J. Food and Dairy Sci., Mansoura Univ., Vol. 8 (8): 341- 345, 2017

Making Low-Fat Butter Spread- Like Enriched with Oat's and Barley's Milk

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ABSTRACT

Oat milk, barley milk and their blend (1:1) were used as an alternative to skimmed milk in the processing of like low-fat butter spread with high quality and cheap. The product was stored in the refrigerator for thirty days and evaluated during this period nutritionally, physically and sensorial. The results obtained showed that all spreads were similar in their content of solids, fat, ash and differed in protein and carbohydrates. The spreads containing oat milk or barley milk or their mixture resulted in an increase in DV % of each carbohydrates, zinc, phosphorus and vitamins B_3 and B_6. Oat and barley spreads without control spread were characterized by their fiber, iron, and selenium content. A high DPPH activity % of oat and barley spreads was detected, compared to control spread. The initial peroxide values (PV) of all spreads were increased during storage, however, the PV remained within legal limits. At the end of storage oat and barley spreads were of lower PV, compared with control spread. Wheying off and oiling off increased gradually of all spreads during storage. The rate of increase was higher in control spread. No significant differences in overall acceptability score were observed between oat- spread and control spread during storage, but they were slight significant when comparing with oat/barley- and barley- spreads. Barley spread had lower production cost followed by oat/barley- and then oat- spread compared to the control. Therefore, we recommend using barley milk or oat/barley milk as substitute of skim milk in low-fat butter spread.

Keywords: - oat milk, barley milk, low-fat butter spreads

INTRODUCTION

Many consumers prefer eating table butter, but its high content of fat (≥ 80%) has been a reason to avoid consuming it due to diseases such as high blood pressure, arteriosclerosis, obesity and others. Therefore, the idea of producing low-fat butter spread-like product was necessary in response to consumers' desire, to reduce the production cost and to provide an opportunity to use of non-milk components with functional properties.

In this product, fat is reduced against the increase of nonfat solids and moisture as well as the use of stabilizers, emulsifiers, emulsifying salts and table salt. These nonfat solids may be milk solids such as whey protein concentrate, skim milk powder, butter milk powder and others or non-milk solids such as vegetable components.

Therefore, the purpose of this part of the study was to use oat milk or barley milk or their blend as source of nonfat solids instead of fresh skimmed milk in the manufacture of low-fat butter spread and evaluate their impact on the quality characteristics of the product during storage in the refrigerator for thirty days.

MATERIALS AND METHODS

Oat's (Avena sativa) and hull less barley's (Hordeum vulgare - Giza 129) grains were purchased from seed stores of the experimental Farm of Agriculture Research Center (A.R.C.), Ministry of Agriculture, Giza, Egypt and stored at 4ºC to minimize changes in composition. Oat milk (10% TS, 0.02% fat, 1.21% protein, 0.41% ash and 8.36% carbohydrates) and barley milk (10% TS, 0.01% fat, 1.18% protein, 0.54% ash and 8.27% carbohydrates) were prepared according to Ali (2012). Fresh buffalo's milk (16.3% T.S, 6.5% fat) was obtained from herds of Faculty of Agriculture, Cairo University and separated at 45ºC to obtain cream (63.68% T.S, 60% fat) and skim milk (10% T.S, 0% fat, 3.9% protein, 0.8% ash and 5.3% carbohydrates). The obtained fresh cream was churned at 8ºC using manual churn to obtain unsalted sweet butter (83.2% T.S, 81.1% fat and 2.1% MSNF). Milk protein concentrate powder (95.4% T.S, 1.4% fat, 70% protein, 5.8% ash and 18.2% carbohydrates) made in USA was obtained from Misr for Milk and Food Co., Cairo, Egypt. Dry soft commercial food grade salt was obtained from El-Nasr Company of Alexandria. Stabilizer (CREAMO 950S) and emulsifier (PALSGAARD® 0093) were obtained from MIFAD, Giza, Egypt. Emulsifying salt (Egy Phos S20) was obtained from Egyptian Co., For Dairy Products and Food Additives (Egy-Dairy), Egypt. Potassium sorbate was obtained from ADWIC Company, Cairo, Egypt.

