EFFECT OF USING OF LIQUID WHEY CHEESE ON SOME PHYSICAL CHARACTERISTICS AND SENSORY EVALUATION OF YELLOW LAYER CAKES

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ABSTRACT

The aim of this study is to using liquid sweet whey as substitute ingredient to milk or/and water in Yellow Layer Cakes. This main recipe was used to prepare the standard cake (control) while the milk was substituted by whey in cake $\mathbf{W_m}$, and in cake $\mathbf{W_w}$ the water was substituted by whey. Also results showed that substitution of milk and water by whey in both cakes increased the shrinkage index to 2cm and 2.5cm compared with standard cake which was 1cm. The substitution of milk and water in both cakes (W_m and W_w) by whey caused increasing of cake volume index, and the volume index for standard cake was 17.3 while it was 18.24 and 17.15 for W_m and W_w respectively. The results showed that substitution milk with whey did not prevent the cake collapse, but there was a benefit effect for using whey instead of milk or water in the cakes uniformity index. The sensory evaluation results showed that, no significant effect of liquid whey addition on enhancingsensory characterististic of whey addition treatment comparied with stander cake.

KEY WORDS:

Whey cheese; Yellow Layer Cakes; shrinkage index; volume index

INTRODUCTION

Whey cheese is a waste by-product of the cheese industry that has caused an environmental pollution. Conversion of whey cheese to a part of food ingredient might been alternative way of value-adding to this by-product. Composition and characteristics of whey are depending on the production technology of the end product and on the quality of the used milk. It consists approximately 93% of water and contains almost 50% of total solids present in the milk; lactose is the main constituent of whey while proteins represent less than 1% of total solids. In fewer amount also minerals and vitamins are present [8]. Whey cheese has a high nutritive value especially whey proteins which is generally considered that is the highest quality natural protein [23]. Whey protein represent 20% of total milk protein and it contains five protein types: ß-Lactoglobulin (ß -Lg) α-Lactalbumin (α -La) Immunoglobulins (Igs), Bovine serum albumin (BSA) and protease-peptones [14]. Nowadays, whey cheese was considered as polluting agent from dairy industry, which commonly discarded with out any treatments in rivers resulted in an environmental problem due to its high organic content agent.

Whey cheese is classified in two different types sweet resulting from rennet coagulation of milk and acid resulting from milk acidification.

Sweet whey has been discarded or used as animal feed. Recovering the solid components of whey is attractive for two main reasons: first is to reduce the organic pollution and the second reason is for optimal utilization of the nutritional and functional properties offered by whey protein [16]. Fresh pasteurized liquid whey is rarely used for foods, but it is rather concentrated by evaporation, reverse osmosis, ion-exchange or ultra-filtration for drying. Whey powder, hydrolyzed whey protein (HWP), whey protein concentrates (WPC), whey protein isolates (WPI), reduced-lactose whey and de-mineralized whey are produced from whey. Each whey product varies in the

amount of protein, carbohydrates, immunoglobulins, minerals and fat in the finished product [13]. In the food processing the tendency to use substitutes of ingredients in some products recipes has been observed for several years. Whey and its preparations may serve as substitutes. According to many sources, their use can have a positive impact not only on the consumers' health, but also on the finance of many companies by reducing the costs of raw materials, and thus lowering production costs [3]. Cost reduction is achieved by the use of whey preparations as partial or complete replacements of milk powder [5], eggs [20], fat [20,19], sucrose[18]. The aim of current study is using sweet whey as milk and water substitute in producing cake and studying of its effect on some physical and sensory properties of the cake.

MATERIALS AND METHODS

MATERIALS

Sweet whey cheese was prepared from enzymatic milk coagulation at dairy lab. at food science dept. college of agricultural sciences, Sulaimani university. Pastry white flour trademark Zer (Turkey), corn oil Zer, liquid milk Almarai (Saudi Arabia), Baking powder Zer, eggs all these materials were purchased from local supermarket of sulaimani city.

METHODS

it was analyzed for its components especially the percentage of protein and fat

Whey fat and protein determination

Gerber method and Micro Kjeldahl method (AOAC, 2000) was used for whey fat and protein determination.

