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Additional Effect of Defatted Wheat Germ Protein Isolate on Nutritional Value and Functional Properties of Yogurts and Biscuits.

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Abstract: Wheat germ is one of the potential sources of proteins at a relative low cost. This study aimed to investigate the effect of additional defatted wheat germ protein on nutritional value and quality of yogurts and biscuits. Defatted wheat germ proteins (DWGP) were extracted by one-step alkaline extraction using alkaline extraction at pH 9.5 and following isoelectric precipitation at pH 4.0. Yogurts were manufactured with 3, 6 and 9 g DWGP/100ml milk. Biscuits were prepared with 10, 20 and 30g DWGP/100g wheat flour (WF). Results found fortified yogurts had higher contents of protein, carbohydrate, and ash. Apparent viscosity and firmness, pH and total solids % values were higher. Prepared yogurts with 3and 6 g DWGP/100milk had significant higher scores of appearance and viscosity. Fortified biscuits had higher contents of protein and ash. Values of weight change %, thickness, volume, lightness, yellowness and saturation index were lower than that of the control. Biscuits with10 and 20g DWGP/100 g WF had higher color, firmness, and general acceptable scores than that of control. Conclusion: DWGP incorporation into milk yogurts and biscuit up to a level of 6g/100ml milk and 20g /100g WF, respectively had a higher acceptable for sensory and physical properties.

Key words: Defatted wheat germ - Cookies – Yogurt- Protein isolate.

INTRODUCTION

Wheat kernel is one of the most stable foods. In the wheat grain, most nutrients with the exception of starch are concentrated in the germ. The germ is a part of the wheat kernel (2.5% of the total weight), along with the bran and the endosperm. Germ removed in the processing of wheat to yield white flour. Wheat germ, being a by-product of the flour milling industry and is one of the most potential and excellent sources of vitamins, minerals, fiber and proteins at a relative low cost (Nichelatti and Hidvegi, 2002). Defatted wheat germ is a high nutritive value of protein material remaining after extraction of the wheat germ oil, which contains more than 30% protein. Wheat germ protein is rich in seventeen amino acids, especially the essential amino acids lysine, methionine, and threonine, in which many cereals are deficient (Yiqiang *et al.,* 2001; 2000; Muhammad *et al.,* 2007) reported that, amino acid content of defatted wheat germ are high (26.793 g/100 g) and the contents of eight essential amino acids were all relatively high.

Yogurt is a popular food in many parts of the world. It is widely consumed both by infant and adult populations. People in Egypt and some other countries of the Middle East have eaten yogurt for thousands of years. The nutritional constituents of yogurt are derived from the milk used in making it, those that are synthesized by the lactic acid bacteria and those that added by the manufactures**.** Yogurt has a high content of conjugated linolenic acid, which has immuno-stimulatory and anticarcinogenic properties. Yogurt is an excellent source of calcium, phosphors, potassium, and vitamin B12. (Adolfsson *et al.,* 2004).

Biscuits had large variations of carbohydrate supply – from 20 to 90% depending on the biscuit type (FAO/WHO, 1997). Biscuits are rich in carbohydrate but are deficient in protein quantity and amino acid balance (Wu *et al.,* 2001). Therefore, the deficiency problem can be solving by consuming biscuits with foods that are rich in protein or by enrichment of biscuits.

The consumption of foods enriched with protein especially from plant sources has been increasing among health people and vegetarian. Improving the nutrition of everyday food products, especially for children is approach to improve the overall nutrient intake. This can be achieved by attractive a familiar food and altering it to make it more nutritious by changing its component. Enriched food products should be inexpensive, economically, nutritive and satisfactory for consumers. Nevertheless, enrichment should not cause any important

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modifications in sensory and functional properties of final product. Because of yoghurt and biscuit are acceptable for children and adults, may be serving as a suitable food for fortification and/or enrichment purposes. The nutritional value of both yoghurts and biscuits might increased by addition of wheat germ protein. Due to the new trends for healthy products suitable for children, this study was conducted to obtain yoghurts and biscuits acceptable in organoleptic and physical properties as well as richer in protein and nutritive value by the addition of defatted wheat germ protein (DWGP) at different levels.