The basic low-fat butter spread formula and its likes (0.2 kg for each) were prepared according to the Egyptian standards of dairy formula as control (CO) and its likes (OMS100, BMS100 and OBMS100), and were standardized to contain 50% T.S, 41% fat, 6% MSNF, 1% emulsifying salt, 0.7% emulsifier, 0.7% stabilizer, 0.1% potassium sorbate and 0.5% table salt. The formulas of these treatments were formed based on preliminary analysis for all raw materials used (Table1). The dry ingredients such as milk protein concentrate powder, stabilizer, emulsifier, emulsifying salt, table salt and potassium sorbate were mixed together then added slowly to hot water with strong stirring in a mixer (electric mixer, Moulinex®, France) at 60°C for 3 min. The resultant mixture was mixed with fresh skim milk in a mixing vessel and heated to 60°C in a water bath. At the same time melted butter was added to the above mixture with the continuous agitation and mixing in a mixer at 60°C for 5 min. The product was heated in a double boiler at 75°C for 2 min, cooled to 60ºC and immediately filled into plastic cups, where every cup had about 60 g low-fat butter spread. The cups were thereafter air tightly closed and kept at refrigerator temperature (7ºC±1) for 30 days. 3 like butter batches were made, from them 2 batches were made by substituting either oat milk or barley milk instead of skim milk with percent 100% (OMS100 and BMS100) and other batch (OBMS100) was made by replacing all skim milk with blend of oat milk and barley milk (1 : 1). Three replicates were carried out for each batch.

The dry matter, fat and total proteins were determined according to the AOAC (1990). Dietary fibers were quantified using the enzymatic gravimetric procedure of the AACC (2003). Total carbohydrates were calculated by the difference of [dry matter –

(protein + fat + ash)] according to Pearson (1976). Minerals (K, Fe, Zn and Se) were analyzed using an inductively coupled plasma optical emission spectrometer, (ICP-AES) Varian- Vista- MPX, (Varian, Inc.) after wet acid digestion with concentrated nitric acid (HNO3 65%) and perchloric acid (HClO4 60%), following the procedure of AOAC official method 975.03 (Horwitz, 2000). Total phosphorus content (P) was measured according to Chaube and Gupta (1983), while Ca was determined as outlined by Gerhrke *et al.* (1954). Vitamins such as niacin (B_3), pyridoxine (B_6), hydroxocobalamin (B_{12}) and ascorbic acid (C) were separated and assayed using HPLC (Agilent 1260 USA) according to Agilent Application Note (2008). The separation is achieved using a binary linear elution gradient with (A) 25 mM NaH_2PO_4 and (B) methanol alcohol. The injected volume was 20 µl. Detection: VWD detector set at 254 nm for vitamin C and 220 nm for vitamins B_3, B_6 and B_{12}. The energetic content was calculated from the caloric coefficient of proteins, lipids and carbohydrates as 4 kcal.g^{-1}, 9 kcal.g^{-1} and 4 kcal.g^{-1}, respectively.

Table 1. formulations of different low fat butter spread batches.

Ingredients	Formulas[1]			
	CO	OMS_{100}	BMS_{100}	$OBMS_{100}$
Fresh buffalo skim milk	50.00	00.00	00.00	00.00
Unsalted sweet butter	100.00	100.00	100.00	100.00
Milk protein concentrate	5.40	5.40	5.40	5.40
Oat milk	00.00	50.00	00.00	25.00
Barley milk	00.00	00.00	50.00	25.00
Emulsifying salt	2.00	2.00	2.00	2.00
Emulsifier	1.40	1.40	1.40	1.40
Stabilizer	1.40	1.40	1.40	1.40
Table salt	1.00	1.00	1.00	1.00
potassium sorbate	0.20	0.20	0.20	0.20
Water	38.60	38.60	38.60	38.60
Total weight (g)	200.00	200.00	200.00	200.00

[1] Formulas: CO: low-fat butter spread without oat's or barley's milk, OMS_{100}: low-fat butter spread was made by substituting oat milk instead of skim milk with percent 100%, BMS_{100}: low-fat butter spread was made by substituting barley milk instead of skim milk with percent 100% and $OBMS_{100}$: low-fat butter spread was made by substituting oat milk instead of skim milk with percent 50% and barley milk instead of skim milk with percent 50 %.

