ab
Appearance	4.20 ± 0.42 a	4.60 ± 0.52 a	4.60 ± 0.52 a
Admission	3.30 ± 0.67 a	4.80 ± 0.42 a	4.80 ± 0.42 a

A: cake containing 30% whey; B: cake containing 40% whey

Table 4: Effect of treatments on the hardness (N) in ten days period of maintenance

Samples	First day	Second day	Tenth day
A	$4.339 \pm 0.344^{B,b}$	$4.332 \pm 0.607^{B,c}$	$7.327 \pm 0.145^{A,c}$
A_1	$4.485 \pm 0.433^{C,b}$	$5.932 \pm 0.889^{B,a}$	$8.107 \pm 0.461^{A,b}$
A_2	$5.939 \pm 0.702^{B,a}$	$5.992 \pm 0.696^{B,a}$	$9.805 \pm 0.711^{A,a}$
A_3	$4.163 \pm 0.469^{C,b}$	$5.199 \pm 0.238^{B,b}$	$7.491 \pm 0.609^{A,c}$
A_4	$4.381 \pm 0.261^{C,b}$	$5.24 \pm 0.307^{B,b}$	$8.168 \pm 1.267^{A,b}$

and second day but from the second to the tenth day after baking, hardness significantly increased. Higher stiffness in treatments compared to control is because of the bands of water in sugar alcohols and its loss during maintenance, as well as, the interaction of these sugars to starch that can be effective on starch retrogradation (Ronda *et al.,* 2005). The results are in agreement with the results obtained by Ronda *et al.* (2005), They stated that cake made with erythritol has the hardest tissue in the other treatments, also Mushtaq *et al.* (2010) showed that with increasing levels of replacement of xylitol with sugar cookies in the formulation, severe decline in cookies were seen.

A: 0% sorbitol + 0% isomalt; A1: 4% sorbitol + 4% isomalt; A2: 8%sorbitol + 8% isomalt; A3: 8% sorbitol + 4% isomalt; A4: 4% sorbitol + 8% isomalt

Capital alphabets and lowercase alphabets indicate a significant difference between the values in days and samples, respectively

According to table 5, sensory evaluation results of five muffin cake formulations indicated more acceptance of prepared A_3 treatment (8% sorbitol+4% isomalt). In this regard, Martinez *et al.* (2012) reported similar results. Totally, prepared cake by using 8% sorbitol+4% isomalt can be introduced as the best treatment.

CONCLUSION

At this study, in the first phase, 30 and 40 percent whey was used in the formulation of chocolate muffin, according to the results, the replacement level of 30% was chosen as the best samples. In the second stage, sorbitol and isomalt were used in muffin containing whey 30%.The results of physicochemical tests showed that the effect of substitution was statistically significant on the moisture content and carbohydrate content of the samples. With increasing of replacement, moisture content increased but carbohydrate was decreased. A significant difference wasn't obtained between the hardness in all samples except sample A_2 (sample containing 8% isomalt + 8% sorbitol), In all the samples, with increasing storage time, hardness increased.

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Table5. Organoleptic properties

Parameters/samples	A	A_1	A_2	A_3	A_4
Texture	4.20 ± 0.79 a	4.10 ± 0.88 a	4.00 ± 0.67 a	4.50 ± 0.71 a	4.20 ±0.92 a
Taste	4.50 ± 0.53 a	4.50 ± 0.53 a	4.30 ± 0.48 a	4.70 ± 0.48 a	4.50 ± 0.53 a
Color	3.90 ± 0.74 a	3.90 ± 0.74 a	3.70 ± 0.48 a	3.80± 0.92 a	3.80 ± 0.92 a
Redolent	4.80 ± 0.42 a	4.70 ± 0.48 a	4.50 ± 0.53 a	4.70 ± 0.48 a	4.70 ± 0.48 a
Appearance	4.60 ± 0.52 a	4.60 ± 0.52 a	4.40 ± 0.52 a	4.70 ± 0.48 a	4.70 ± 0.48 a
admission	4.80 ± 0.42 a	4.50 ± 0.53 ab	4.30 ± 0.48 b	4.80 ± 0.42 a	4.60 ± 0.52 ab

A: 0% sorbitol + 0% isomalt; A_1: 4% sorbitol + 4% isomalt; A_2: 8%sorbitol + 8% isomalt; A_3: 8% sorbitol + 4% isomalt; A_4: 4% sorbitol + 8% isomalt

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