MATERIALS AND METHODS

Materials:

Defatted wheat germ was obtained from Cairo North Mill Co., Cairo Egypt. Cow's milk was obtained from the Animal Sci. Dep., Faculty of Agricultural, Ain Shams University, Cairo, Egypt. Wheat flour (WF), milk powder, butter, salt and powder sugar were procured from local market in Cairo, Egypt.

Methods:

Defatted Wheat Germ Protein Isolate:

Defatted wheat germ proteins (DWGP) were extracted by one-step alkaline extraction as described by (Yiqiang *et al.,* 2000) using alkaline extraction at pH 9.5 and following isoelectric precipitation at pH 4.0.

Preparation of Yogurts:

Yogurts were manufactured from cow's milk. Fresh milk was pasteurized and fortified with defatted wheat germ protein at three different levels (3, 6 and 9 g/100 ml milk). Pasteurized milk was inoculated with 2% yogurt culture. Inoculated yogurts were dispensed into 120mL plastic containers and covered, then incubated at 42°C until complete coagulation. After coagulation, the containers were stored 5 ± 1°C in the cold refrigerator for 12hours.

Preparation of Biscuits:

Biscuits were prepared without and with defatted wheat germ protein at three different levels (10, 20 and 30g/100g WF). The recipe used for biscuit is presented in Table 1. Biscuits were prepared as the procedure described by (Halaby *et al.,* 2000).

Table 1: Ingredients used for biscuits preparation with or/and without defatted wheat germ protein.

Ingredients	Control	Fortified with DWGP per 100g WF		
		10	20	30
Wheat flour (g)	220	220	220	220
Sucrose (g)	120	120	120	120
DWGP (g)	Non	22	44	66
Butter (g)	110	110	110	110
Egg yolk (g)	40	40	40	40
Milk (ml)	5	5	5	5
*B.p (g)	5	5	5	5
Vanillin (g)	5	5	5	5
Salt (g)	2	2	2	2

* B.P: baking powder

Proximal Composition:

Moisture, crude protein, fat and ash contents of yogurts and biscuits samples were determined according to the standard methods of (AOAC, 1995). Total carbohydrate was calculated by difference.

Physical Properties of Yogurts:

The prepared yogurts were evaluated physically to determine the best level of DWGP that maintained better properties and acceptability to the final products. Yogurts were evaluated objectively after 12 hours of cold storage period at 5±1Cº. Physical properties were achieved by using the following properties:

pH values:

PH was recorded using pH meter apparatus (HI 9021).

Total Solids Content Percentage (TS %):

Total solid % was determined by using AR 200 digital, Handhold Refractomater apparatus.

Syneresis:

Yogurts were subjected to analyze for syneresis at three different times 2, 4 and 6 hours as described by (Konar, 1980).

Viscosity:

Viscosity was measured with DVE viscometer (model RVDVE, BROOKFIELO) using spindle L4, steady shear analysis (50 s-1 rpm). The temperature of yogurt samples was maintained at 5 ± 1°C throughout the experiment by a cooled water bath.

Firmness:

The firmness of yogurts was measured by using Pentrometer apparatus, Model H-1240 with serial number of 99101240 spec: Ast M, Humboldt, MFG, Co., USA**.** The method was based on determination of the distance (mm) a cone penetrates the sample during sec.

Physical Properties of Biscuits:

Biscuits fortified with DWGP and control was evaluated objectively to determine the best level of defatted wheat germ protein that maintained biscuit quality. The following properties of biscuits were evaluated:

Weight:

Biscuits were weighed before and after baking, change in baked weight (g) was calculated and represented as percentage using the following equation:

% change in weight=Weight before baking –Weight after baking/Weight before baking x 100.