Low-fat butter spread and its likes were analyzed for wheying off and oiling off according to de Man and Wood (1958). PV value, as an indicator of oxidative deterioration, was determined according to AOAC (2000). The DPPH, as an indicator of oxidative stability of fat, was measured for all samples according to Aromatic *et al.* (2013).

Fifteen panelists including the staff members of Dairy Dept., Fac. Agric., Cairo University were selected as arbitrators to evaluate the sensory quality of the spreads weekly during thirty days of storage in the refrigerator. Arbitrators judged the spreads in terms of spreadability (40), flavor (50) and color (10) using the hedonic scale described by Patange *et al.* (2013).

Cost of production was calculated by evaluating the prices of materials used to make spread based on common prices in local market.

The data were statistically analyzed using ANOVA, and the treatment means were compared by using Duncan's Multiple Range test to determine the effects of treatments when the F-test was statistically significant at $P<0.05$ (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Results obtained from the chemical analysis (Table 2) showed that all spreads (CO, OMS_{100}, BMS_{100} and $OBMS_{100}$) were identical to Egyptian standard specifications (2007), and were similar in their content of solids, fat, ash and differed in protein and carbohydrates. OMS_{100}-, BMS_{100}- and $OBMS_{100}$- spread showed lower protein content and higher carbohydrate content than CO spread. This might be due to the high carbohydrate content of oat milk and barley milk.

The nutritional label, which was designed on the basis of 14 grams of spread in the standard meal (2000 calorie diet), showed that the daily values percent (DV %) of the calories, fat, potassium and vitamins C and B_{12} were identical in all spreads (CO, OMS_{100}, BMS_{100} and $OBMS_{100}$), wheras spreads containing oat milk or barley milk or their mixture resulted in an increase in DV % of each carbohydrates, zinc, phosphorus and vitamins B_3 and B_6. Oat and barley spreads without CO spread were characterized by their fiber, iron, and selenium content (Table 3).

Table 2. Chemical composition of spreads*

Type of spread*	Constituents (%)				
	Total solids	Fat	Protein**	Ash	Carbohydrates
CO	50.22	40.3	3.87	3.31	2.74
OMS_{100}	50.04	40.0	2.53	3.22	4.29
BMS_{100}	50.19	40.1	2.49	3.35	4.25
$OBMS_{100}$	50.01	40.0	2.51	3.31	4.28

*** see Table 1,** Total protein of CO = TN x 6.38, OMS_{100}, BMS_{100} and $OBMS_{100}$ = TN x 6.243**

Measuring the antioxidant activity of the spreads, showed high DPPH activity (%) of oat- and barley-spreads, compared to CO spread (Table 3). This might be due to the high content of these spreads of fiber, zinc and iron, which play an important role in this property (Simic *et al.*, 2017).

The initial peroxide values (PV) of all spreads increased during storage at refrigerator temperature (7±1°C) (Table 4). The increase was insignificant until the end of the first period (10 days) of storage, and then became significant until the end of storage. However, PV remained within legal limits. At the end of storage OMS_{100}-spread had lower PV (0.95 meq O_2 /kg fat), followed by $OBMS_{100}$- spread (0.99 meq O_2 /kg fat) and BMS_{100}- spread (1.06 meq O_2 /kg fat) while Co- spread had higher PV (1.21 meq O_2 /kg fat). This is due to the fiber content of oat's and barley's milk which acts as an antioxidant, particularly β-glucan (Johansson *et al.*, 2004).

