Faculty of Home Economics

Journal of Home Economics
Menoufia University, Shibin El Kom, Egypt
https://mkas.journals.ekb.eg

Menoufia University

Nutrition and Food Sciences

Utilization of Whey Milk by-Product for the Production of Biscuits

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Abstract

Dairy products were previously left behind during the production of whey as a by-product, posing a major concern for dairy producers. The whey was disposed away with sewage since it contains many organic compounds, which harms the ecosystem. The goal of this study was to produce milk whey enriched biscuits by supplementing sweet whey concentrate for wheat flour at various levels of substitution and to evaluate the nutritional quality and stability of the product during storage. The cost of the product was also examined. With different amounts of whey (25 percent, 50 percent, 75 percent, and 100 percent), a control and four experimental treatments were created. The chemical composition of all of the experimental treatments and the control samples was determined. Results showed that A4 >A3 > A2 > A1>CO was the chemical analysis rating for moisture content, protein content, and fat content. Based on the findings, it was concluded that biscuits substituted water by different concentrations of whey milk enriched all tested sensory evaluation (color and appearance, flavor and taste, body and texture, and overall acceptability) of samples. In conclusion, the use of whey milk instead of water in biscuit production improves protein and fat values while maintaining a high sensory evaluation, while increasing product storage.

Keywords: Milk wests, Bakery products, Quality attributes.

Introduction:

Whey was a major concern for dairy facilities only a few decades ago. It had not been recycled to the extent that it is now. Whey, along with sewage, was removed because of the organic compounds it contained, which constituted a hazard to the ecosystem [(1)].
Whey is the liquid left over after curdling and filtering milk. It is a byproduct of the cheese or casein manufacturing process that has a variety of commercial applications. Sweet whey is a byproduct of the production of rennet-based hard cheeses such as cheddar and

Swiss cheese. Acid whey (also known as sour whey) is a byproduct produced when acid dairy products like cottage cheese or strained yoghurt are made. -lactalbumin, -lactoglobulin, serum albumin, immunoglobulins, and proteose peptones are all found in whey proteins [(2)]. Today's health-conscious consumers are increasingly selecting foods based on their ability to give health benefits, such as improving body functioning or lowering the risk of certain diseases. Many traditional dairy ingredients offer the food industry unparalleled opportunity to improve existing products and/or generate new ones with distinct health benefits. New technology for isolating dairy constituents, as well as new research pinpointing dairy ingredients' biological roles, such as whey proteins, are fueling interest in their potential application in functional foods [(3)]. Whey is a complete protein, which means it has all nine essential amino acids. Whey is also regarded as a high-quality protein based on human and animal protein quality tests [(4)]. Whey proteins are the highest-quality proteins on the market, with excellent digestion and a balanced amino acid profile. Whey proteins are also advised because of their benefits in boosting immunity and lowering the risk of heart disease and cancer [(5)]. In the manufacture of cheese, ten parts milk yield nine parts whey and one part cheese [(6)]. Because of their formulation possibilities and cheap manufacturing costs, whole meal biscuits with a high fiber content have become one of the fastest growing sectors of the food business in recent years. More natural products with higher nutritional features are in demand, which can help supplement nutritional shortfalls such as low fiber intake [(7)]. Biscuits are cookies that have been dried to a very low moisture level [(8)]. As a result, biscuits' low nutritive content is a major source of concern, as biscuits are the most widely consumed snacks by schoolchildren, who require more protein per unit of body weight than adults. The need for biscuits with a sufficient amount of protein and a high biological value will aid in the development of nutritionally balanced biscuits for the creation of high-density protein biscuits. Biscuits enhanced with whey Several studies on whey-enriched biscuits have been conducted [(9)]. Biscuits are the most popular bakery foods due to their excellent nutritional value, ready-to-eat nature, and economical availability in a variety of forms and sizes. Biscuits and other sweet baked goods are high in sugar (mostly sucrose) and fat, therefore calorie-conscious consumers avoid them. The functional qualities of biscuits can be improved or modified by improving or modifying the key ingredients, such as flour, sugar, and fat, as well as adding health-promoting additives such as whey protein concentrate, skimmed milk powder, dietary fiber, and so on [(10)]. Biscuits have recently been produced as functional foods to include nutritional whole multigrain flour, artificial ingredients, and health-promoting chemicals in the daily diet. These innovative products have positive health effects and can minimize the risk of chronic illness development. By altering the basic composition of biscuits, Vitali, Verdina, and Sebecic attempted to improve the mineral content and bio-accessibility [(11)].