Thickness, Volume, and Density*:*

Products thickness (cm) was measured by using caliber apparatus. Volume (cm^3) was determined by seeds displacement method according to (Penfield and Campbell, 1990). Density of biscuits was done by using the following equation:

Density = Weight (g)/ volume (cm^3)

Firmness:

Biscuits firmness was measured by using Pentrometer apparatus, Model H-1240 with serial number of 99 101 240 spec: Ast M, Humboldt, MFG, Co., USA as described by (Penfield and Campbell, 1990). The method was based on determination of the distance (mm) a cone penetrates the sample during a defined period of time (sec.) as indication for product tenderness.

Color Evaluation of Biscuits:

Biscuits color was measured using a Spectrocoloimeter (Tristimulus color machine) with CIF, lab color scale (Hunter, Lab Scan XE, and Reston VA) calibrated with a white standard tile of Hunter lab Color standard (LX No.16379): X = 77.26, Y= 81.94 and Z= 88.14 (L* = 92.43, a*= 0.86, b*= 0.16). Color difference (ΔE) was calculated from a, b and L parameter, using Hunter-Scotfild's equation (Hunter, 1975).

$\Delta E = (;\ a^2 +;\ b^2 +;\ L^2)^{1/2}$

Where: ; a=a-ao, ; b= b-bo and ; L= L-Lo

Subscript "o" indicates color of control.

Saturation index $= \sqrt{a^2 + b^2}$ was also calculated.

Organoleptic Evaluation:

Yogurts and biscuits samples were subjected to sensory evaluation by twenty semitrained panelists (who are regularly consuming biscuit and/or yogurt) using score sheet according to the method described by (Kulp *et al.,* 1985). Panelists were asked to evaluate yoghurts characteristics such as appearance, color, odor, taste, viscosity and general acceptable. On the other hand, organoleptic evaluation of biscuits was included characteristics of appearance, color, taste, odor, tenderness, and general acceptable.

Statistical Analysis:

The obtained results were expressed as Mean ± SE. Data were evaluated statistically using one-way analysis of variance (ANOVA). Significant difference between means was estimated at $p<0.05$ according to (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSIONS

Proximal Composition of Yogurts:

The values of major chemical composition (%) for yogurts are found in Table (2). The tabulated results indicated that protein, carbohydrate, and ash contents of fortified yogurts with different levels of DWGP were higher than that of control. These increased was more detectable with increasing the level of DWGP. Whereas, fortified yogurts had lower contents of moisture and total fat as compared to control. Therefore, the addition of DWGP improves the nutritional value of yogurts, especially protein, carbohydrate and ash contents. These results were agreed with (Tamime and Robinson, 1999). The higher protein content of yogurts fortified with DWGP may be related to the higher amino acid content of defatted wheat germ and the contents of eight essential amino acids**.** Defatted wheat germ is a high nutritive value protein material remaining after extraction of the wheat germ oil as reported by (Yiqiang *et al.,* 2000).

Table 2: Major chemical composition of fortified yogurts with different levels of defatted wheat germ protein and control.

Chemical composition (%)	Control	Fortified yogurts with DWGP (g/100 ml milk)		
		3	6	9
Moisture	82.37	80.10	77.67	74.55
Total protein	5.56	8.06	9.96	12.06
Total fat	4.37	3.84	3.57	3.03
Total carbohydrate	7.13	7.20	7.90	9.32
Ash	0.75	0.85	0.90	1.04

Physical Properties of Yoghurts:

Selected measurements for objective evaluation of yogurts prepared with different levels of DWGP and control are presented in Table (3). Results showed pH and TS % values for yogurts prepared with different levels of DWGP were increased as compared to control. The increase in pH and TS % my be explained on based the increase in protein and the decrease in lactose contents of the yogurts as well as the chemical composition of DWGP. Therefore, in fortified yogurts with DWGP, acid production could be controlled because lower initial lactose levels. This result was in concurrence with the findings of (Seckinkomal, 2004) who mentioned that protein contents in yoghurt increased with the removal of lactose.

