STUDIES ON SOME BAKERY PRODUCTS AS FUNCTIONAL FOODS

By

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Cereal-based foods have vital importance in human diet. Bread is a basic cereal food, which is an important source of carbohydrates, and as a consequence takes an important place in the recommended daily calorie intake

The use of improvements in the production of baked goods is a common practice today. Also a part of the technological effort to produce baked goods that have a valuable sensory, and practical value, and high nutritional value. In addition to the use of dough machines, processing and baking improvements are used specifically to improve the production methods and the quality of bakery products.

Functional foods have one or more physiological benefits and reduce the risk of chronic diseases beyond providing basic nutrition to human beings. So far functional food ingredients have been brought to the consumers mainly through dairy or confectionery products. This is one of the reasons of higher cost of functional foods than their conventional counterparts and therefore, they remain a part of daily diet of only economically sound consumers.

The aim of this investigating can be summarized in the following points:

- Extraction of dissolved whey protein from the produced whey from cheese production processing
- Functional properties of whey protein concentrate, whole egg powder and white egg powder

- A study of the effect of using shark proteins on some baked goods.
- To study some properties of pan bread, cake and angel cake during storage at room temperature
- To study effect dried whey protein concentrate on pan bread, cake and angel cake during storage at room temperature anti-microbial.

1. Chemical analysis of raw materials:

2.1. Hard and Soft wheat flower:

Data showed that Hard wheat flour (72% extraction) used to produce pan bread was higher in protein, ash, crude fibers, fat contents and carbohydrate were 13.17, 0.61, 0.59, 0.54 and 85.08%, respectively. Than the same components of soft wheat flour which were 12.13, 0.57, 0.52, 0.49 and 86.30%, respectively.

2.2. Whey cheese liquid whey protein concentrate:

Results revealed that, liquid cheese whey contains about 93.14% of water and the following nutrients from the original milk: lactose, (4.85%), soluble proteins (0.7%), fat (0.11%) and ash (0.90%). Also, chemical composition of dried whey protein concentrate was 7.04% of moisture and the following nutrients from the original milk: lactose, 10.47%, crude proteins 66.87%, fat 3.65% and ash 5.63%.

2.3. Chemical composition of whole egg powder and white egg powder

Whole egg powder contained 47.08% crud protein, 10.61% fat content, 3.62% moisture content and 3.06 ash. White egg powder contained 80.27% crude protein, 0.42% fat content, 5.50% moisture and 3.46% ash. Whole egg powder showed the higher total carbohydrates value (35.63) than white egg powder (10.35).

Extraction of whey protein:

Whey proteins concentrate (WPC) were obtained by thermal treatment of whey as follow: whey was acidified with lactic acid till pH 4.6 then, the temperature was raised to 90°C for. After that whey was shocked cooled in cold water bath for about ten min. Therefore, precipitated whey proteins were aggregated and filtered by clean mucilin cloth and the precipitated proteins were washed several time with distilled water then, dried at 40°C over night.

2. Amino acids composition:

2.1. Amino acids composition of dried whey protein.

The results showed that whey proteins contained a high content of essential, non-essential and branched amino acids: leucine, isoleucine, valine, phenylalanine and thyronine were higher in proportion to the necessary amino acids relative to them in comparison of whole egg protein and egg white protein. Also, aspartic and glutamic amino acids are found at a higher rate in Whey protein is similar to that of whole egg protein and egg white protein.

The analysis also showed that the ratio of essential amino acids for whey protein is equal to the ratio of amino acids for eggs complete according to the FAO. It was also noticed that thyronine and phenylalanine in whey protein were the lowest percentage compared to egg whites and whole egg protein, while leucine and tyrosine were the most deficient in egg white protein and phenylalanine was the most deficient in whole egg protein.

3. Functional properties of dried whey protein concentrate, dried whole egg and dried white egg:

3.1. Water absorption capacity (WAC):

Data showed dried whey protein concentrate was recorded 4.8 g/g for water absorption capacity while dried whole egg and dried white egg recorded 3.5 and 1.7g/g, respectively) water absorption capacity of both samples were significantly different ($p<0.05$) with WPC having the highest WAC (4.8 g/g) followed by DOE (3.5 g/g) and DWE (1.7 g/g).

3.2. Fat absorption capacity (FAC):

The oil absorption ratio was estimated for each of the whey protein, egg white protein and whole egg protein. The highest absorption ratio was for egg white protein, then whey protein followed by the whole egg protein. The ratio was 2.5, 2.2, 1.5 g/g.