Table 3. Nutritive value of one serving (14 g) of low-fat butter spreads

Constituents	Spreads[1]			
	CO	OMS_{100}	BMS_{100}	$OBMS_{100}$
Total calories, Kcal	54.44	54.20	54.25	54.20
% Daily Value[2]	2.72	2.71	2.71	2.71
Fat, g	5.64	5.60	5.61	5.60
% Daily Value	8.91	8.85	8.86	8.85
Protein, g	0.54	0.35	0.35	0.35
% Daily Value	1.08	0.70	0.70	0.70
Total carbohydrates, g	0.38	0.600	0.590	0.600
% Daily Value	0.12	0.180	0.180	0.180
Carbohydrate, g	0.38	0.561	0.579	0.573
Dietary fibers, g	ND[3]	0.039	0.011	0.027
% Daily Value	0.00	0.160	0.044	0.110
Minerals				
Calcium (Ca), mg	13.07	9.43	9.18	9.24
% Daily Value	1.31	0.94	0.92	0.92
Phosphorus (P), mg	8.71	11.30	8.29	9.94
% Daily Value	0.87	1.13	0.83	0.99
Potassium (K), mg	7.96	7.53	7.80	7.61
% Daily Value	0.18	0.16	0.17	0.17
Iron (Fe), mg	Traces	0.058	0.042	0.048
% Daily Value	0.0	0.4	0.3	0.3
Znic (Zn), mg	0.084	0.116	0.102	0.111
% Daily Value	0.84	1.16	1.02	1.11
Selenium (Se) µg	ND[3]	0.033	0.049	0.044
% Daily Value	0.0	0.11	0.16	0.14
Vitamins				
Ascorbic acid (vit.C) mg	0.113	0.110	0.105	0.111
% Daily Value	0.13	0.13	0.13	0.13
Niacin (vit.B_3) mg	0.169	0.184	0.228	0.205
% Daily Value	1.12	1.23	1.52	1.37
Pyridoxine (vit.B_6) mg	0.017	0.019	0.022	0.02
% Daily Value	1.21	1.36	1.57	1.43
Hydroxocobalamin (vit B_{12}) µg	0.0217	0.0209	0.0206	0.0204
% Daily Value	0.904	0.87	0.858	0.85
DPPH %	47.04	50.17	47.96	48.65

[1] see Table 1
[2] % Daily value is based on 2000 calorie diet (www.nal.usda.gov/fnci/foodcomp) **[3] ND: not detected**

Wheying off and oiling off increased gradually of all spreads during storage at refrigerator temperature (7±1°C) (Table 4). The rate of increase was higher in CO spread, whereas released water and free oil increased from initial 0.5553 to 0.7065 g and 0.2961 to 0.3564 g/ 9 g sample, respectively, after 30 days of storage. The rate of increase in wheying off and oiling off was the lowest in oat- spreads (OMS_{100} and $OBMS_{100}$) followed by barley- spread (BMS_{100}). Thus there was preventing effect of dietary fibers on wheying off and oiling off development (Temelli, 1997), who observed that barley β-glucan gum was of great potential as a thickener or stabilizer in soups, sauces, desserts and salad dressings.

Results of the sensory evaluation of control (CO) and experimental spreads (OMS_{100}, BMS_{100} and $OBMS_{100}$) at zero time and during 30 days storage in refrigerator were presented in Table (5).

Until the end of the storage, there were no significant differences in flavor between experimental spreads and control, except for BMS_{100}- spread, which differed slightly from control and showed mild bitterness aftertaste. As for the effect of storage on flavor, storage periods varied between them, and as storage progressed, the difference increased. Slight decrease in flavor was detected during the storage, but it increased markedly at the end of the storage. These findings are in accordance with those of Reddy *et al.* (2001), Deshmukh *et al.* (2003) and Patang *et al.* (2013).

