ISSN: 0378-2700

STUDIES ON PROCESSED CHEESE IN EGYPT. A REVIEW

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(Accepted 19/9/2005)

SUMMARY

Processed cheeses are among cheese varieties appreciated by the Egyptian consumer. They have received much attention, and many research studies by Egyptian scientists. The aim of the present paper was to review different activities carried out in Egypt concerning processed cheeses. Studies were grouped into seven activities i.e., analysis of market processed cheeses; the cheese base used in processed cheese, the use of preparations of milk proteins in processed cheese, the use of ingredients of vegetable origin, low fat processed cheese and cheese analogues, flavoured processed cheese and effect of packaging.

Key words: Processed cheese, spreads, cheese base, low fat, fat replacers, milk protein products; rheological properties, cheese analogues, flavoured cheese

INTRODUCTION

Processed cheese is defined as the product obtained by heating a blend of shreded natural cheese (different types and degree of maturity) and an emulsifying agent with slow constant agitation until a homogeneous mass is obtained and then packaged while still hot. Other dairy and non-dairy ingredients may be added in thé blend. Caric and Kalab (1993) mentioned that the advantages of processed cheeses compared to natural cheeses are:

1- reduced refrigeration cost during storage and transport, which are especially important in hot countries;
2- better keeping quality, with less apparent changes during prolonged storage;
3- great diversity of type and intensity of flavour e.g. from mild to sharp, native cheese flavour or specific other flavour e.g. spices;
4- adjustable packaging for various usage, economical and imaginative;
5- suitability for home use as well as for snack resturants e.g. in cheese burgers.

However, processed cheeses in Egypt are coverd by two Standards; Standard No.999 for processed cheese and spreads and Standard No 1132 for processed cheese and spreads containing vegetable fats (Egyptian Standards Organization, 2002a,b).

These standards are almost the same of CODEX-Standards. Table 1 shows the specifications of processed cheeses in Egypt. According to these specifications processed cheeses and spreads (natural/ vegetable fat) from different types have the same fat content but different moisture content

Table (1): Standard specifications of processed cheese and processed cheese spread

Type of cheese	Fat %	Moisture %	
		Cheese	Spread
High fat	> 65	47	55
Full-fat	60-65	48	56
	55-60	49	56
	50-55	50	57
	45-50	52	59
Three quarter-fat cheese	40-45	54	61
	35-40	56	64
Half-fat cheese	30-35	58	67
	25-30	60	69
Low-fat cheese	20-25	62	71
	15-20	63	71
	10-15	64	71
Free-fat cheese	< 10	66	71

1. Studies on market processed cheese

Hofi (1957) collected random samples of processed cheese from the local market and analysed it for moisture, fat, ash and sodium chloride contents. He showed that the moisture content of locally produced processed cheese to range from 39.5 to 52.2%, fat content from 21.5 to 31.5%, ash content from 4.26 to 7.24% and the NaCl content from 0.99 to 3.35%.

El-Sadek and Zaki (1958) analysed 8 samples of locally produced and 3 samples of imported processed cheese for its microflora. They found that the total bacterial count of all samples to range from 3.6×10^3 to 2.3×10^6 cfu/g with no differences between the locally or imported samples. They found that most of the bacterial species in these samples belong to Bacillus spp. Moulds were also found with variable counts.

Al-Ashmawy *et al.* (1977) found that the average total bacterial count of 40 samples of market processed cheeses to be 2.87×10^3 cfu/g and moulds count 52±7 /g. They found anaerobic bacteria in all samples and coliforms in 12.5% of the samples. They isolated *Bacillus orculanes* from 52.5% of the samples *B.subtilis* from 42.5%, *B. coagulans* from 52.5%, B.cerus from 52.5%, *B.licheniformis* from 10%, *E.coli* from 5%, *Enterococcus cloacue* from 10%, *Ent. Liquefaciens* from 5% *Staph. aureus* from 5%, *Staph. epidermis* from 30% and Micrococci from 42.5%, and moulds (*Geotrichum spp & Aspergillus spp)* from 15% of the samples.

