Utilization of Goats Milk in Manufacture of Processed Cheese

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Abstract: Two Formulas Of Different Blends Are Used For Manufacture Processed Cheesed. First Formula, F_1; (Cow. Processed Cheese) Consist Of 38.44% Ras Cheese, 12.80% Cheddar Cheese, 10.26% Butter, 5.12% Skim Milk Powder, 2.50% Emulsifying Salts And 30.88% Water. Second Formula; F_2 (Goats Processed Cheese) Consist Of Goats Cheese Base 66.40%, 19.92% Butter, 6.64% Skim Milk Powder, 2.00% Emulsifying Salts And 5.04% Water. Both Processed Cheeses Were Storage At 7°C For 3 Months. Organoleptical, Chemical And Physical Properties Were Studied. Obtained Results Showed That Processed Cheese That Made From Goats Base (F_2) Had Gained A Higher Scores For The Breakdown Properties, Spreading Quality And Free From Gumminess Than Control (F_1) And Had Lower Soluble Nitrogen As Well As TVFA Than Control Either Fresh Or During Storage. Also F_2 Had A Higher Values In Penterometer Reading And Meltability While Lower In Oil Separation. The Colour Of Treatment (F_2) Is Prefer Than F_1.

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1. Introduction:

Goat milk differs in its composition and characteristics than that of cow's milk Goats milk is richer in fat, smaller in fat globules, higher in short chain fatty acids, more easily digested and do not tend to form clusters, higher in casein as a percent of total protein. Goats dairy products are growing in Egypt by leaps and boundes(Riel 1985). Number of investigations were carried out to produce various goats dairy products such as soft cheese (Youssef, 1989; Emara, 1990), hard cheese (Youssef, 1989), Roquefort cheese (Enab 1993), yoghurt and beverage (Hassan, 1992).

Processed cheese spread (PCS) is a product obtained by blending cheeses of different types and maturity, with melting salts (Chambre & Daurelles, 2000) certain processed cheeses are aromatized by a supply of aroma ingredients of animal or plant origin (Meyer, 1973).

In Egypt the consumption of Processed cheese spread PCS increased markedly during the last decade. PCs represented about one quarter of the total cheese imports in 1997. the production reached about 10 thousand ton either in spreadble or block form (Awad, 2003). The PCs mainly manufactured from blends containing imported cheddar and Gouda cheeses as well as locally produced Ras cheese. The locally produced Ras cheese requires ripening period of about 4 months to develop the desired flavour and body characteristics which in sum increase the total capital costs of production (El Neshany et al., 1987). Also, biogenic amines may be formed and steady increased during the maturation of cheese (El-Sonbaty et al., 1998). Biogenic amines content in cheddar, Gouda and Ras cheese have been determined in several studies. Matured cheeses rich in biogenic amines for production of PCs can give vise to food intoxication.

Processed cheese is an attractive product that enjoys great popularity. It is produced by heating and stirring blends of various natural cheese and other ingredients in the presence of emulsifying salts (Uhlman, 1985). Also many unconventional ingredients are currently used for production of processed cheese analogue (Caric and Kalab, 1993). The properties of processed cheese and cheese spread are greatly influenced by the composition of blend and emulsifying salt used and other ingredients. Therefore the aim of this research is studying the feasibility of using Gouts milk in production of cheese-base to prepare processed cheese and study the properties of resultant processed cheese.

2. Material and Methods

Materials:

Raw materials for preparing processed cheese (PCs)

Ras cheese (one month old) was obtained from Arabic food Industrial co. (Domety) 6th October City, Egypt. Also matured cheddar cheese (8 months old) and Kasomel emulsifying salt K2394 (Rhone-Poulenc Chimic- France) were obtained from International Dairy and Foods Co. (Milkyland), 10th Ramadan City, Egypt. Low heat skin milk powder and butter were procured from Irish Dairy Board, Grattan House, lower Mountst, Dublin Ireland Goate

milk obtained from a herd (20-30heants) of private farm in Gizadistrict. Chemical composition of the Ingredients used in manufacturing processed cheese spread are presented in table (1).

Methods:

Manufacture of processed cheese:

Processed cheese were manufactured according to the method of Meyer (1973), from goats milk, young Ras and matured cheddar cheese, emulsifying salt (2.5%), butter, skim milk powder and water were placed into the processing batch type kettle of 10 kg capacities, a pilot machine locally made in Egypt (Mohamed, 2004) in National Research Center processed cheese manufactured from cows milk (F_1) and from Goats milk (F_2).