Our results also detected that whey syneresis of fortified yogurts after 2, 4 and 6 hours were lower than that of the control. There was no whey syneresis found of fortified yogurts with 6 and 9g DWGP/100 ml milk as compared to fortified yogurt with 3g DWGP and control (5 and 2 ml/100g, respectively). The comparison results of whey syneresis reflected that, yogurts made with DWGP displayed minimal free whey were better in quality as compared to control. This may be attributed to its higher contents of solids particularly protein content. The obtained results agreed with (Modler *et al.,* 2000) who reported that, with increased protein content in yogurt, the syneresis was decreased. Lower whey syneresis also, may be related to water holding capacity of DWGP as reported by (Yiqiang *et al.,* 2000) who reported that wheat germ protein had excellent water retention, especially at higher pH value.

Results also, recorded that apparent viscosity and firmness of fortified yogurts with different levels of DWGP were higher than that of control. The increase in viscosity and firmness was more detectable with increasing the level of wheat germ protein. The differences in the apparent viscosity among different yogurt samples may be attributed to the differences in protein content and TS %. As expected, yogurts made with DWGP in all cases had higher viscosity than control. These results agreed with (Alvarez *et al.,* 1998; Magenis *et al.,* 2006) who reported that viscosity of yogurts increased with increasing protein contents. Increased gel strength and viscosity of yogurts occurred with increased average of total solids (Savello and Dargan, 2004). Recent studies also reported that, addition of ingredients, which increases the dry matter contents, increased the rheological parameters of fermented milk. The texturing capacity was directly related to the dairy ingredient and protein content (Sodini *et al.,* 2002; IsIeten *et al.,* 2008). Results also indicated that each incremental increase in DWGP required greater force to penetrate the yogurt gel, reflecting the effect of increased yogurt protein content on gel firmness. Increased protein contents in yogurts with DWGP added resulted in a higher firmness in these yogurts. The reason for lower firmness of control, compared with that made with DWGP added may be due to the partial denaturation of the proteins during the manufacture of yogurts. Increasing the total solids in yogurt increases the density of the gel network and reduces pore size. Consequently, water was bound more firmly in the product, increasing the firmness of the yogurt. (White, 1995) found that, increased protein content in yogurt resulted in an increase in the level of bound water and led to firm and viscous yogurts. The firmness of yogurt is dependent on TS % content and on the protein content of the product as well as on the type of protein (Oliveira *et al.,* 2001; Puvanenthiran *et al.,* 2002) In this study, apparent viscosity and firmness were highly correlated with the protein level. This indicates that, protein content is one of the responsible factors for the firmness and viscosity of the product.

Table 3: Physical properties of yoghurts fortified with different levels of defatted wheat germ protein and control.

Properties	Control	Fortified yogurts with DWGP (g/100 ml milk)		
		3	6	9
pH	5.00	5.50	6.00	6.50
TS%	10.00	11.00	14.50	18.50
Syneresis (ml/100g)				
After: 2hr.	17	15	10	8
4hr.	9	10	6	5
6hr.	5	2	0	0
Viscosity (cP)	600	700	900	1100
Firmness (mm/sec)	18.00	18.50	19.00	20.00

Organoleptic Evaluation of Yogurts:

Organoleptic properties (appearance, color, odor, taste, viscosity and general acceptable) of yogurt samples are presented in Table (4). Results found that prepared yogurts with 3 and 6 g DWGP/100 ml milk had significant higher scores (mean ± SE) of appearance and viscosity, while there was no significant changes in taste and general acceptable as compared to control. Scores (mean ± SE) values of color were significantly decreased as compared to control. With regard to odor, yogurts prepared with 3g DWGP/100 ml milk had no significant lower score (8.55±0.22), while yogurts prepared with 6 and 9 g DWGP/100 ml milk had significant lower scores (8.05 ± 0.19 and 6.95 ±.030, respectively) as compared to control (8.90 ±0.20).

Table 4: Organoleptic properties of yogurts fortified with different levels of defatted wheat germ protein and control yogurt.