3.3. Foam capacity (FC) and stability (FS):

Foam capacity (FC) of DWE was significantly higher than that WPC, which was significantly higher than that of DOE, with the value of 80%, 50% and 30%, respectively. The foam stability (FS) of DWE was significantly than that of WPC, which was significantly higher than that of DOE, with values of 88,7%, 80,2% and 69.2%, respectively.

3.4. Bulk density (BD):

The apparent bulk density of whey protein, egg white protein and whole egg protein was estimated as 0.52, 0.43 and 0.40 g/cm^3, respectively.

3.5. Gelation

When performing the gel formation test for whey protein, egg white protein and whole egg protein, the highest concentration of gel formation in whey protein and egg white protein was up to 10, 12% compared to whole egg protein where the gel formation was less.

3.6. Antimicrobial activity of dry whey protein:

Whey proteins exhibited antimicrobial activity against both gram-negative and gram-positive bacteria with various degrees. The highest inhibition zone was recorded for *E. coli* and *Bacillus cereus* (10 mm) followed by *Staphylococcus aureus* (9 mm) while *Salmonella tyhimurium* recorded the lowest inhibition zone (8 mm). But also, against yeasts and fungi such as *Aspergillus niger* recoded (8.5 mm).

4. Effect of replacement of wheat flour by dried whey protein concentrate on pan bread quality:

4.1. Chemical composition of pan bread:

The obtained data showed that the highest moisture content (39.83%) was observed in sample 4 (20% dried whey protein concentrate), while the lowest moisture content of 28.48% was found for control sample.

The highest value for protein content (13.53%) was observed in pan bread made using (20% dried whey protein concentrate) compared with the lowest value of (11.80%) for control sample. While, the highest value of fat (6.46%) was observed in sample No 4 (20% dried whey protein concentrate supplemented pan bread) while the lowest value (4.69%) was observed in control sample.

Ash content of pan bread which increased significantly from 1.74 to 2.81%. The highest value of ash content (2.81%) was reported in T4 (20% dried whey protein concentrate

The maximum fiber content of 1.95% was observed in control sample while T4 showed lowest fiber content of 0.82%. Finally, the available Carbohydrates content of all pan bread were decreased significantly from 45.34 to 36.55% in T4 which contained 20%

4.2. Physical characteristics of pan bread made using dried whey protein concentrate:

These results declared that, the effect of replacement dried whey protein concentrate at different levels 5, 10, 15 and 20% to wheat flour 72%, increased volume and specific volume gradually with increasing the level of addition as compared to their corresponding control sample. Addition 20% of dried whey protein concentrate led to best increase in volume and specific volume of pan bread compared to control.

4.3. Texture profile of pan bread made using different replacement levels of wheat flour with dried whey protein concentrate during storage period:

Hardness

At zero-time data showed that the hardness values for control were increased more than values for all treatments of dried whey protein concentrate 5, 10, 15 and 20%. At storage times when comparing with control, the results indicated that with increasing addition level for dried whey protein concentrate up to 20%, the hardness values were decreased.

Cohesiveness

The effect of adding dried whey protein concentrate up to 20% to pan bread on the cohesiveness values which revealed an increasing in cohesiveness values correlated with increasing replacement levels dried whey protein concentrate during storage times when compared with control sample, While, during storage time there was a shrinkage of cohesiveness for all treatments but control was less than all samples.

Gumminess and chewiness

At zero times data revealed a decrease in both gumminess and chewiness values more than control by increasing level replacement of dried whey protein concentrate up to 20%, While, during storage time there was an increase for both gumminess and chewiness for control higher than all treatments of dried whey protein concentrate up to 20%

Resilience and Springiness

Resilience and Springiness of DWPC samples were decreased for all treatments during storage time parallel with losing moisture and staling. At zero times by increasing replacement levels up to 15 and 20%%, resilience values were increased However, springiness values were increased springiness values showed that DWPC samples was more springiness than control increasing addition levels up to 20%.

4.4. Sensory evaluation of pan bread made using different levels of dried whey protein concentrate:

The obtained data showed that the mean score regarding overall acceptability of pan bread revealed that T4 (20% D WPC) have the maximum score (90.7) of overall acceptability, while the T5 (25% DWPC) have the minimum score compared to control treatment (45.01).

