J. Food and Dairy Sci., Mansoura Univ., Vol. 2 (8): 443 - 458, 2011

PREPARATION AND EVALUATION OF A NOVEL ULTRAFILTERED MILK- SOFT CHEESE, CONTAINING FULL-FAT CORN GERM OF HEALTHY BENEFITS

Hefny, A. A. and Asmaa H. H. Aziz
Dairy Technology Res. Dep., Animal Production Res. Inst., ARC ,Dokki Giza ,Egypt.
E-mail address : hefny - hefny @ hotmail. Com

ABSTRACT

In developing new food products, it is important to balance the quantity and quality of protein and fat , that offered nutritional value , health benefits, good chemical characteristics, and acceptable sensory properties . In this respect, a novel UF-soft cheese containing full-fat corn germ was made from ultrafiltered buffaloes milk (concentrated factor, CF 3) with the use of different levels (1%,2% and 3%) of full-fat corn germ as a source of unsaturated fatty acids, USFAs , in order to balance the protein quality (amino acids pattern) of corn germ , and modify the pattern of the fatty acids composition of buffaloes milk fat in favour of USFAS. The cheese were analyzed chemically and examined organoleptically , throughout storage period (up to 30 days). Fatty acids and amino acids composition were assessed in fresh samples. The results clearly show that UF-soft cheese containing full-fat corn germ resulted in soft cheese close of somewhat composition and sensory quality to that of the control cheese. Such UF-cheeses reveal that as full fat corn germ increased , bad saturated fatty acids(SFA) , decreased , whereas USFAS ,especially beneficial oleic acid (C18 :1) and polyunsaturated fatty acids(PUSFs) e.g ., omega – 6 lenoleic acid(C18 :2)and omega -3 linolenic acid (C 18:3) increased. The ratio of omega-6 to omega -3 in UF –soft cheeses containing full -fat corn germ ranged from 2.1:1 to 2.3:1 ,which was found to be close to that of recommended healthy beneficial ratio (2:1). On the other hand, comparing the essential amino acids pattern of such UF- soft cheese with that of the Recommended Dietary Allowance ,RDA, it will noticed that, buffaloes milk protein improves the quality of full- fat corn germ protein, particularly, histidine , isoleucine , phenylalanine + tyrosin, and to a lesser extend leucine , valine and therionine. Generally speaking,the high nutritive value of buffaloes milk protein in UF -soft cheeses containing full- fat corn germ makes it an integral part of food intervention in many developing countries, especially in some tropical areas , where protein energy malnutrition problems are found among children and vegetarians, whose diet consists largely of plant sources (e.g. , corn , corn germ and other cereals).

Keywords :UF- soft cheese full – fat corn germ ,omeg-3 fatty acid omeg-6 fatty acid, amino acids.

INTRODUCTION

Full-fat dairy products are high in saturated fatty acids (SFA), which have been linked to heart disease, hence the use of vegetable oils (e.g., corn oil) in the dairy industry, especially, in cheese making is well known to increase unsaturated fatty acids (USFA) . However, utilization of liquid oils in dairy industry is generally limited to dairy factories that have invested in suitable equipment (e.g., storage tanks , homogenizers, pumps,…). Therefore, full-fat corn germ is a suitable alternative to corn oil sources,

particularly when specialized handling and equipment are not available. Corn germ is prepared by a process that isolate embryo of the corn plant. It contains the most useful nutrients. Full-fat corn germ typically contains 43-54 %fat and 12-15% protein on dry matter basis .

Corn oil has a few characteristic benefits that set it a part from other oils and gave it a place within a healthy diet, when used in moderation. Corn oil is high in poly- unsaturated fatty acids (PUFA) of approximately 55%, which is a heart- healthy fat;and low in SFAof approximately 15%, which is unhealthy fat that cause high cholesterol and heart problems, and hence, the low SFA content of corn oil is desirable. Also, corn oil has a moderate amount of monounsaturated fatty acids (MUFA) of approximately 30%, which further proves beneficial for the heart (St-Onge and Singh,2009) . Over 99% of MUFA are oleic acid (C18:1). 98% of PUFA are the omega – 6 linoleic acid (C18:2n-6), with the 2%remainder being the omega-3 alpha-linolenic acid (C18:3n-3),USDA(2007). The USFA help to protect the metabolism, improve inflammable and rheumatic illnesses and blood function and are directly involved in the construction of nerve cells. Besides energy in the brain, the advantageous corn germ oil brings protection against free radicals and their damages (Louisse, 2010).In fact ,when compared to higher SFA and trans diets, diets rich in corn oil have been shown to produce beneficial effect on the lipid profile. To achieve such benefits, include slightly less than 1 tablespoon (12 gram) of corn oil per day in