Materials and methods:

Raw materials

From the local market in Shibin El-Kom City, Menoufia Governorate, wheat flour (WF 72 percent extraction) was obtained from Ebn Al-Khtab Company.

Whey

Whey milk obtained from the Department of Food Science and Technology, Faculty of Agricultural, Shebin El-Kom City, Menoufia Governorate, Egypt.

Other materials

Sugar, baking powder, salt, oil, and vanilla were acquired from a local market in Menoufia Governorate's, Shebin El-Kom City, Egypt.

Methods:

A -Biscuit Production

In this recipe, water weights of 25, 50, 75, and 100 percent milk whey were added to the wheat flour. Using a rotary moulder, mix for 3 minutes in a Kenwood Chef Mixer with a thickness of 3 (a bakery similar). The baking was done in a baker's type oven at a temperature of 250°C/temperature (Aronstein, Germany). The biscuits were sealed under 50 percent vacuum pressure in polyethylene bags and stored at 20°C after cooling for 30 minutes at ambient temperature.

Short dough biscuit formulation (control recipe)

The flour is 100 percent, and the remainder of the ingredients are proportioned to the flour as follows. The oil percentage is 35 percent, the sugar percentage is 35 percent, the water proportion is 20 percent, the salt percentage is 0.7 percent, the baking powder percentage is 10%, and the vanilla percentage is 5% **(12)**.

B- Chemical composition:

The Food Science and Technology Institute, Agricultural Research Center and the Central Research Laboratory, Faculty of Agriculture, Menoufia University, analyzed raw materials and biscuit samples for research, protein, fat, fiber, and ash content in accordance with the AOAC's method **(13)**.

C- Rheological characteristics:

The rheological characteristics of dough samples were tasted using a farinograph and an extansograph, as described in the method of **AACC (14)**.

D- Sensory evaluation:

According to Lawless and Heymann (15), twenty stuff members of the Nutrition and Food Science, Faculty of Home Economics at Menoufia University, examined biscuit pieces for sensory evaluation. Color (10 points), taste (10 points), flavor (10 points), crispness (10 points), texture (10 points), appearance (10 points), and overall acceptance (10 points) were given to the panelists.

Statistical analysis

One way ANOVA was used to statistically evaluate the data using a computerized COSTAT Program. The findings are provided as Mean ±SD, with significant differences between treatments at ($P \leq 0.05$).

Results and discussion:

By supplementing wheat flour with sweet whey concentrate at various levels of substitution, milk whey had a beneficial and significant effect on enhanced biscuits. Table 1 shows that while the percentage of milk whey increased by 100 percent whey, it did not reach statistical significance when compared to the control of 100 percent water.

On the other hand, at 75 percent water +25 percent whey, there was a highly significant drop. Maximum declines in enriched biscuits by supplementing percentage in all investigated, as compared to the control, were detected at 75 percent water +25 percent whey. The increasing milk whey percentage has a positive relationship with the induced amount of improved flavor and functionality. A similar result of milk whey bio-stimulation was reported by **(16)** who found that whey can partially replace meat protein, as well as soy protein and other binding agents, fillers, modified starch, and hydrocolloids, in some cases.

New technologies enable the production of whey proteins with better flavor and usefulness. It's critical to match the function of a whey product to the features we wish to attain when selecting one. High-protein concentrates or isolates, for example, are utilized to alter fat content **(17)**. With the addition of sweet whey, there is a little rise in sweetness (which enables reduced addition of sweeteners) **(16)**.

To evaluate the nutritional quality and storage stability of milk whey enriched cookies, researchers supplemented wheat flour with sweet whey concentrate at various levels of substitution.