Properties	Control	Fortified yogurts with DWGP (g/100ml milk)		
		3	6	9
Appearance	b 8.00±0.15	a 8.95±0.17	a 8.90±0.14	c 6.65±0.18
Color	a 9.10±0.18	b 7.55±0.15	c 6.45±0.21	c 5.95±0.17
Odor	a 8.90±0.20	a b 8.55±0.22	b 8.05±0.19	c 6.95±0.30
Taste	a 8.45±0.30	a 8.55±0.27	a 8.30±0.18	b 6.85±0.20
Viscosity	b 7.35±0.17	a 8.75±0.19	a 8.55±0.22	b 7.45±0.21
General acceptable	a 8.75±0.28	a 8.95±0.15	a 8.75±0.12	b 6.50±0.22

Data are presented as mean± SE. SE: stander error.

Difference superscript letters in the same row donates significant differences at $p < 0.05$.

Proximal Composition of Biscuits:

Results of major chemical composition (%) for biscuits are presented in Table (5). The tabulated results indicated that, fortified biscuits with DWGP had higher contents of protein and ash than that of control. These increases were more detectable with increasing the level of DWGP. On the other hand, moisture, fat and total carbohydrate contents of fortified biscuits were lower than that of control. The difference in protein content of biscuits may be attributed to higher protein content of DWGP. The increased in protein and ash content may be related to the content of DWGP and its effect on decreased moisture, fat and carbohydrates contents. This result agreed with (Hettiarachchy *et al.,* 1996) who found defatted wheat germ protein isolate contains about 90% proteins.

Table 5: Major chemical composition of biscuits fortified with different levels of defatted wheat germ protein and control.

Chemical composition (%)	Control	Fortified biscuits with DWGP (g/100g WF)		
		10	20	30
Moisture	5.55	4.49	3.41	3.20
Total protein	10.03	11.65	13.58	16.09
Total fat	17.91	17.37	16.66	15.95
Total carbohydrate	65.56	65.49	65.20	63.41
Ash	0.95	1.00	1.15	1.35

Physical Properties of Biscuits:

Results of physical evaluation of biscuits prepared with different levels of defatted wheat germ protein and control are found in Table (6). It was illustrated that weight values of prepared biscuits with DWGP were higher than that of the control. These results were confirmed by the obtained values of percent change in weight, which were less in prepared biscuits with DWGP than that of the control. The difference in weight may be related the ability of DWGP to retain water as reported by (Yiqiang *et al.,* 2000), thus decreased water lose during baking. These results agreed with (Tomoskozi *et al.,* 2002) who reported that the addition of wheat germ protein increased the water absorption of wheat flour.

Thickness values for prepared biscuits with different levels of DWGP were lower (0.44, 0.36 and 0.36 cm, respectively) than that of the control (0.46 cm). There was slightly decreased in volume for biscuits prepared with different levels of DWGP as compared to control. Biscuits prepared with different levels of defatted wheat germ protein have higher density and firmness values as compared to control.

The observed changes in thickness, volume, density and firmness may be attributed to the dough constituents. Dough constituents changed as the percentage of DWGP changed in each biscuit variable. The dough constituents react on heating to give rise to intermolecular and intermolecular cleavages, which produce highly cross-linked macromolecular structures. Due to these changes, swelling and softening of starch and denaturation of protein occurs, which reduces the ability of dough to conduct heat (Fessas and Schiraldi, 2000). Therefore, decreased the denaturation temperature and increased denaturation in wheat glutenins before the raise in baked products and decreased thickness and volume of biscuits. The change in density may be due to associated between weight and density, as the weight increases, the density increases.

As found, each incremental increase in DWGP required greater force to penetrate the biscuits, reflecting the effect of increased biscuit protein content on firmness. Increased protein content in biscuit with DWGP added resulted in a higher firmness. (Tomoskozi *et al.,* 2002) reported that the DWGP had as much as 89.58% of protein and 72.9% glutenins. Gluten is a protein complex formed in flour products when water and protein flour are mixed (Lauterbach and Albrecht, 1995) gluten makes baked products less tenderness and required to higher amount of force to compress products. Therefore, as the percentage of DWGP increases in a variable, the more gluten was form and the tougher it was become. Increasing the gluten content increases dough consistency and hardness. In similar, the biscuit's density and firmness raise, while the dimensional parameters decreased slightly along with increasing gluten.