Analysis of processed cheese spread PCs

I chemical analysis:

The PCs samples were analyzed for fat content, total nitrogen, soluble nitrogen (SN) content and pH values (using pH meter model cole-Amer Instrument Co., USA) as described in Ling (1963). Total volatile fatty acids (TVFA) were determined according to Kosikowski (1970) and values were expressed as ml 0.1 N NaOH / 100g. Ash was determined according to AOAC (1990).

Lactose content according to the method of Barrnett and Abdel-Tawab (1957). Relative casein by Arithmetic operations S.N/ T.N. – 100.

Table (1) reflect the chemical composition (%) of the ingredients which used in manufacture of processed cheese spread.

Table (1): Chemical composition (%) of the ingredients used in manufacture of processed cheese

Composition	Ingredients				
	Ras cheese	Cheddar cheese	Goats chees. Bus.	Cow butter	Skim milk powder
T.S	54.96	65.40	29.98	84.00	96.00
Fat	24.88	34.70	10.5	82.00	0.99
Total protein	22.24	25.38	13.5	N.D.	37.13
Soluble Nitrogen	0.66	1.20	N.D.	N.D.	0.83
Lactose	1.60	0.10	3.0	N.D	47.50
Ash	5.70	5.41	2.1	N.D	7.89

Physical analysis

The PCs penetrometer was measured using a penetrometer (Kochler Instrument Co. Inc., USA) as described by Gupta and Reuter (1993). The penetration depth was recorded in units of 0.1mm, oil separation in mm was determined according to the method outlined by Thomas (1973). Meltability in millimeters (mm) of the PCs samples was measured as described by Olsen and Price (1958) with the slightly modification by Savello et al., (1989) colour parameters using a Hunter Lab. Colorimeter Model b25 A-2 (Hunter Assoc. Lab. Inc. Va, USA) and the instruction of user manual. The instrument was first standardizing using a reference with white surface. As in the Hunter L, a and b scale describe lightness {back (O) to white (100)}, redness (+) to greenness (-) and yellowness (+) to blueness (-), respectively were measured.

Organoleptic properties:

Processed cheese samples were sensory evaluated organolcptically for the different sensory properties using a hedonic scale of 1-5, which was designed based on the hedonic scales provided by Ottawa (1977). The scoring panel consisted for 20 experienced staff members of the Department.

Statistical analysis:

The experimental data were analyzed using the general linear models procedure of the Statistical Analysis System (SAS, 1996). Significance of differences was defined at $p < 0.05$.

3. Results and Discussions

Table (2) illustrated the formulations of the different blends used for manufacture of processed cheese. Control (F_1) composed of (38.88%) Ras cheese, (12.80%) cheddar cheese, (10.26%) butter, (5.12%) skim milk powder, (2.50%) emulsifying salts and (30.88%) water. On the other hand F_2 (Goats processed cheese) had (66.40%) Goats cheese, (19.92%) butter, (6.64%) skim milk powder, (2.00%) Emulsifying salts and (5.04%) water. The F_2 had a higher content of butter, skim milk powder and lower content of emulsifying salts and water than F_1.

Table (3) show the chemical composition of resultant cheese (F_1&F_2) Two processed cheeses spread satisfy the legal standard (Es organization 2002). It is clear that F_2 had slight a higher content of T.S. (44.99%) and lactose (5.95%) than F_1. On the other hand F_1 had slight higher content of Fat/ DM (50.13%), protein (14.22%), Ash (3.96%), pH (5.78) and total volatile fatty acids (27.80%) than F_2. These may be due to the formula of the two types (F1, F2). Statistical analysis at $P<0.05$ showed that there is a

significantly different between (F1,F2) for Lactose, Ash and Total Volatile fatty acids.

Table (2): Formulations of the different blends used for manufacture of processed cheese

Ingredients	Cow. P.C.	Goats P.C
Ras cheese	38.44	—
Cheddar	12.80	—
Goats cheese bas	—	66.40
Butter	10.26	19.92
S.M.P	5.12	6.64
Emulsifying salts	2.50	2.00
Water	30.88	5.04
Total	100.00	100.00

Table (3) Chemical Composition of the different blends used for manufacture of processed cheese

Ingredients	F_1	F_2
T.S	44.88	44.99
Fat/P.M	50.13	50.00
Protein	14.22	14.10
Lactose	2.85^{b}	5.95^{a}
Ash	3.96^{a}	2.98^{b}
pH	5.78	5.75
Tv.F	27.80^{a}	22.70^{b}

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (4) indicate the Nitrogen fractions of both cow and Goats processed cheese. It shows that Goats processed cheese had a higher content of relative cosein (90.21%) than cow processed cheese. This result is agreement to *(Riel 1985)* whereas cows processed cheese had slight a higher content of T.N (total nitrogen), soluble nitrogen (SN) and S.N/ T.N than Goats processed spread cheese this may be due to the using of cheddar and Ras cheese which they are ripening. Statistical analysis at P<0.05 showed that there is a significantly different between (F1,F2) for Soluble nitrogen, Soluble nitrogen/Total nitrogen and relative casein fresh and during storage at P<0.05.