To examine the nutritional quality and storage stability of milk whey enriched biscuits, researchers supplemented wheat flour with sweet whey concentrate at various levels of substitution **(18&19)**. Dairy proteins are divided into two categories: casein and whey. Both proteins have the ability to emulsify **(20)**. Whey proteins have better foaming characteristics than caseins because they can absorb water. Browning reactions occur when dairy proteins are added to baked items, influencing flavor, stability, and color. Browning is primarily a sugar-protein interaction or a Maillard-type reaction that results in the formation of brown polymers or melanoidins **(21).**

The chemical composition of biscuit samples according to the percentage of milk whey are shown in table (2). When compared to the untreated control group, the obtained data were found to be non-significant ($P \leq 0.005$). The effect of varying chemical composition percentages in biscuit samples. Data in table 2 also shows how the quality of the biscuits

supplied has improved. Whey preparations, which are a source of high-quality protein and active peptides, are commonly employed by infant food manufacturers, according to reports [(6)].

Table (1): Sensory evaluation of biscuit samples according to the percentage of whey

Groups	Taste	Color	Flavor	Crispness	Texture	Appearance	Overall-acceptability
Parameter	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD
Co	8.1ab±.82	7.75b±1.1	7.6B±1.0	7.8bc±1.0	7.60b±0.8	7.7b±0.9	7.7b±0.8
A1	7.5bc±.82	7.2b±0.8	7.4B±.94	7.45c±0.9	7.45b±0.8	7.4bc±0.7	7.5b±0.8
A2	7.5bc±.82	7.3b±0.8	7.4B±.94	7.45c±0.9	7.45b±0.8	7.4bc±0.7	7.5b±.8
A3	8.6a±.82	8.45a±0.8	8.35a±.93	8.3ab±0.9	8.40a±0.9	8.4a±0.9	8.4a±1.0
A4	8.6a±.82	8.50a±0.9	8.45a±.88	8.45a±0.9	8.40a±0.9	8.45a±0.9	8.5a±0.9

*Means in the same column with different letters are significantly different. * Significant (P ≤ 0.05). Co - control (100% water), A1 - (75% water + 25%whey), A2 - (50% water + 50% whey), A3 - (25% water + 75%whey) and A4 - (100% whey)*

Establishing an acceptable ratio of whey proteins to casein, which in the case of whey-based supplements should approach 60:40, i.e., the same ratio seen in breast milk (the ratio in cow's milk is 20:80), is a typical method. In this instance, WPCs and demineralized whey powder are mostly used **(22)**. The increased amount of amino acids in newborn formulae is also significant (they are of particular importance in the nutrition of infants born prematurely).

Table (2): Chemical composition of biscuit samples according to the percentage of whey.

Groups Parameter	Moisture Mean ±SD	Protein Mean ±SD	Fat Mean ±SD	Fiber Mean ±SD	Ash Mean ±SD	Carbohydrate Mean ±SD
co	6.9a±1.2	10.00a±2.89	8.0a±.55	.06b±.0022	3.75b±.22	70.39a±2.35
A1	7.3a±.9	10.6a±1.22	8.4a±.82	.05a±.007	3.70b±.09	68.93a±3.14
A2	7.4a±1.16	10.9a±1.32	8.7a±1.03	.5a±.0011	3.66b±.180	68.25a±2.85
A3	7.7a±1.89	11.0a±1.19	9.0a±1.47	.05a±.0013	3.65b±.024	67.70a±3.11
A4	7.9a±1.45	12.2a±1.03	9.4a±1.52	.05a±.0009	3.18a±.07	65.88a±2.74

*Means in the same column with different letters are significantly different. * Significant (P ≤ 0.05). Co - control (100% water), A1 - (75% water + 25%whey), A2 - (50% water + 50% whey), A3 - (25% water + 75%whey) and A4 - (100% whey)*

Table (3) revealed significant differences in all samples from the use of whey in various quantities in biscuit kneading. 100% whey was the most effective treatment. Water absorption, arrival time, stability time, and extensibility had mean values of 65.0±2.2,

1.0±0.33, 13.0±0.75, and 170.0±3.32, respectively, while the control had mean values of 61.2±1.5, 1.0±0.05, 12.0±0.22, and 130.0±2.75, respectively. New technologies enable the production of whey proteins with better flavor and functionality. It's critical to match the function of a whey product to the features we wish to attain when selecting one. High protein concentrates or isolates, for example, are utilized to alter fat content [(17)]. With the addition of sweet whey, there is a little rise in sweetness (which enables reduced addition of sweeteners) [(16)]. Whey proteins also include a high quantity of necessary amino acids and are considered a high-quality protein source, according to the study. In addition, they have a high calcium content as well as other nutrients like potassium and zinc [(23)]**.** Data from Table 3 shows the results of quality testing on biscuits with various combinations of whey content. With biscuit kneading, the highest volume of different proportions was attained in 100 percent whey.