Table 6: Physical properties of biscuits fortified with different levels of defatted wheat germ protein and control.

Properties	Control	Fortified biscuits with DWGP (g/100g WF)		
		10	20	30
Weight (g):				
Before baking	10	10	10	10
After baking	9.00	9.40	9.55	9.60
Change (%)	10.00	6.00	4.50	4.00
Thickness, (cm)	0.46	0.44	0.36	0.36
Volume (cm^3)	23.50	23.00	22.00	21.50
Density (g/cm^3)	0.38	0.41	0.43	0.45
Firmness (mm/sec)	37	40	42	45

Color Evaluation of Biscuits:

Values of Hunter color for baked biscuits using different levels of defatted wheat germ protein and control are presented in Table (7). It was found that lightness (L) values for backed biscuits with the different levels of DWGP were lower (62.7, 60.73 and 58.75, respectively) than that of the control (64.02). Biscuits prepared with DWGP had higher redness (a) values (13.20, 15.01 and 16.38, respectively) and lower yellowness (b) values (33.90, 33.04 and 30.76, respectively) as compared to control values (10.60 and 35.52, respectively). Concerning saturation index, baked biscuits with different levels of DWGP had lower values (36.38, 36.29 and 34.85, respectively) as compared to control (37.07). ΔE values for backed biscuits with DWGP were increased; the increased was more detectable with increasing DWGP levels.

Saturation index is related to Hunter redness (a) and yellowness (b) values as a degree of color intensity. The value of ΔE is the total color difference parameter, it was found to useful in simulating the results of color evaluation. Data as compared to ΔE control values revealed that, the highest change in samples was observed in baked biscuits with DWGP. Biscuits made with DWGP tend to be darkened gradually in color when DWGP level increased and brightness value of control sample was higher than L values of DWGP added biscuits. The difference in biscuit color may be related to the difference rate of browning reaction that depends on a number factors, including the time, temperature, type of sugars and the type of protein as reported by (Parker, 2003). Defatted wheat germ protein has 89.58% protein that will enhance browning reaction (Tomoskozi *et al.,* 2002).

Table 7: Hunter color values of biscuits fortified with different levels of defatted wheat germ protein and control.

Measurements	Control	Fortified biscuits with DWGP (g/100g WF)		
		10	20	30
Lightness (L)	64.02	62.70	60.73	58.75
Redness (a)	10.60	13.20	15.01	16.38
Yellowness (b)	35.52	33.90	33.04	30.76
a/b 0.30	0.39	0.45	0.53	
Saturation index	37.07	36.38	36.29	34.85
ΔE non	3.33	6.81	9.16	

Organoleptic Evaluation of Biscuits:-

Results of sensory evaluation characteristics for biscuits are recorded in Table (8). It was found that fortified biscuits with10 and 20g DWGP/100 g WF had lower scores (mean ± SE) values of appearance and odor, and higher scores of color, firmness and general acceptable as compared to control. Fortified biscuits with 10 DWGP/100 g WF had lower score (mean ± SE) value of taste, while biscuits with 20g DWGP/100 g WF had higher scores as compared to control. These changes were not significant at $p<0.05$ as compared to control. Fortified biscuit with 30g DWGP/100g WF had a significant lower scores of appearance, color, taste, odor and general acceptable at $p< 0.05$ (8.10±0.19, 7.75±0.18, 8.55 ± 0.21, 8.45 ± 0.18 and 7.80 ±0.18, respectively) as compared to control (9.25±0.16, 8.80 ±0.14, 9.20 ±0.19, 9.35 ± 0.13 and 9.00 ±0.16, respectively). While, Firmness score was significantly higher (9.00±0.19) than that of the control (8.35 ± 0.11).