Table(4): Nitrogen fractions of cow processed cheese and Goats processed cheese

Ingredients	F_1	F_2
T.S %	2.2296	2.2100
S.N %	0.3999^{a}	0.2163^{b}
S.N / T.N	17.936^{a}	9.787^{b}
Relative casein	82.06^{b}	90.21^{a}

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (5) illustrate the physical properties of cows processed cheese and Goats processed cheese. The penetrometer reading (mm) of F_2 is a higher (192 mm) than F_1 (160 mm). This may be due to the composition of F_2 it had a higher content of TS as shown in Table (3). From Table (5) It clear that oil separation (%) is higher at F_1 (33.33%) than F_2. Melting index (mm) is higher (177 mm) in F_2 than F_1 Pecrease in pH values may lead to weak of protein bonds and demulsify of fat (Shime, 1985). These change due to the type of milk from previous Table (3) F_2 had lower pH than F_1. Statistical analysis at P<0.05 showed that there is a significantly different for penterometer reading and Melting index between (F1, F2).

Table (5): Physical properties of cows processed spread cheese and Goats processed spread cheese

Ingredients	F_1	F_2
Penterometer reading (mm)	160^{b}	192^{a}
Oil separation (%)	33.33	25.00
Melting index	95^{b}	177^{a}

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (6) shows that the whiteness (- value) of processed cheese is higher in F_2 than F_1 while the intensity of green (a-value) higher in F_1 than F_2. On the other hand yellow (b-values) is higher in control than treatment these due to the kind of ingredients in control and treatment. Therefore (F2) is prefer than (F1). There is a significantly difference at P<0.05 for L,a and b between (F1, F2).

Table (6): Colour properties of cow processed spread cheese and Goats processed spread cheese:

Ingredients	F_1	F_2
L (whiteness)	85.98^{b}	89.89^{a}
a (green)	-1.59^{b}	-1.85^{a}
b (yellow)	25.35^{a}	23.36^{b}

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (7) indicate the change of some physical properties during storage (7°C) it show that F_2 had a high penterometer reading (192 mm) than F_1 (160mm) and gradually decreased till 3 months in both F_1 and F_2. This mean that the curd of F_2 is softer than F_1 and this due to the type of ingredients (Goat's). the differences in the penentration values

during storage could be related to the interaction between emulsifying salts and state of protein network as well as the changes in chemical composition during storage (Younis et al., 1991) and Azzam (2007). However, during processing whey protein are subjected to denaturation, which can bind more water (Abd El-Salam et al., 1997) and increase the emulsification of the fat globules in penetration cheese spread which also increase viscosity. From the same table we notice that oil separation is higher in control (33.33%) than treatment (25.00%) and increased gradually during storage 7°C, till three month in both control and treatment. This result is agreement to (Azzam, 2007) and (Hussein, 2008). There is a significantly different for penterometer reading, Oil separation and Melting index between (F1, F2).

Table (7): Change in physical properties during storage at (7 °C)

Storage period (Month)	Pemterometer reading		Oil separation %		Melting index	
	F_1	F_2	F_1	F_2	F_1	F_2
0	160 [a]	192 [a]	33.33 [c]	25.00 [c]	95 [a]	177 [a]
1	156 [b]	190 [a]	35.00 [b]	30.33 [b]	94 [a]	170 [b]
2	155 [b]	179 [b]	36.33 [b]	31.66 [b]	91 [b]	166 [c]
3	149 [c]	171 [c]	38.00 [a]	33.33 [a]	90 [b]	150 [d]

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (7) indicated melting index it is higher in F_2 than F_1 it reaches to 95, 177 (mm) for control and treatment respectively during storage (7°C) for 3 month the melt ability/ mm) decreased till 3 month ethier F_1 or F_2. These results are in agreement to (Hussein, 2008).