4.5. Effect of storage period of pan bread made using dried whey protein concentrate at room temperature (28±2˚C) on bacterial growth:

The obtained results for total aerobic count bacteria and total mold and yeast count of pan bread samples during storage at room temperatures for 72 hours. It could be primarily observed from our results that the pan bread samples treated with 10, 15 and 20% whey protein concentrate had no total count of bacteria and fungi growth at zero time.

In other words, as the concentration of whey proteins increased, the total count of bacteria was decreased. Total count of bacteria and fungi were increased for 24 hr to 8.0x10 to $2.2x10^2$ and 8.0x10 to $1.6x10^3$ cfu/g, after 24 hours of storage at room temperature until it reached the maximum after 72 hours of storage (from $2.3x10^3$ to $6.0x10^3$ and 6.0x10 to $4.0x10^3$ cfu/g). Similarly, the same trend was observed to the growth of fungi. The results indicated that, with an increase in the level of addition 15 and 20% DWPC, there is no statistical count of bacteria and fungi after 24 and 48 hours during the storage period

5. Effect of replacement whey protein concentrate to wheat flour on cake quality:

5.1. Chemical composition of cakes

The replacement of both whey protein and whole egg protein resulted in an increase in the percentage of moisture as seen in T4 100% DWPC compared to the control. The replacement also increased the protein percentage and was the highest value of the increase in T2 (50% DOE + 50% WPC) In comparison to the control the lowest value, an increase in fat was observed and the highest value in T3 (25% DOE + 75% WPC) while the lowest value in T2 (50% DOE + 50% WPC). An increase in ash percentage was observed and the highest value in the control while the lowest value was seen in T2 (50% DOE + 50% WPC).

5.2. The physical characteristics of cake:

The replacement of whey proteins and whole egg protein led to an increase in both size and specific size to the replacement level of 75% DWPC, where it recorded the highest reading while the lowest value was seen in T2 (50% DOE + 50% WPC).

5.3. Texture profile of cake made using different replacement levels of dried whey protein concentrate, dried white egg and dried whole egg during storage

Hardness

The results indicated that with increasing levels of replacement to both whey protein 75% and whole egg protein up to 52% in T3, the hardness value decreased to its lowest level at these levels of replacement if a particular control was compared in different storage times as the results showed hardness values during. The storage period has increased the control and all transactions until the control value of the solidity is the highest value of the hardness of the length of the storage period over the rest of the transactions.

Cohesiveness

At storage times when comparing with control, cohesiveness was affective slightly by increasing replacement of both DWPC, DOE and generally decreased during storage time for control and all treatments as control was the less cohesiveness.

Gumminess and Chewiness

In the different storage times, when comparing with the control, it was found that the energy needed to break down and chew the cake was less than the control by increasing the percentage of replacement to 50%, 75% whey protein, 25% of the whole egg protein, where the lowest values for these two traits were at this level of protein replacement while during the storage period was The energy required for grinding and chewing transactions increases for both additives and controls as the control records the highest values for these two attributes during the storage period. During storage time the gumminess and chewiness were increased for control and all treatments but control was possessed the highest values for both gumminess and chewiness.

Springiness and Resilience

At storage times resilience and springiness as illustrated were increased by increasing replacement of both DWPC and DOE. Resilience and springiness are measures of the ability of a sponges to recover after compression. The highest values for these characteristics was noticed in T3.

Resilience and springiness values were decreased for control and all treatments of both replacement levels, however resilience and springiness values for control were higher than those for both replacement levels.

5.4. Sensory evaluation of cakes:

The results showed that the sensory qualities of the cake improved significantly compared to the control at the level of replacement of T3 (25% DOE + 75% DWPC) of the whole egg protein, where it gave the highest rate of sensory crystals.

5.5. Effect of cake storage period at room temperature (28±2˚C) on microbial growth:

Results indicated that the total counts of bacteria and fungi were increased in cake as the storage period increased. While total counts of bacteria and fungi the total viable bacterial count cannot be detected numbers at zero time, after 4 days they ranged from $6.0x10^2$ to $4.5x10^3$ cfu/g and $5.0x10^2$ to $2.4x10^3$ cfu/g in the same order after eight days of storage. After storage for 8 days at room temperature 28°C, the results showed that the total number of bacteria and fungi ranged from $1.0x10^3$ to $3.3x10^3$, $2.5x10^3$ to $5.0x10^2$ cfu/g, respectively. After storage for 14 days, all results were recorded. The total number of bacteria and fungi was less than the control, which ranged between $2.0x10^3$ to $6.0x10^3$ cfu/g. The fungi were higher in the control than recorded, as they were recorded in the control $4.5x10^3$ cfu/g, while the total number of fungi decreased to $1.0x10^3$ cfu/g.