the diet will not increase calories, SFA or cholesterol (FDA , 2007) . However , scientific evidence establishes that , including corn oil-containing foods in the diet may reduce risk of heart disease (FDA , 2007). These effects on cardiovascular disease (CVD) risk profile might be due to the unique combination of PUFA and MUFA found in corn oil, but might also be the result of corn oils other phytochemical compounds , e.g. , tocopherols , tocotrinols and phytosterols , (St _ Onge and Singh, 2009) . Corn oil contains tocopherols (α-β-Y-,s-tocopherols) and the corresponding tocotrinols in corn oil , together (tocols) are summarised under the term vitamin E , but Institute of Medicine (2000) defined α – tocopherol (α-T) as the only tocol contributing toward meeting the vitamin E requirement . The main function of α-T is that a radical – chain – breaking antioxidant in cell membranes and lipoproteins , as well as in foods. Therefore it is believed to reduce the risk of CVD and of certain types of cancer. Despite lower plasma concentrations other tocols are still capable of exerting antioxidant and biologically activities . Y-T in corn oil , for instance , has been reported to be more potent than α T in decreasing platelet aggregation , LDL oxidation, and delaying intra - arterial thrombus formation. Likewise tocotrienols have been shown to inhibit cholesterol biosynthesis (Oufnac , 2006 ,and Schuartz *et al* , 2008). Phytosterols in corn oil are also of nutritional interest because of their potential to lower both total serum cholesterol and LDL cholesterol in humans by inhibiting the absorption of dietary cholesterol, as well as the reabsorption of cholesterol excreted into the bile in the course of centrohepatic cycle (Schwartz , 2008) . Mohammad *et al* (2010) found that in rabbit fed cholesterol- free semi purified diet, an increase in the intake of casein raises serum cholesterol concentration , whereas increase in the dietary level of

corn oil has a cholesterol lowering effect. It is clear that dietary casein and corn oil have opposite effects on serum cholesterol concentrations in rabbits. It could thus be suggested that hypocholestrolemic effect of dietary casein is antagonized by dietary corn oil (Alhaidary *et al* , 2010). On the other hand , the excellent nutritional quality of the protein in corn germ is verified by its protein efficiency ratio (PER) of 2.44 normalized to PER of 2.5 for casein (Nielsen *et al* , 1979) . Additionally , protein in corn germ are balanced in most of essential amino acids and does not contain any major anti – nutrients , and have lower digestible energy than that of casein diet (Gupta and Eggum , 1998 : and Nasir *et al* , 2010), and is also rish in many essential minerals (Barbieri and Casiraghi , 1983). Corn germ is higher in zinc (ten times the amount of zinc found in wheat germ). Corn germ also contains pentosan , which is one of the important fibre components of the non-starch polysaccharides in cereals , hemicelluloses . In terms of dietary fibre components of human nutritional aspects , pentosan is not only has an effect on food absorption, but has also an effect on decreasing absorption of cholesterol Therefore, pentosan is very useful in human diet (Mohammed Khani , 2005) .

The high quality of milk protein stems from the fact that it contains, in varying quantities, all of the amino acids in resembles that needed by human. Both casein and whey protein have a relative surplus of the essential amino acids lysine , threonine , methionine and isoleusine, which make proteins valuable in supplementing vegetable protein , particularly those of cereals (e.g. corn), which are limiting in those amino acids. For example, the high nutritive value of milk protein makes it an integral part of food interventions in many developing countries , where protein energy malnutrition is found among children whose diet consists largely of cereals . Therefore, the protein nutriture of vegetarians , as well as their nutritional statues in general , can be improved by adding animal protein such as that in milk to diet containing mainly cereal and other vegetable proteins (Walstra and Jenness , 1984; and Wong *et al*., 1988). Whereupon , full- fat corn germ and milk combination have a better nutrional and healthy benefits than either one alone .

Being a rich source of good quality protein and fat , there is potential for a wide range of uses of full- fat corn germ for various food products for human consumption. Very little research has been done to promote corn germ in food formulation , although its use as a food ingredient has been often proposed (Gupta and Eggum , 1998)- one such study by Fayed (1996) was reported on manufacture of processed cheese spread with the use of mixture of casein and corn germ. However

in developing new food products, it is important to balance the quality and quantity of protein and fat that offer nutritional value and health benefits, and cost effectiveness . However, acceptable chemical characteristion, nutritional value of protein and fat, and sensory properties are essential in product development endeavours for successful marketing of any newly developed products with add corn germ (Nasir *et al* , 2010). The main objectives of this study were to evaluate chemical properties nutritional quality of protein and fat, and sensory characteristics of UF soft- cheese

made from ultrafiltered - buffaloes milk and containing different levels of full – fat corn germ.

MATERIALS AND METHODS

3x (concentration factor 3)-UF buffaloes skim milk (25.5 % MSNF) and fresh cream (40% milk fat) were obtained from the processing unite of Diary Technology Production Research Institute (APRI). Full – fat corn germ used for partially substitution of milk fat (12% protein and 55% fat) was obtained from Cairo Starch of Glucose Manufacturing Company .Animal rennet powder (HA-LA)was obtained from Chr –Hansen's Lab . A /S Denmark . Commercial fine food grade salt was supplied from local market .