Our results found that, baked biscuits with10 and 20g DWGP/100 g WF had higher acceptable for appearance, taste and odor among the other biscuits. For color, firmness and general acceptable, fortified biscuits with 10 and 20 g DWGP/100 g WF were evaluated as most desirable and the 30 g DWGP/100 g WF was evaluated as the least desirable. These results were agreement with the obtained results of physical properties. Color is one of significant factors, which affect acceptability of food products by consumer. It is desired that biscuits should have red golden color. Biscuits made with 10 and 20 g DWGP/ 100gWF tended to be golden-red in color, while biscuits mad with 30 g DWGP/ 100gWF were red-brown. Firmness also is one of the potential properties, which affect acceptability of biscuits. Backed biscuits with 10 and 20 g DWGP/ 100gWF tended to be tough more than of control, while backed biscuits with 30 g DWGP/ 100gWF were tougher.

Table 8: Organoleptic properties of biscuits fortified with different levels of defatted wheat germ protein and control.

Properties	Control	Fortified biscuits with DWGP (g/ 100g WF)		
		10	20	30
Appearance	a 9.25±0.16	a 8.95±0.22	a 8.85±0.23	b 8.10±0.19
Color	a 8.80±0.14	a 9.30±0.18	a 9.15±0.18	b 7.75±0.18
Taste	a 9.20±0.19	a 9.20±0.17	a 8.95±0.17	b 8.55±0.21
Odor	a 9.35±0.13	a 9.30±0.15	a b 8.90±0.18	b 8.45±0.18
Tenderness	b 8.35±0.11	ab 8.65±0.20	ab 8.85±0.17	a 9.00±0.19
General acceptable	a 9.00±0.16	a 9.10±0.18	a 9.05±0.20	b 7.80±0.18

Data are presented as mean± SE. SE: stander error.
Difference superscript letters in the same row donates significant differences at $p < 0.05$.

Conclusion:

Our results concluded that, the different combination of defatted wheat germ protein had considerable effects on chemical, physical, and sensory properties of yogurts and biscuits. DWGP incorporation into milk yogurts up to a level of 6g/100ml milk seems suitable in terms of physical and sensory properties. Biscuits made with 10 and 20g DWGP/100gWF had a higher acceptable in appearance, taste and odor. For color, firmness and general acceptable, fortified biscuits with 10 and 20 g DWGP/100 g WF were evaluated as most desirable. This finding offers DWGP is a potential source of protein for possible food applications, especially for children.

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REFERENCES

Adolfsson, O., S. Meydani and R. Russell, 2004. Yogurt and gut function. American Journal of Clinical Nutrition, 80: 245-256.

AOAC, 1995. Official methods of analysis, 16th ed. Association of Official Analytical Chemists, Washington DC.

Alvarez, F., M. Arguelles, M. Cabero, F. Riera, R. Alvarez, J. Iglesias and J. Granda, 1998. Fermentation of concentrated skim milk. Effects of different protein/lactose ratios obtained by ultrafiltration-diafiltration. Journal of the Science of Food Agricultural, 76: 10 – 16.

FAO/WHO. Carbohydrates in Human Nutrition. Report of a Joint FAO/WHO Expert Consultation, Rome, 14-18 April 1997. FAO Food and Nutrition Paper 66. Rome: Food and Agriculture Organization of the United Nations, 1998.

Fessas, D. and A. Schiraldi, 2000. Starch gelatinization kinetics in bread dough DSC investigations on simulated baking processes. Journal of Thermal Analysis and Calorimetry, 61: 411–423.

Halaby, B., A. Nadir and E. Said, 2000. Fortified biscuits baked by microwave oven. Journal of Agricultural Science Mansoura University, 25(7): 4413- 4423.

Hettiarachchy, N., V. Griffinand R. Gnansambandam, 1996. Preparation and functional properties of a protein isolate from defatted wheat germ. Cereal Chemistry, 73(3): 364-367.

Konar, A., 1980. Study of effects on yogurt quality of cow, ewes, goat, and buffalo milks in different temperature and vary times. Agricultural Faculty, Food Technology Department, Association Thesis, Adana, Turkey, 85-91.

Kulp, K., H. Chung, M. Martinez and W. Doerry, 1985. Fermentation of water ferments and bread quality. Cereal Chemistry, 32(1): 55.