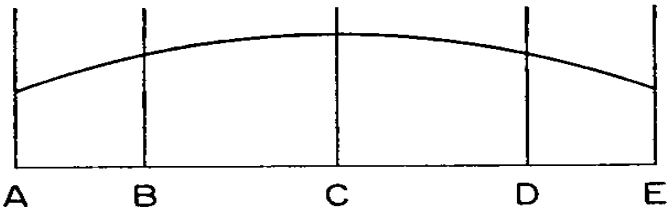
Cake preparation

The cakes were prepared as following:

Cake recipes: The batter formula for AACC method No. 10.90 (AACC, 1983) was used with some modification related to the purpose of this study. Flour (230g), sugar (130g), corn oil (130g), three Eggs (50gm*3=150g), baking powder (18g) liquid milk (20g) or whey (20g),water (130ml) or whey (130 ml). This main recipe was used to prepare the standard cake (control) while the milk water was substituted by whey in cake $\mathbf{W_m}$, while in cake $\mathbf{W_w}$ the water was substituted by whey. All studied cake samples were prepared by the same procedure as following: - Eggs were whisked very well at medium speed for five minutes where a white foamy mixture was formed then the sugar was added with continuous whisking until a creamy mixture formed then the oil was added with continuous mixing at the same speed until homogenize. The dry materials of flour and baking powder mixture was added to the homogenized mixture, alternately with liquids of milk and water or whey with continuous mixing until the cake batter is became smooth and has a good thick. Finally, the homogenized cake batter was poured in suitable pan to fill about ¾ of it. Cake batter was baked at 170-175°C for 45 minutes and then cooled to room temperature for 20 minutes to measure the cake dimensions according to AACC method, use of layer cake measuring template, No. 10.91 (AACC, 1983), the cake samples were physical tested as following procedure:

1. Cake was carefully cut vertically through center then it was placed with cut surface down on template, center, and aligned with baseline of template. Alternatively, cut section of cake was placed on shelf and make necessary readings.
2. Diameter (A to E) to nearest 0.1 cm was read then the diameter subtracted from 20.3 cm to obtain shrinkage value.
3. Height of cake to nearest 0.1 cm was read off at vertical lines B, C, and D.

These lines are designated for calculations as illustrated in diagram below:



Calculations

Volume index = B + C + D.

Symmetry index = 2C - B - D.

Uniformity index = B - D.

Sensory evaluation:

According to Lee [11], the cake samples were sensory evaluated with little modification that was, use chewability characteristic instead of overall appearance in addition to give the evaluation scores due to the importance of each characteristic as following: Taste (30

scores), flavor (25 scores) crumb color (15 scores), chewability (15scores) and softness (15 scores) in which the high scores was the best characteristic. Five expert panelists evaluated the sensory characteristics of studied cakes.

Statistical analysis:

The data were statistically analyzed according to the methods of analysis of variance as a general test (Completely randomized design) using program XL STAT 2017. All possible comparisons among the means were carried out by using Least Significant Difference (LSD) test at a significant level of (0.05) after they show their significance in the general test.

RESULTS AND DISCUSSION

Whey composition

The result showed in Table 1 whey composition that was used for biomass production, according to its average composition whey cheese is approximately 93% water and contains 7% total solid of which protein comprise only 0.24% of it.

PHYSICAL PARAMETERS OF STUDIED CAKES

Cake shrinkage

Cake shrinkage is one of the most undesirable faults in cake making [15]. The results of physical properties of studied caked (table 2) showed that changing of standard recipes caused increasing of shrinkage index compared with standard cake.

Table 1: whey cheese composition

Components	Percentage (%)
Water	93± 0.5
Total solid	7± 0.5
Fat	0.1± 0.05
Protein	0.24± 0.04
SNF	6.9± 0.5

The results showed that substitution of milk by whey in cake W_m increased the shrinkage index to be 2cm while substitution of water by the same amount of whey caused more increasing of shrinkage index to be 2.5 cm compared with standard cake which was 1cm. The availability of water may be the major factor that effect on shrinkage index of cake [6].The value of shrinkage index of standard cake was in agreement with Ma, et al., [12] which the value of their study was 1.37 cm, also they found that modification of the protein can increase this value. Tan, et al., [21] attributed the cake collapse to the higher denaturation temperature of whey protein that resulted in higher coagulation temperature and caused over-expanded gas cells in cake batter to collapse during baking.