Pasteurized 3x – buffaloes skim milk and fresh cream (40% milk fat) were used for the preparation of five treatments of UF – buffaloes milk . One served as control , the other three treatments were formulated to contain 1% , 2% and 3% full- fat corn germ ,respectively, as a source of corn oil and corn germ solid – not fat (CGSNF),for the partial substitution of milk fat (to increase the beneficial unsaturated fatty acids). All formulation were standardized to contain 15% fat and 20% SNF (Table 1).

The modified method of Hefny and Kandeel (1990)was adopted for making UF –soft cheeses containing 1% , 2% and 3% full – fat corn germ , respectively. UF – buffaloes milk treatments containing full –fat corn germ were heat – treated at 76°c for 5 minutes (Rao and Renner1988; and Hefny *et al* ;2004), cooled to 35°c , salted at the rate 2% . Standard rennet powder was added at the rate of 5 grams / 100 kg UF – milk . Portions (500grams)of the UF – cow's milk were distributed in plastic cups (capacity 600 gram) and left until complete coagulation within 2-3 hour at 35°c , without any whey drainage , then stored under refrigeration for 30 days . Sampling was carried out immediately (according to ISO : 707 (2008) , after coagulation , 7 , 15 and 30 days of storage under refrigeration , for chemical analysis , sensory evaluation ,and fatty acids and amino acids determination.

Cream and 3x –UF buffaloes skim milk were analysed for milk fat (ISO: 2450, 1999) and total solids (ISO: 6731 , 1989), respectively .

UF -soft cheese was analysed for fat content (ISO: 1735, 2004), total solid (ISO:5534, 2004).Nitrogen and titratable acidity were determined as described by ling (1963).PH values were measured using Jenway PH meter , model 505 . Amino acid composition (Anderson *et al* ,1977), preparation of fatty acid and methyl esters in cheese fat (ISO :15885 , 2002) were adopted.

The cheese samples were scored by a regular scores panel staff members (10 persons) of the Diary Technology Research Department , Animal Production Research Institute (APRI). Flavour scored out of 50 points , body & texture out of 25 points , and appearance & colour out of 25 points.

Experiment was repeated in triplicate and average result were tabulated. Statistical analysis was carried out with SAS- soft ware program (2000) at $p < 0.05$ level of significance.

Table (1): Formulation of soft cheese treatments.

Treatments / Components	Traditional soft type cheese	UF-soft type of cheese containing full -fat corn ger		
	Control	1%	2%	3%
Total fat	15	15	15	15
Milk fat	15	14.45	13.90	13.35
Corn oil	_	0.55	1.10	1.65
(1) Total SNF	20	20	20	20
(2) MSNF	20	19.63	19.26	18.89
(3) GSNF	_	0.37	0.74	1.11
Total solids	35	35	35	35

(1) Total solid - non fat
(2) Milk solid - non fat
(3) Corn germ solid – non fat

RESULTS AND DISCUSSION

Table (2) shows insignificant differences in moisture and moisture on a fat- free basis (MFFB) content between traditional soft cheese (control) and UF – soft cheeses containing 1% and 2% full fat corn germ (I and II), in addition to the insignificant variables between UF- soft cheeses (I , II and III) ; and throughout storage period ($p< 0.05$). But the results reveal a markedly significant variable between control soft cheese and UF- soft cheese (III), which could be attributed to the addition of full- fat corn germ , resulted in significantly higher content of protein (Table 6) .Hung and Zayas (1992) mentioned that,corn germ protein flour is an effective protein source in terms of water retention and for fat binding .

A considerable international trade exists in the principle cheese varieties , which are produced in several countries , but which may not be identical (e.g. , UF soft cheese containing full- fat corn germ in this study). Therefore , to assist international trade, Codex Alimentarius Commission (CAC) , has approved the classification of cheese according to firmness and ripening characteristics in Codex Standard A-6 (1978). The classification scheme consisting primarily of four groups based essentially on moisture in fat- free basis , MFFB% : extra hard cheese (< 51%); hard cheese (49 -56 %) : firm / semi – hard cheese (54 – 69 %); and soft cheese (> 64%).

$$\text{MFFB\%} = \frac{\text{Weight of moisture in the cheese}}{\text{Total weight of cheese – weight of fat in the cheese}}$$

In this respect , Table (2) illustrates that , UF – soft cheeses containing 1% , 2% or 3% full- fat corn germ (I , II and III) , had an averages of 70.51 – 73.38 MFFB % , consequently , these three treatments could be classified as soft cheese (> 64% MFFB).