Table 4. Changes in peroxide value (PV), wheying off and oiling off of spreads[1] with and without added oat's and barley's milk

Parameters	Storage period	CO	OMS_{100}	BMS_{100}	$OBMS_{100}$	Mean T
Peroxide value (PV)	Zero time	0.76	0.79	0.80	0.77	0.78^C
	10 days	0.80	0.77	0.81	0.79	0.79^C
	20 days	1.14	0.89	1.05	0.97	1.01^B
	30 days	2.12	1.35	1.59	1.42	1.62^A
	Mean S	1.21^A	0.95^C	1.06^B	0.99^C	
LSD at 0.05 samples = 0.04, time = 0.04						
Wehying off %	Zero time	6.17	5.46	5.98	5.55	5.79^D
	10 days	6.28	5.77	6.23	5.85	6.03^C
	20 days	6.78	6.33	6.64	6.36	6.53^B
	30 days	7.85	6.83	7.14	7.02	7.21^A
	Mean S	6.77^A	6.10^C	6.50^B	6.20^C	
LSD at 0.05 samples = 0.14, time = 0.14						
Oiling off %	Zero time	3.29	2.94	3.15	2.99	3.09^D
	10 days	3.39	3.01	3.20	3.12	3.18^C
	20 days	3.64	3.34	3.47	3.38	3.46^B
	30 days	3.96	3.46	3.65	3.49	3.64^A
	Mean S	3.57^A	3.19^C	3.37^B	3.24^C	
LSD at 0.05 samples = 0.07, time = 0.07						

[1]See Table 1, [A, B, C, D] Means with the same letter in the same column or the same row are not significantly different.

Although spreadability, appearance and color scores decreased for OMS_{100}-, BMS_{100}- and $OBMS_{100}$- spreads as storage progressed, the decrease was insignificant, compared to CO spread. No significant differences were observed between spreadability scores of all spreads at different storage periods and zero time. Appearance and color changed during different storage periods but they remained acceptable until the end of the storage.

No significant differences in overall acceptability score was observed between OMS_{100}- spread and CO spread during storage in refrigerator, but it was slight significant when comparing with $OBMS_{100}$- and BMS_{100}- spreads. The lowest scores for flavor and thus overall acceptability were obtained in BMS_{100}- spread where the panelist comments pointed to mild bitterness aftertaste at the end of the storage, but it had high overall acceptability percent (95.3%) compared to CO spread. No significant differences were observed between overall acceptability scores for all spreads at different storage periods and zero time.

Results of the calculation of the cost (per Kig.) of the examined experimental spreads (OMS_{100}, BMS_{100} and $OBMS_{100}$) indicated that BMS_{100} spread had lower production cost, followed by $OBMS_{100}$- and then OMS_{100}- spread. The decrease(%) in the production cost of BMS_{100} spread was about 3.6%, compared to the control (CO), while the cost of $OBMS_{100}$ spread decreased by 2.02% only (Table 6).

Table 5. Sensory evaluation results of spreads[1] with and without added oat's and barley's milk

Parameters	Storage period	Spread samples[1] CO	OMS_{100}	BMS_{100}	$OBMS_{100}$	Mean T
Flavor (50)	Zero time	45.75	46.00	45.00	46.75	45.88^{A}
	10 days	47.45	46.50	41.50	45.00	45.06^{AB}
	20 days	44.00	46.50	42.00	43.50	44.00^{AB}
	30 days	45.50	43.00	42.00	44.00	43.63^{B}
	Mean S	45.63^{A}	45.50^{A}	42.63^{B}	44.81^{A}	
LSD at 0.05 samples = 1.91, time = 1.91						
Spreadability (40)	Zero time	37.75	37.50	36.25	36.25	36.94^{A}
	10 days	36.25	36.00	38.25	36.00	36.63^{A}
	20 days	38.75	36.00	36.00	36.75	36.88^{A}
	30 days	37.50	39.25	35.00	35.75	36.88^{A}
	Mean	37.56^{A}	37.19^{A}	36.38^{A}	36.19^{A}	
LSD at 0.05 samples = 1.63, time = 1.63						
Appearance & color (10)	Zero time	10.00	10.00	10.00	10.00	10.00^{A}
	10 days	9.50	10.00	9.50	9.50	9.63^{AB}
	20 days	9.50	10.00	9.00	9.50	9.50^{AB}
	30 days	9.50	9.50	9.25	9.50	9.44^{B}
	Mean	9.63^{A}	9.88^{A}	9.44^{A}	9.63^{A}	
LSD at 0.05 samples = 0.53, time = 0.53						
Total acceptability (100)	Zero time	93.50	93.50	91.25	93.00	92.81^{A}
	10 days	93.00	92.50	89.25	90.50	91.31^{A}
	20 days	92.25	92.50	87.00	89.75	90.38^{A}
	30 days	92.50	91.75	86.25	89.25	89.94^{A}
	Mean	92.81^{A}	92.56^{A}	88.44^{B}	90.63^{AB}	
LSD at 0.05 samples = 3.03, time = 3.03						