CAKE VOLUME INDEX

The results of comparing between the standard cake and treated cakes (table 2) showed that the substitution of milk and water in W_m and W_w by whey caused increasing cake volume index. Volume index for standard cake was 17.3 while it was 18.24 and 17.15 for Wm and Ww respectively. The increasing of cake volume for that contained whey was observed by Tan, et al., [21]. Kohrs, et al.,[10] they found that using of isolate whey proteins may decrease volume index while addition guar gum with whey treatment was increased the volume index which may attribute to the use of high amount of whey proteins. However, the results of this cake property were in agreement with other researchers [10]

SYMMETRY INDEX

Table (2) shows the results of the effect of whey substitution on cake symmetry index. The high value and positive value of symmetry index indicates that the center of cake rise more than the two sides while the negative values indicate a collapsed center of cake [4]. The results showed that substitution milk with whey waso prevented the cake collapse that may happen due the imbalance in recipe, dry matter to liquid especially water and method of cake preparing and baking [9]. This results is agreement with the results of Paton, et al.[17].

Table 2: Physical Parameters for Different Cakes (Standard, W_m and W_w)

Cake Parameters	Standard cake		Diameter of W_m cake		Diameter of W_w cake	
	Replicate1 (cm)	Replicate 2(cm)	Replicate1 (cm)	Replicate 2(cm)	Replicate1 (cm)	Replicate 2(cm)
Diameter of cake temple	22	22	22	22	22	22
Diameter of cakes	21	21	20	20	20.5	20.5
A	5	4.5	5	5	4.5	5
B	6	5.5	6	6	5.6	5.5
C	5.5	6	6	6.5	5.5	6
D	5.6	6	6	6	5.7	6
E	4.5	5	5	5	5	4.5
Shri. Index	1	1	2	2	2.5	2.5
Vol. Index	17.1	17.5	18	18.5	16.5	17.5
Sym.Index	-0.6	0.5	0.0	1.0	-0.3	0.5
Unif. Index	0.4	-0.5	0.0	0.0	-0.1	-0.5

Also in W_w the differences between the two sides was decreased in replicate 1 to be – 0.1 while it was 0.5 in replicate 2 compared with Wm which was 0.0 for two replicates. The results were indicated that substitution of milk protein by whey protein had clear effect on uniformity index as in W_m while presence of excess lactose had a little effect on this property as it is shown in Ww cake.This result was agreement with Tan, et al. [21], who found that uniformity index for control cake was 0.1 while it is value increased with change of cake recipes with amaranth flour. The uniformity index is preferred if it is zero which it means that there is a complete uniformity between the two sides of cake layer.

SENSORY EVALUATION

The sensory evaluation results (table 3) showed that, although there is an improving effect of whey addition on sensory characteristics of studied cakes compared with standard cake, but this effect was statically insignificant. However, substitution of milk or water of cake recipes with whey increased the evaluation marks of cake taste from 23.600 to reach to24.800 and 25.800 for W_w and W_m cake samples respectively. Wani et al., [22] were found that 4% of concentrated whey proteins increased the cookie sensory evaluation scores especially taste and flavor characteristics. The results also showed that the scores of flavors for cake samples that contained whey increased compared with standard cake. Stoliar [20] was reported that addition of whey improves caketaste and flavor in addition to increase crust color which is produced by non-enzymatic browning reaction. Cake crumb color also improved by whey substation may due to whey proteins orientate the crumb structure that assist in increasing of light reflecting then will increase the whiteness of crumb. This finding was agreement with Kohrs, et al., [10] who found that the color of cake crumb became less yellowish and more whitish with whey compared to standard cake (without whey).Both cake characteristics, chewability and softness scores increased in $W_m$treatment compared with standard cake and W_w cake which may attribute to the whey proteins that were the main variable in this treatment. It was known that whey proteins contains a considerable amount of sulfhydryl groups [7] which interact with gluten sulfhydryl giving a soft gluten network causing improving of the chewability and softness of cake [20].

Table 3: The main scores of sensory evaluation of studied cakes

sample	Taste 30 scores	Flavor 25 scores	Crumb color 15 scores	Chewability 15scores	Softness 15scores
Standard	23.60	20.00	11.80	11.60	11.60
W_m	25.80	20.20	12.60	12.20	12.20
W_w	24.80	21.40	12.60	11.60	11.60
$LSD_{(p\leq0.05)}$	3.05	3.38	3.06	2.15	2.15

CONCLUSION

Our study was conclused that substitution of milk and water by whey cheese was increased shrinkage index and volume index with a benefit effect of uniformity index in Yellow Layer Cakes. Whey addition affects the sensory characteristics of the studied cakes compared with standard cake especially in the taste and flavor.

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