Table (2): Moisture and moisture of a fat – free basis (MFFB) content in control – soft cheese and UF – soft cheese, containing different levels of full fat corn germ

Properties	Treatments	Storage period (days)			
		0	7	15	30
Moisture%	Control	Ba 63.00	Ba 62.46	Ba 62.29	Ba 61.88
	I	ABa 64.00	ABa 63.48	ABa 63.19	ABa 62.72
	II	ABa 64.57	ABa 64.45	ABa 64.21	ABa 63.40
	III	Aa 65.65	Aa 65.38	Aa 65.10	Aa 64.51
MFFB%	Control	Ba 71.68	Ba 71.61	Ca 70.90	Ba 70.51
	I	ABa 72.73	ABa 72.15	BCa 71.89	ABa 71.48
	II	ABa 73.38	ABa 73.26	ABa 73.05	ABa 72.21
	III	Aa 74.60	Aa 74.38	Aa 74.10	Aa 73.35

Different letters (A,B,C…, and a,b,c,…) are significantly different (p<0.05).
-I,II,and III treatments =UF-soft cheese containing 1%,2%,and 3% full-fat corn germ, repecttively.-

Table (3): Titratable acidity and PH values of control soft cheese and UF soft cheese containing different levels of full –fat corn germ

Properties	Treatments	Storage period (days)			
		0	7	15	30
Acidity	Control	Ba 0.15	Ba 0.15	Bb 0.20	Bc 0.25
	I	ABa 0.20	ABa 0.20	ABb 0.25	ABc 0.30
	II	ABa 0.25	ABa 0.25	ABb 0.30	ABc 0.35
	III	Aa 0.30	Aa 0.30	Ab 0.35	Ac 0.40
PH	Control	Aa 6.61	Aa 6.60	Ab 6.43	Ac 6.32
	I	ABa 6.49	ABa 6.46	ABb 6.35	Ac 6.29
	II	ABa 6.39	ABa 6.37	ABb 6.30	ABc 6.18
	II	Ba 6.33	Ba 6.31	Bb 6.23	Bc 6.11

Different letters (A,B,C…, and a,b,c,…) are significantly different (p<0.05).
-I,II,and III treatments =UF-soft cheese containing 1%,2%,and 3% full-fat corn germ, repecttively.

The results presented in Table(3)show that, as expected, a significant increase in titratable acidity(T.A), and decrease in pH value could be noticed after 15 and 30 days of storage ($p \leq 0.05$)in all treatments . On the other hand, significant variations in T.A and pH values could be observed between control soft cheese and UF-soft cheese (III), which can be attributed to the highest content of full-fat corn germ (3%).

It is obvious from Table(4) that all treatments show insignificant changes in Fat/DM through storage period ($p \leq 0.05$) , with the exception of the markedly significant variations between control soft cheese and UF- soft cheese containing 3% full fat corn germ (III). The lower Fat/DM content in UF-soft cheese (III)than that in control soft cheese might be attributed to inadequately method used in fat determination (ISO:1735:2004) , because it is used in milk fat determination in traditional cheese.

Table (4):Fat on dry matter (F/DM)content of control – soft cheese and UF – soft cheeses, containing full- fat corn germ.

Properties	Treatments	Storage period (days)			
		0	7	15	30
F/DM%	Control	Aa 34.93	Aa 34.96	Aa 34.81	Aa 34.47
	I	ABa 33.96	ABa 33.84	ABa 33.81	ABa 33.33
	II	ABa 33.33	ABa 32.91	ABa 32.87	ABa 32.76
	III	Ba 32.49	Ba 32.07	Ba 32.22	Ba 32.11

Different letters (A,B,C…, and a,b,c,…) are significantly different (p<0.05).
-I,II,and III treatments =UF-soft cheese containing 1%,2%,and 3% full-fat corn germ, repecttively.

Concern has been expressed regarding the content of fat in the diet in general and of saturated fatty acids and cholesterol in particular. Scientists postulated that an increased dietary intake of saturated fatty acids and cholesterol (e.g., as found in animal fat) elevated blood cholesterol levels and increased the risk of coronary heart disease . Therefore, nutritionists have recommended substituting mono – unsaturated and poly unsaturated fats for saturated fats (FDA , 2007 ;and Ben best , 2010). However , the general healthy population , irrespective of their blood cholesterol levels , has been advised by various medical experts and organizations to consume a diet of low cholesterol and saturated fatty acids. Therefore , full fat – corn germ (of high unsaturated fatty acids and cholesterol free) was used in this study to modify the fatty acid composition of UF- soft cheese in favour of unsaturated fatty acids . From a nutritional stordpoint , corn oil in corn germ is similar to milk fat and other fats , serves as a concentrated source of energy

In terms of composition, Table (5) illustrates the pattern of fatty acids composition in UF - soft cheese , as affected by the addition of 1% , 2% and 3% full- fat corn germ (as a source of unsaturated fatty acids),compared with traditional soft cheese (control). The results show that , although all of the fatty acids involved are alike , the relative fatty acids composition in all treatments are not similar . These variations reflect a difference in fatty acids composition in milk fat and corn oil . The results reveal also that , as full -fat corn germ (as a source of corn oil) increased from 1% and up to 3% in UF-soft cheese , unsaturated fatty acids increased (23.22%.37.92% and 50.12% , respectively, with comparatively higher value for oleic acid (C18:10), 22.56% , 36.82% and 48.27% in UF- soft cheese containing 1% , 2% and 3% full-fat corn germ, respectively (I, II and III) . Hefny *et al* (2007) and Virginia Messinal