[1] See Table 1, A, B Means with the same letter in the same column or the same row are not significantly different.

Table 6. Production cost of spreads[1] with added oat's and barley's milk compared to the control.

Ingredients	Price L.E/kg	Spread batches[1] CO (L.E)Price of ingredients	OMS_{100}	BMS_{100}	$OBMS_{100}$
Fresh buffalo skim milk	5.50	0.28	0.00	0.00	0.00
Unsalted sweet butter	55.00	5.5	5.5	5.5	5.5
Milk protein concentrate	50.00	0.27	0.27	0.27	0.27
Oat milk	5.00	0.00	0.25	0.00	0.125
Barley milk	1.00	0.00	0.00	0.05	0.025
Emulsifying salt	45.00	0.09	0.09	0.09	0.09
Emulsifier	75.00	0.105	0.105	0.105	0.105
Stabilizer	55.00	0.08	0.08	0.08	0.08
Table salt	2.00	0.01	0.01	0.01	0.01
potassium sorbate	50.00	0.1	0.1	0.1	0.1
Total cost (L.E/ 0.2 kg spread)		6.435	6.405	6.205	6.305
Total cost (L.E/ 1.0 kg spread)		32.175	32.025	31.025	31.525

[1] See Table 1

REFERENCES

AACC, American Association of Cereal Chemists (2003). St. Paul, Minn. (May 20, 2003).

Agilent Application Note. Publication number 5989 – 9313 EN, 2008

Ali, M. S. A. (2012). Studies on some dairy products substitutes. M.Sc. Thesis, Faculty of Agric., Cairo University, Egypt.

A.O.A.C. (1990). Official methods of analysis of the Association of Official Analytical Chemists. (15th ed). (Arlington, VA).

A.O.A.C. 17th edn, (2000). Official method 965.33 Peroxide Value in oil and fats. Pearsons Composition and Analysis of Foods 9th end. P 641.

Aromatic, F.A.; Elmhdwi, M.F.; Aromatic, F. and Aromatic, O.O. (2013). Estimation of antioxidant activities of fixed and volatile oils extracted from Aromatic aromatic(clove). Der. Chemica. Sinica.,4(3):120-125.

Chaube, M.A. and Gupta, V.K. (1983). Spectrophotometric determination of phosphate in polluted water by solvent extraction of molybdenum blue. Analyst, 108: 1141 – 1144.

DeMan, J.M. and Wood, F.M. (1958). Oiling off properties of butter. J.Dairy Sci., 41:369–374.

Deshmukh, M.S.; Patil, G.R.; Sontakke, A.T.; Kalyankar, S.D. and Padghan, P.V. (2003). Storage study of low-fat spread from safflower milk blended with buffalo milk. J. Dairy Foods Home Sci., 22:63–66.

Egyptian standards for dairy fat spreads (2007). Egyptian Organization for Standardization and Quality, ARE. ES, 2987/2007

Gehrke, C.W. ; Affsorung, H.E. and Lee, Y.C. (1954). Direct ethylenedi amine tetra acetat titration methods for calcium and magnesium. Anal. Chem., 26 (12): 1944 – 1948.