Isleten, M. and Y. Karagul-Yuceer, 2008. Effects of functional dairy-based proteins on nonfat yogurt quality. Journal of Food Quality, 31(3): 265-280.

Lauterbach, S. and J. Albrecht, 1995. Functions of baking ingredients. The University of Nebraska- Lincoln Cooperative Extension, Institute of Agriculture and Natural Resource. http://ianrpubs.unl.edu/foods/nf186.htm.

Magenis, R., E. Prudencio, D. Amboni, N. Junior, R. Oliveira, B. Soldi and H. Benedet, 2006. Compositional and physical properties of yogurts manufactured from milk and whey cheese concentrated by ultrafiltration. International Journal of Food Science and Technology, 41: 560-568.

Muhammad, U., M. Faqir and Z. Tahir, 2007. Nutritional assessment of cookies supplemented with defatted wheat germ. Food Chemistry, 102 (1):123-128.

Modler, H., M. Larmond, C. Lin, D. Froehlich, D. Emmons, 2000. Physical and sensory properties of yoghurt stabilized with milk proteins. Journal of Dairy Science, 66(3): 422-429.

Nichelatti, M. and M. Hidvegi, 2002. Experimental and clinical results with Avemar (a dried extract from fermented wheat germ) in animal cancer models and in cancer patients. Nogyogyaszati Onkologia, 7: 180–185.

Oliveira, M., I. Sodini, F. Remeuf and G. Corrieu, 2001. Effect of milk supplementation and culture composition on acidification, textural properties and microbiological stability of fermented milks containing probiotic bacteria. International Dairy Journal, 11: 935-942.

Parker, R., 2003. Introduction to food science. Delmer, a division of Thomson Learning, Inc. US.

Penfield, M. and A. Campbell, 1990. Experimental food science. Academic press, Inc. London (ed): p 33.

12- Hunter, R. 1975. Scales for measurements of color differences: In measurements of appearance, Eds., J. Willy, pp: 133.

Puvanenthiran, A., R. Williams and M. Augustin, 2002. Structure and visco-elastic properties of set yogurt with altered casein to whey protein ratios. International Dairy Journal, 12: 383-391.

Savello, P. and R. Dargan, 2004. Improved yogurt physical properties using ultrafiltration and very-high temperature heating. Milchwissenschaft, 50(2): 86-90.

Snedecor, G and W. Cochran, 1980. Statistical methods, Ames, Iowa State University Press, USA, (7th ed): pp: 39-63.

Sodini, I., A. Lucas, M. Oliveira and F. Remeuf, 2002. Effect of milk base and starter culture on acidification, texture, and probiotic cell counts in fermented milk processing. Journal of Dairy Science, 85: 2479-2488.

Tamime, A. and R. Robinson, 1999. Yoghurt Science and Technology, Oxford, U. K., Pergamon Press.

16- Seckinkomal, S. 2004. Nutritional value of strained yoghurt produced by traditional method. Ege University Tyrkey, 59: 41-43.

Tomoskozi, S., F. Bekes, R. Haraszi, P. Gras, J. Varga and A. Salgo, 2002. Application of micro Z-arm dough mixer in wheat research- effect of protein addition on mixing properties of wheat dough. Periodica Polytechnica Ser Chemical Engineering, 46(1): 31–38.

White, C., 1995. Manufacture of high quality yogurt. Cultural of Dairy Product Journal, 30(2): 18-26.

Wu, Y., G. Hareland and K. Warner, 2001. Protein-enriched spaghetti fortified with corn gluten meal. Journal of Agricultural and Food Chemistry, 49: 3906-3910.

Yiqiang, G., S. Aidong, N. Yuanying and C. Tongyi, 2001. Study and development of a defatted wheat germ nutritive noodle. European Food Research Technology, 212: 344–348.

Yiqiang, G., S. Aidong, N. Yuanying and C. Tongyi, 2000. Some Nutritional and Functional Properties of Defatted Wheat Germ Protein. Journal of Agricultural and Food Chemistry, 48 (12): 6215–6218.