(2010) reported that oleic acid , omega -9 , reduced heart disease , and the latter mentioned that eating vegetable oils or nuts rich in oleic acid five or more times per week reduced heart disease by about 50% . The results show also that , as full -fat corn germ increased from 1% and up to 3% in UF - soft cheese , saturated fatty acid decreased to 76.88% , 62.33% and 49.88% in UF- soft cheese I, II and III respectively, with markedly decrease in myristic acid (C14:0) , lauric acid (C12:0) and capric acid (C10:0) , compared with control soft cheese. Saturated fatty acids in the diet can increase the risk of heart disease from atherosclerosis (fatty plaques on blood vessels walls)by raising blood cholesterol (Ben best (2010), Bonanome and Grundy (1988) found that , Lauric acid (C12:0) , myristic acid (C14:0) and palmitic acid (C16:0) , have been shown to elevate blood cholesterol . Of these , myristic acid (C14:0) elevates cholesterol the most . Marilyn *et al* (2009) recommended limiting saturated fatty acids to less than 7% of total energy intake.

Table(5): Relative fatty acids composition of UF – soft cheeses as affected by different levels of full- fat corn germ compared with traditional soft cheese (control)

Fatty acids	Relative composition %			
	control	1%	2%	3%
Butyric acid , C_4:0	___	___	___	___
Caproic acid C_6:0	___	0.64	0.10	___
Caprylic acid C_8:0	1.26	1.64	0.60	0.51
Capric acid C_{10}:0	8.55	5.97	3.16	2.00
Lauric acid C_{12} : 0	10.88	7.92	4.46	2.72
Myristic acid C_{14} :0	27.27	26.90	17.29	11.37
Palnitic acid C_{16} :0	29.82	33.38	36.62	33.17
Stearic acid C_{18} :0	0.51	0.43	0.10	0.11
Oleic acid c_{18} :1	21.27	22.56	36.82	48.27
Linoleic acid c_{18} :2 (omega – 6) w-6	0.34	0.46	0.75	1.25
Linolenic acid c_{18} :3 (omega – 3) w-3	0.10	0.20	0.35	0.60
SFA[a]	78.29	76.88	62.33	49.88
USFA[b]	21.71	23.22	37.92	50.12
MUFA[c]	21.27	22.56	36.62	48.27
PUFA[d]	0.44	0.56	0.85	1.85
W-6 : w-3[e]	3.4:1	2.3:1	2.1:1	2.1:1

a- Saturated fatty acids
b- Unsaturated fatty acids
c- Monounsaturated fatty acids
d- Polyunsaturated fatty acids
e- Omega-6:omega-3 ratio

Fats (e.g. ,omega-3 and omega -6 fatty acids) are important component of membranes in heart, brain, immune cells and most of the other tissues of our bodies. Sixty percent of the brain and all cell membranes consist of fat. Since we need these fats , it is important to insure that we have the right kind of fats , and that we have enough of them. It is very important that, the cell membranes contain enough omega-3 fatty acids relative to omega -6 fatty acids to stay supple and elastic in order to be able

of adequately respond to different stimuli .Optimum dietary benefit from fat for most people would come from a programme of reduced saturated fatty acids and increased proportions of omega-3 relative to omega-6 essential fatty acids . Both are essential for life and cannot be produced in the body , but must be supplied by the food (Plasaldeen and Tom Saldeen , 2006 ; and Ben best , 2010). There are three main physiologic systems for which substantial evidence reveals the benefits of omega -3 . This includes the cardiovascular system , the neurological system , and the inflammatory and immune system within each of these systems , multiple beneficial actions are possible in the prevention and amelioration of diseases (Harris 2001) .

In this respect Table(5) shows that as full –fat corn germ increased in UF –soft cheese (I, II, and III), PUFA (e.g. , linoleic acid C18:2 and linolenic acid, C18:3) increased compared with that in control soft cheese . Michael (1997)found that , PUFA has often been recommended to reduce coronary heart disease .