Colour parameters of PCs for F_1 and F_2 during storage at 7° for 3 months are shown in Table (8). We observed that there is difference between F_1 and F_2. The lightness (L-values) of treated sample had a higher value than control. During storage the values slight decreased till 3 months either control or treatment whereas control had higher than F_2 and increased gradually during storage till 3 months in both F_1 and F_2 (yellow) higher in F_1 than F_2 and increased during storage till 3 months for F_1 and F_2. The results agree with those of Khader et al. (1997) and Guinee (2003), they reported that during storage, PCs gradually become darker due to occurred the millard browning reactions.

Table (8): Change in color during storage (7°C)

Storage period (Month)	Pemterometer reading (mm)		Oil separation %		Melting index	
	F_1	F_2	F_1	F_2	F_1	F_2
0	85.98	89.89	-1.59 [a]	-1.85 [a]	25.35 [c]	23.36
1	85.90	89.66	-1.70 [b]	-1.93 [b]	26.17 [b]	23.50
2	85.74	89.54	-1.78 [b]	-1.99 [b]	26.79 [b]	23.79
3	85.11	89.06	-1.93 [c]	-2.23 [c]	27.93 [a]	23.88

- Different superscript (a, b,…) at the same raw are significantly different (P < 0.05)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (9) illustrate the change in nitrogen fractions and total volatile fatty acids during storage. It is clear that F_2 is lower content of soluble nitrogen than F_1 and slightly increased during storage in both F_1 and F_2. This may be due to the ingredients of cheese formula. The change occurred in soluble nitrogen. TVFA took the same trend fresh and during storage. This due to the hydrolysis of fat contents during storage which may be due to the enzymatic activity of heat resistant proteinase or psychrotrophic spore forming bacteria present in the product (Tamime et al., 1990, Younis et al., 1991, Aly et al., 1995). There is a significantly different at P<0.05 between (F1, F2) for soluble nitrogen fresh and during storage, while there is no significantly different at P<0.05 between (F1, F2) for total volatile fatty acids fresh and during storage.

Data presented in Table (10) show that processed cheese made with Goat's milk different in most sensory compared with control. Treatment gained higher scores for the breakdown properties and spreading Guality and free from gummines. The storage of processed cheese spread not effect on the organoleptic properties. These results are in agreement to Abd Rabo, et al. (2005). There is a significantly different at P<0.05 between (F1, F2) for firmness of body, spreading quality stickness,

smoothness of texture, breakdown properties, chewiness, flavor and a overall preference.

Table (9):Change in nitrogen fractions and volatile F.A. during storage

Storage period (Month)	Soluble Nitrogen		TV FN	
	F_1	F_2	F_1	F_2
0	0.3999 [b]	0.2163 [c]	27.80 [b]	22.70 [b]
1	0.4005 [a]	0.2188 [a]	28.00 [b]	-22.85 [b]
2	0.4011 [a]	0.2195 [b]	28.18 [ab]	-23.15 [a]
3	0.4019 [a]	0.2206 [a]	28.46 [a]	-23.35 [a]

- Different superscript (a, b,…) at the same raw are significantly different ($P < 0.05$)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

Table (10): Sensory evaluation of first and second fermula of processed cheese

Sensory attribute (5 point)	F_1	F_2		
Surface appearance	4.66	4.50	$1_{\text{dull very much}}$	$5_{\text{shiny very much}}$
Firmness of body	1.91 [a]	1.00 [b]	$1_{\text{very soft}}$	$5_{\text{very firm}}$
Spreading quality	3.41 [b]	4.66 [a]	$1_{\text{diffult to spread}}$	$5_{\text{easy to spread}}$
Stickiness	1.83 [a]	1.00 [b]	$1_{\text{not sticky}}$	$5_{\text{very sticky}}$
Smoothness of texture	1.91 [a]	1.00 [b]	$1_{\text{very smooth}}$	$5_{\text{not smooth}}$
Break down properties	2.83 [b]	4.83 [a]	$1_{\text{descont dissolve}}$	$5_{\text{dissolve very well}}$
Chewiness	3.41 [b]	5.00 [a]	$1_{\text{very showing}}$	$5_{\text{not showing}}$
Gumminess	1.00	1.00	1_{absent}	$5_{\text{very pronounced}}$
Oil separation	1.00	1.00	1_{absent}	$5_{\text{very pronounced}}$
Flavour	4.5 [a]	4.00 [b]	$1_{\text{very weak}}$	$5_{\text{very strong}}$
Overall preference	4.1 [b]	4.66 [a]	$1_{\text{dislike very much}}$	$5_{\text{like very much}}$

- Different superscript (a, b,…) at the same raw are significantly different ($P < 0.05$)
- F_1: Cow. processed cheese - F_2 : Goats processed cheese

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