6. Effect of replacement whey protein, egg white protein to angel cake.

6.1. The effect of replacement whey protein and egg white protein on the chemical properties of angel cake

The addition of both whey protein and egg white protein increased humidity as seen in T4 (100% DWPC) compared to the control. The replacement also increased the protein percentage and was the highest value of the increase in T4 (100% WPC) compared to the control less values. An increase in the fat was observed and the highest value in T4 (100% WPC), while the lowest value in the control an increase in the ash percentage and the highest value in T2 (50% DWE + 50%

DWPC) while the lowest value was seen in T1 (75% DWE + 25% DWPC).

6.2. The effect of protein replacement on the physical properties of angel cake.

The replacement of whey proteins and egg white protein led to an increase in both size and specific size until the level of replacement in T3 whey protein 75% and egg white protein up to 25% in T3.

6.3. The effect of replacement both whey protein and egg white protein on the properties of angel cake using a textures analysis device during the storage period at room temperature:

Hardness:

Zero-time data showed that the hardness values for control were increased more than values for all treatments of dried whey protein concentrate 75% and dried white egg 25% in T3. At storage times when comparing with control, the results indicated that with increasing replacement level for dried whey protein concentrate up to 75% and dried white egg 25% the hardness values were decreased while increase in control.

Cohesiveness:

At storage times when comparing with control, cohesiveness was affected slightly by increasing replacement of both DWPC, DWE and generally decreased during storage time for control and all treatments as control was the less cohesiveness. T3 recorded the highest cohesiveness rate of 0.90 compared to the control and decreased during the storage period, but with a lower degree of control.

Gumminess and chewiness:

From these results it could be noticed that best replacement level for gumming were The lowest values for these characteristics was noticed in T3 (25% DWE + 75% DWPC) was (10.69) and T4 (100% DWPC) was (12.36). the gumminess and chewiness were increased for control and all treatments by increasing time. From these results it could be noticed that the best replacement level for chewiness were T3 (25% DWE + 75% DWPC) and T4 (100% DWPC).

Springiness

At storage times resilience and springiness as illustrated were increased by increasing replacement level of both DWPC and DWE. Resilience and springiness are measures of the ability of a sponges to recover after compression. The highest values for these characteristics was noticed in T3 (25% DWE + 75% DWPC).

Resilience

Resilience and springiness values were decreased for control and all treatments of both replacement levels, however resilience and springiness values for control were higher than those for both replacement levels.

6.4. Sensory evaluation of Angel cake:

The results showed that the sensory characteristics of angel cake improved significantly compared to the control at the level of replacement 75% whey protein + 52% egg white protein, where it gave the highest rate of sensory characteristics in the T3.

6.5. Effect of storage period of Angel cake at room temperature (28±2˚C) on bacterial growth.

At zero time, data indicated that, the total viable bacterial count and fungi cannot be detected numbers. Angle cake treated with different levels and combinations of DWPC and DWE stored for 4 days the results showed that total count of bacteria and fungi ranged from 4.0×10^2 to $1.0x10^3$ and 3.0x10 to $7.0x10^2$ cfu/g, respectively. The highest total count of both bacteria was recorded for the control treatment (100% DWE) while the combination between dry whey proteins (DWPC) and Dry white egg (DWE) in T3 (4.0×10^2) showed the least total count of bacteria and sample (1) showed the least total fungi (3.0×10). stored for 8 days. The total count of bacteria was ranged from $6.0x10^2$ to $2.5x10^3$ cfu/g, whereas the total count of fungi ranged from 2.0x10 to $1.5x10^3$ cfu/g. The highest total count of both bacteria and fungi was recorded for the control treatment (DWE). The combination between dry white egg (DWE) and dry whey protein concentrate (DWPC) in T4 (100% DWPC) showed the least total count of bacteria and fungi 6.0×10^2, 2.0×10^2, respectively.

Conclusion:

From the results obtained, we can recommend the use of whey protein center in supporting bakery to raise the nutritional value, as well as in replacing dried eggs or dried egg whites when making regular cakes, angel cakes or other bakery products that are used in the manufacture of eggs. This is because of its nutritional value and functional properties in improving the quality of baked goods.