The body is always trying to strike the right balance between inflammation and anti-inflammation .In achieving this balance , omega-3 and omega-6 fatty acid are known to have opposing role .The following events maintain this inflammatory pump. When an inflection or foreign invader is detected , the immune system triggers production of prostaglandin II from omega-6 fatty acids .To quarantine the infection or invader , prostaglandin II produces an inflammatory response that sends white blood cells to the effected erea .Almost immediately ,the immune system also triggers the production of prostaglandin I from omega-3 fatty acids to suppress inflammation and begin the healing process . Therefore the balance between omega-3 and omega-6 fatty acids can affect the inflammatory pump balance. Consequently ,nutritin ists believe that a ratio of 2:1 of omega-6 to omega-3 fatty acids help keep the inflammatory pump in the balance (Nicole Cutler , 2010). In this respect, Table (5) shows that , the ratio of omega-6 to omega-3 fatty acids in UF -soft cheese containing different levels of full -fat corn germ (l %and up to 3%) was found to be close (2.1:1 to 2.3:1) to that found by Nicole Cutler (2010) , than that obtained with control soft cheese (3.4:1).As mentioned before , it is very important that , the cells membranes contain enough omega-3 fatty acids to stay supple and elastic to be able of adequately respond to different stimuli . If the cell membrane is very rigid , it will not react in an optimal way to stimuli , for example from hormones , such as insulin . As a result , the sensitivity of the cell to insulin will be decreased , which can result in increased blood sugar level , development of the metabolic syndrome , and eventually diabetes mellitus . If the saturated fatty acids in the cell membrane are replaced by omega-3 fatty acids the sensitivity to insulin will be increased and the risk of the diabetes will be reduced .In the same way , the omega-3 can increase the sensitivity of the cell to other hormones and stimuli (Plasaldeen and Tom Saldeen , 2006)

It could be seen from Table (6) that, control soft cheese and UF- soft cheeses (I, II, and III) containing different levels of full- fat corn germ, show insignificant variables in protein content , and all though storage period ($p \leq 0.05$), but with exception of the markedly significant changes between control -soft cheeses and UF- soft cheese containing 3% full- fat corn germ

(III) .The markedly highest protein content in UF -soft cheese treatment III , can be attributed to the higher addition of full -fat corn germ (3%).

Table (6): Protein content of control – soft cheese and UF – soft cheeses, containing full- fat corn germ

Properties	Treatments	Storage period (days)			
		0	7	15	30
Protein%	Control	Ba 13.21	Ba 13.30	Ba 13.56	Ba 13.62
	I	ABa 13.33	ABa 13.45	ABa 13.58	ABa 13.72
	II	ABa 13.46	ABa 13.52	ABa 13.72	ABa 13.87
	III	Aa 13.59	Aa 13.73	Aa 13.81	Aa 14.01

Different letters (A,B,C…, and a,b,c,…) are significantly different (p<0.05.

-I,II,and III treatments =UF-soft cheese containing 1%,2%,and 3% full-fat corn germ, repecttively.

The number of protein function in the living cells is enormous . The body needs nitrogen to replace the depleted protein tissues in the steady state of the synthesis and breakdown .This need of nitrogen in the form of protein is called the requirement of the body for maintenance .However it is not the protein but its amino acids , that are used by the body. The quality of a protein is not only determined by its amino acid pattern, but also by availability of the essential amino acids provided for the synthesis of nitrogen containing compounds within the body (Hambraeus,1992).

The average value of the essential amino acids and the other acids in protein of UF- soft cheese containing different levels (1%,2%and 3%) of full -fat corn germ (I,II and III), compared with that in control soft cheese (expressed as mg/g protein), are shown in Table(7) .The results reveal that, the pattern of distribution of amino acids in all treatment resembles that needed by human . But there are variations between the average values of control -soft cheese and UF -soft cheeses , are attributed to the addition of full- fat corn germ to the later treatments , which is limiting in amino acids , especially essential amino acids (Wong *et al* , 1988) . One can also find that ,as full -fat corn germ increased up to 3%in UF-soft cheeses , amino acids concentration is decreased .However , the high quality of milk protein in control -soft cheese stems from the fact that, milk protein contains in varying quantity all of the amino acids.

Amino acid imbalance was defined by Harper (1959) as any change in the properties of the amino acids in the diet resulting in an adverse effect , which can be prevented by supplementing the food with the relatively small amounts of the most limiting amino acids. Therefore, the imbalance of full -fat corn germ protein , used in this study , was treated when supplementing with UF-buffales milk protein during UF- soft cheese making . However NRC (1988) introduced an amino acid scoring pattern (i.e. Recommended Dietary Allawonce , RDA),which was proposed as a provisional reference of a balanced protein. This pattern may be used to correct the protein amino acid composition of the food. Table (7) reveals that if the essential amino acids pattern of control -soft cheese and UF- soft cheeses containing different

levels (1%,2%and3%) of full -fat corn germ , is compared with the that of RDA , it will especially noticed that milk protein improve the quality of corn germ protein in UF -soft cheeses (I, II and III), particularly histidine, isoleucine , phenylalanine + tyrosine, and to a lesser extend Lucien and valine in all treatments containing full- fat corn germ ;and threonine in UF- soft cheese containing 3% full -fat corn germ(III).