Horwitz, W. (2000). Official Methods of Analysis of AOAC International. Maryland: AOAC International: Association of Official Analytical Chemists, AOAC (Washington, D.C.).

Johansson, L.; Tuomainen, P.; Ylinen, M.; Ekholm, P. and Virkki, L. (2004). Structural analysis of water-soluble and -insoluble *β*-glucans of whole-grain oats and barley. Carbohydr. Polym., 58(3):267–274.

Patange, D. D.; Patel, A. A.; Singh, R. R. B.; Patil, G. R. and Bhosle, D. N.(2013). Storage related changes in ghee-based low-fat spread. J. Food Sci. Technol., 50(2):346–352.

Pearson, D. (1976). The chemical analysis of foods (7th ed.). London,UK: Churchill Livingstone. Peterson, D.M. (1992). Composition and nutritional characteristics of oat grain and products. In: Oat science and technology. Eds H.G. Marshall, M.E. Sorrells. Madison, WI Am. Soc. Agron., 265-292.

Reddy, Y.K.; Laxminarayana, M.; Sarma, K.S.; Ranganathan, M. and Kumar, S. (2001). Storage related changes in flavour and certain chemical properties of chakka based butter spread. Indian J. Dairy Sci., 54:257.

Šimić, G.; Horvat, D.; Dvojković, K.; Abičić, I.; Viljevac Vuletić, M.; Tucak, M.; Lalić, A. (2017). Evaluation of total phenolic content and antioxidant activity of malting and hulless barley grain and malt extracts. Czech J. Food Sci., 35: 73–78.

Steel, R.G.D.; Torrie, J.H. and Dickey, D. (1997). Principles and Procedures of Statistics: A Biometrical Approach. 3rd ed. McGraw Hill Book Co. New York.

Temelli, F. (1997). Extraction and functional properties of barley β-glucan as affected by temperature and pH. Journal of Food Science, 62: 1192 - 1201.

تصنيع منتج شبيه لمفرود الزبد منخفض الدهن غني بلبن الشوفان ولبن الشعير

محمد أحمد عزام ، فاطمه محمد محمود سلامه و محمد سعد عبد الحميد علي
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أستخدم لبن الشوفان ولبن الشعير وخليطهما (١:١) كبديل للبن الفرز في تصنيع شبيه مفرود الزبد منخفض الدهن عالي الجودة ورخيص الثمن. خزن الناتج بالثلاجة لمدة ٣٠ يوماً قيم خلالها تغذوياً وفيزيقياً وحسياً. وقد أشارات النتائج المتحصل عليها إلى ما يلي: * تشابهت كل المفرودات في محتواها من الجوامد والدهن والرماد ولكن إختلفوا في المحتوى البروتيني والكربوهيدراتي. * أظهرت المفرودات التي تحتوي علي لبن الشوفان وكذلك لبن الشعير والخليط منهما علي نسبة عالية من تلبية أحتياجات الفرد البالغ يومياً من الكربوهيدرات والزنك والفوسفور وفيتامينات ب٣ ، ب٦ . كما تميزت تلك المفرودات عن الكنترول بمحتواها من الألياف والحديد والسيلنيوم ، وكذلك إرتفاع نشاطها الضد أوكسيدي. *زيادة قيم البيروكسيد لجميع المفرودات خلال فترة التخزين ، إلا أنها ظلت داخل الحدود القانونية. *أنخفاض قيم البيروكسيد لمفرودات الشوفان والشعير عن قيم البيروكسيد للكنترول. *زيادة معدل خروج الماء وتحرر الزيت من الكنترول عن مثيله لمفرودات الشوفان والشعير. *كان مفرود الشوفان الأقرب حسياً للكنترول من مفرودات الشعير والخليط *كان مفرود الشعير هو الأقل تكلفة تليه مفرودات الخليط ثم الشوفان بالمقارنة بتكلفة الكنترول. لذلك نوصي بإستخدام لبن الشعير أو خليط لبني الشوفان والشعير(١:١) في صناعة شبيه لمفرود الزبد منخفض الدهن.