Table (3). Rheological analysis of different samples from the use of whey in different proportions in biscuit kneading.

Parameters	**Water absorption**	**Arrival time**	**Dough development**	**Stability time**	**Elasticity**	**Extensibility**	**P_N**	**Energy**
Samples	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**	**Mean ±SD**
co	61.2a±1.5	1.0a±.05	3.00a±.54	12.0a±.22	320.0d±1.5	130.0e±2.75	2.46d±.056	65.0d±1.88
A1	62.3a±3.12	0.05b±.001	6.0b±0.11	12.0a±.258	310.0c±3.46	140.0d±2.41	1.97c±0.08	60.0c±1.31
A2	63a±2.99	.05b±.004	6.0b±.145	12.0a±.479	300.0b±4.11	150.0c±3.12	2.00c±0.05	50.0b±1.58
A3	63.5a±1.89	.5b±.004	8.0c±.61	12.0a±.09	300.0b±3.75	160.0b±3.12	1.87bc±0.79	50.0b±1.22
A4	65.0a±2.2	1.0a±.033	3.0a±.12	13.0b±.75	280.0a±3.66	170.0a±3.32	1.64a±0.55	45.0a±1.09

*Means in the same column with different letters are significantly different. * Significant (P ≤ 0.05). Co - control (100% water), A1 - (75% water + 25%whey), A2 - (50% water + 50% whey), A3 - (25% water + 75%whey) and A4 - (100% whey)*

Conclusion:

In biscuits, using whey for water as a base weight enhances protein and fat while keeping a high sensory evaluation, with the additional benefit of whey milk's longer shelf life

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الاستفادة من شرش اللبن كمنتج ثانوى فى انتاج البسكويت

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الملخص العربي

في الماضي، كان يتخلف من منتجات الألبان أثناء تصنيعها شرش اللبن كمنتج اثانوي والذى يسبب مشكلة كبيرة لمنتجي الألبان, نظرًا لاحتوائه على العديد من المواد الكيميائية العضوية ، فقد تم التخلص من شرش اللبن جنبًا إلى جنب مع مياه الصرف الصحي ، مما يلحق الضرر بالنظام البيئي. كان الهدف من هذه الدراسة هو إنتاج بسكويت غني ببروتين شرش اللبن عن طريق إضافة مركز شرش اللبن الحلو لدقيق القمح بمستويات مختلفة من الاستبدال ، وتقييم الجودة الغذائية ومعرفة التغيرات التى تحدث اثناء تخزين المنتج. كذلك تم فحص تكلفة المنتج أيضًا. تم استخدام كميات مختلفة من شرش اللبن الحلو (٢٥ %، ٥٠ %، ٧٥ %، ١٠٠ %) ، حيث تم تحضير مجموعة بسكويت كنترول ١٠٠ % ماء وأربع معاملات بإضافة نسب متفاوتة من شرش اللبن الحلو. تم تقدير التركيب الكيميائي لجميع المعاملات المختلفة. اظهرت النتائج المتحصل عليها أن التحليل الكيميائي لمحتوى الرطوبة ومحتوى البروتين ومحتوى الدهون كان كالتالى A4> A3> A2> A1> CO. بناءً على النتائج ، تم التوصل إلى أن البسكويت االمستبدل بشرش اللبن الحلو بدلا من الماء أدى إلى تحسين الخواص الحسية المختبرة (اللون والمظهر والنكهة والمذاق والقوام والقبول العام). في الختام ، استخدام شرش اللبن الحلو بدلا من الماء فى انتاج البسكويت يحسن من قيم البروتين والدهون مع الحفاظ على تقييم حسي مرتفع ، مع زيادة تخزين المنتج.

الكلمات المفتاحية: مخلفات اللبن، منتجات المخابز، سمات الجودة.