Generally speaking , the high nutritive value of milk protein makes it an integral part of food intervention in many developing countries , where protein energy malnutrition (kwashiorkor) is found among children whose diet consists largely of cereals , e.g. corn and corn germ , (Jellffe , 1959) .Moreover ,the protein nutritious of vegetarians as well as their nutritional statues in general , can be improved by animal protein such as that in milk to diet containing mainly cereal and vegetable protein to mach the RDA pattern (The American Dietetic Association ,1980; and American Academy of Pediatric 1977)

A comparison of the requirements, mg/kg body weight per day by age group, as shown in Table(7) reveals that, UF- soft cheese containing 1% , 2% and 3% full- fat corn germ , furnish important excess of all essential amino acids for children age 10-12 years and adults , and to lesser extend of children age 2 years .

Table(7): Amino acid composition of UF - soft cheeses as affected by different levels of full- fat corn germ , compared with Recommended Dietary Allowance, RDA[a] and amino acid requirements[b].

Amino acid	Quantity in protein (mg/g)					Requirements,mg/kg per day, by age group[b]		
	Control	1%	2%	3%	RDA[a]	Children age 2 yr	Children age10-12yr	Adults
Essential amino acid								
Histidine	48.8	45.1	41.7	2.99	17	?	?	8-12
Isoleucine	54.5	52.8	48.6	42	42	31	28	10
leucine	75.7	67.3	67.0	51.1	70	73	42	14
lysine	100.5	89.0	73.2	59.2	51	64	44	12
Methionine Cystine	24.3 ND	16.6 ND	15.6 ND	14.8 + ND	26	27	22	13
Pheylalanin Tyrosine	67.0 58.6	55.6 44.1	52.2 34.2	45.1+ 33.7	73	69	22	14
Threonine	41.5	41.1	35.4	29.5	35	37	28	7
valine	49.3	40.3	36.6	28.3	48	38	25	10
tryptophan[c]	ND	ND	ND	ND	11	12.5	3.3	3.5
Other amino acid								
Serine	44.8	43.8	39.2	31.6				
aspatric	64.9	62.5	56.8	45.5				
glutamic	106.1	103.5	97.2	88.2				
prolein	82.7	82.3	72.2	59.2				
glycine	25.4	24.0	21.0	15.4				
alanine	35.8	35.2	30.4	24.3				
argenine	37.9	34.4	33.8	30.7				
ammonia	43.4	39.6	36.1	31.3				

a-Profisional Scoring Pattern for essential amino acids(NRC,1988).
b-(NRC,1988). c-ND=not determined.

It could also be seen from the same Table (7) that all treatments could furnish important excesses of non – essential glutamic and aspartic acids , which promote the secretion of gastric juices (Fox , 1993 ; and Hefny *et al* 1999). Also all treatments contain adequate amount of arginine . NRC (1988) reported that when arginine is present in small amount relative to the other amino acids or when liver function is compromised , arginine synthesis may be insufficient for adequate function of the urea cycle. However for children age 2 years their diet containing UF -soft cheeses containing full- fat corn germ should be supplemented with other sources of essential amino acids derived from meat,, fish , poultry , egg and other products.

The sensory properties of all treatments samples were assessed up to 30 days , Table (8) showed that , body & texture and appearance & colour of all treatments all through storage period scored equally very good ($p \leq 0.05$).

Table (8): Sensory evaluation of control soft cheese and UF – soft cheeses containing different levels of full – fat corn germ

Storage period (days)	Treatments	flavour	Body& texture	Appearance & colour	Total
0	Control	Aa 48	Aa 25	Aa 25	Aa 98
	I	Ba 46	Aa 25	Aa 25	Aa 96
	II	Cb 44	Aa 25	Aa 24.5	Ba 93.5
	II	Cb 43	Aa 25	Aa 24	Bb 92
7	Control	Aa 48	Aa 25	Aa 25	Aa 98
	I	Ba 46	Aa 25	Aa 25	Aa 96
	II	Cb 44	Aa 25	Aa 24	Ba 93
	III	Cb 43	Aa 25	Aa 24	Bb 92
15	Control	Aa 49	Aa 25	Aa 25	Aa 99
	I	ABa 47	Aa 25	Aa 25	ABa 97
	II	ABa 47	Aa 25	Aa 24	Ba 96
	III	Ba 46	Aa 25	Aa 24	Ba 95
30	Control	Aa 49	Aa 25	Aa 25	Aa 98
	I	ABa 47.5	Aa 25	Aa 25	ABa 96.5
	II	ABa 47	Aa 25	Aa 24	Ba 94
	II	Ba 46.5	Aa 25	Aa 24	Ba 93.5

Different letters (A,B,C…, and a,b,c,…) are significantly different ($p<0.05$.-

-I,II,and III treatments =UF-soft cheese containing 1%,2%,and 3% full-fat corn germ, repecttively.

concerning flavour UF- soft cheese I , II and III showed a reduced scoring ($p \leq 0.05$), when fresh and after 7 days of storage , which can be attributed to the slightly oily flavour . After 15 and 30 days of storage , the flavour of UF-soft cheeses , were improved and found to be resemble that of control soft cheese ($p \leq 0.05$) with the exception of treatment III , due to the slightly oily flavour.

In referring to total score , control -soft cheese and UF –soft cheese containing 1% full -fat corn germ (I) showed insignificant differences in total score up to 30 days of storage , and both showed significant variable in total score with UF- soft cheeses treatments II and III up to 7 days of storage .After 15 days of storage and up to 30 days total score of UF- soft cheese II and III showed insignificant variable with UF- soft cheese I .

The forgoing results clearly indicate that , UF- soft cheese making containing different levels (1% , 2% and 3%) of full- fat corn germ, gave soft cheese close or some what composition and quality to the traditional soft cheese (control).

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تحضير و تقيم منتج من الجبن الطرى المصنع من اللبن المركز بتقنية الترشيح الفوقى يحتوى على جنين الذرة كامل الدسم وذو فوائد صحية

عبد القادر عبد العظيم حفنى واسماء حسين حسين عزيز

قسم بحوث تكنولوجيا الالبان – معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية - الدقى - جيزة

عند تطوير اى منتج غذائى جديد يكون من المهم العمل على اتزان كمية و جودة البروتين و الدهن فى هذا المنتج ، حيث يكون لهما تاثير ايجابى على القيمة الغذائية ،و الفوائد الصحية ،و الخواص الكيميائية ،و الجودة الحسية المقبولة . وفى هذا المجال قد تم تصنيع منتج جديد من الجبن الطرى المصنع من اللبن الجاموسى المركز بتقنية الترشيح الفوقى (معامل تركيز ٣) ويحتوى على نسب مختلفة من دقيق جنين الذرة كامل الدسم (١%، ٢%، ٣%) كمصدر للاحماض الدهنية غير المشبعة المفيدة ،وذلك من اجل تحسين جودة بروتين دقيق جنين الذرة كامل الدسم ، والعمل على اتزان محتواه من الاحماض الامينية الاساسية نتيجة لوجود بروتين اللبن الجاموسى المركز من ناحية ،ولتعديل تركيب الاحماض الدهنية فى دهن اللبن الجاموسى بزيادة محتواه من الاحماض الدهنية غير المشبعة المفيدة صحيا ، و خفض محتواه من الاحماض الدهنية المشبعة الضارة ، نتيجة لوجود دقيق جنين الذرة كامل الدسم. وقد تم تحليل عينات الجبن المتحصل عليها كيميائيا وفحصها حسيا طوال مدة التخزين لمدة ٣٠ يوم ،بجانب تحليل عينات الجبن للاحماض الدهنية والاحماض الامينية و هى طازجة . وقد اوضحت النتائج ان هذه الجبن المحتوية على نسب مختلفة من دقيق جنين الذرة كامل الدسم اعطت جبن طرى ذو خواص كيميائية و حسية متطابقة او متطابقة لحد كبير مع خواص الجبن الطرى التقليدى (جبن المقارنة). و قد اوضحت النتائج انه كلما زادت نسبة دقيق جنين الذرة كامل الدسم فى الجبن انخفضت نسبة الاحماض الدهنية المشبعة الضارة ، بينما زادت نسبة الاحماض الدهنية غير المشبعة المفيدة صحيا ، خاصة حمض الاوليك ،و الاحماض الدهنية عديدة عدم التشبع المفيدة صحيا من نوع حمض اللينوليك و حمض اللينولينك . كما اوضحت النتائج ان نسبة احماض اوميجا-٦:اوميجا-٣ فى هذه الجبن كانت تتراوح ما بين ١:٢٠١ الى١:٢٠٣ وهى تقارب النسبة المفيدة صحيا والموصى بها (١:٢) . ومن جهه اخرى ،فقد اوضحت النتائج انه عند مقارنة تركيب الاحماض الامينية الاساسية فى هذه الجبن بالاحماض الامينية الموصى بتناولها فى اليوم ، وجد ان بروتين اللبن الجاموسى قد حسن من جودة بروتين دقيق جنين الذرة كامل الدسم فى هذه الجبن ، خاصة احماض الهستدتين والايزوليوسين ،والفينايل الانين + تيروسين ، ولحد ما احماض الليوسين و الفالين ، التيروثين . وقد اوضحت النتائج ان القيمة الغذائية العالية لبروتين الجاموسى فى هذه الجبن المحتوية على دقيق جنين الذرة كامل الدسم ،جعلت من هذا البروتين الحيوانى مكملا غذائيا فى عديد من الدول الفقيرة خاصة تلك التى فى المناطق الحارة ،حيث يعانى الاطفال والنباتيون فيها من المشاكل التغذوية الناتجة من نقص الطاقة المستمدة من البروتين نتيجة اعتمادهم على البروتين نباتى المصدر مثل الذرة ، وجنين الذرة والانواع الاخرى من الحبوب .

قام بتحكيم البحث

أ.د / طه عبد الحليم نصيب — كلية الزراعة – جامعة المنصورة

أ.د / جمال الدين احمد مهران — كلية الزراعة – جامعة عين شمس