Mahfouz *et al.* (1986) analysed 62 samples of processed cheese representing 15 varieties from the great Cairo markets. The fat content of cheeses ranged widely from 19.70 to 60% and lactose content from 2.09 to 28.35% (on dry matter basis). Also, the free and potential hydroxy-methylfurfural ranged from 0.0 to 0.81 and from 2.06 to 12.92 µmole/100 g respectively. They found that samples contained 60 to 5000 cfu/g for total bacterial count and were free from coliform and anaerobic sporeformers. Few samples contained few numbers of staphylococcus and moulds and yeasts respectively which they attributed to post contamination.

Abd Alla *et al.* (1996) analysed 24 samples of processed cheese from Cairo and Giza markets. Enterobacteriaceae, enterococci, aerobic sporeformers, anaerobic sporeformers (clostridia) and lactobacilli were present in 12.5, 12.5, 100, 75 and 62.5% of examined samples. Also, histamine, tyramine, putrescine and cadaverine were detected in 45.5, 36.4, 27.3 and 27.3% of the samples. The bacterial counts and formation of biogenic amines increased slightly during storage for 60 days at room temperature.

Khader *et al.* (1997) analysed market processed cheeses representing 13 varieties (3 samples each). Samples showed wide variation in composition but all fall within the Egyptian standards specifications for processed cheeses. Wide variations were observed in its free oil (0-95%), meltability (0.0-33.3 mm) and whiteness (4-66.0%). Also cheeses differed widely in their initial viscosities and behaviour with time.

Fresh samples from different brands of processed cheeses were stored at room temperature for 4 months and changes in their composition and properties were followed (Hamed *et al.*, 1997). The moisture, fat, total and non protein nitrogen, pH and lactose decreased slightly while NaCl content increased. The colour of cheeses was darkened during storage and the meltability decreased. Also, there was a great variation in viscosity of cheeses at the start of the experiment and throughout the storage period.

El-Sonbaty *et al.* (1998) analysed samples of 8 brands of locally made processed cheese including 2 brands containing vegetable oils and 2 others containing vegetables. The cheeses contained total essential amino acids higher than the reference protein set by FAO/WHO, but cheeses containing vegetables had less essential amino acids than other brands. The processed cheeses contained variable contents of Ca,P, Na,K, Cu, Fe, Zn and Mn. The cheeses provide (per 100 g) 100-150, 25-55%, 35-65, 50 and more than 100% of the recommended daily allowance of vitamin B1, B6, nicotenic acid, calcium and phosphorus respectively. The analysed samples contained low levels of the biogenic amines.

Abou El-Nour (2001) compared the physicochemical and rheological properties of processed cheese spreads in the Egyptian and German markets. He found wide variations in the dry matter and fat content in cheeses in both markets. The salt content and meltability of processed cheese spreads were nearly the same in both markets. However, the hardness of

cheeses from the German market was distinctly higher than Egyptian samples.

2. The cheese base used in processed cheese

Traditionally processed cheese is made using Cheddar cheese as a cheese base. However, several attempts have been made to replace Cheddar cheese in the blends with locally produced cheeses.

Shehata *et al.* (1982) prepared processed cheese from 4 blends containing different quantities of Ras cheese and skim milk powder. Increasing the quantity of Ras cheese increased the total bacterial and aerobic sporeformers counts in the processed cheese food. Proteolytic and saccharolytic anaerobes were detected but were not sufficient or active to cause undesirable changes. The butyric acid bacteria, yeasts and molds were not detected. They concluded that processed cheese of good quality can be made from a blend containing 62% Ras cheese (50% current + 50% medium ripe), 18% Bascee (fermented skim milk slurry 50% solids) 2.5% emulsifying salts, 17.5% water, 0.1% sodium bisulphite and 0.03% annatto colour.

Magdoub *et al.* (1984a) reported that processed cheese spread with acceptable quality can be made from a blend of 44% Ras cheese (60% current + 40% medium ripened), 18% Bascee, 7% butter oil, 2.2% emulsifying salts (Joha NO + Joha S9S 1:2), 0.5% gelatin and 28.3% added water.

Magdoub *et al.* (1984b) found that good quality processed Ras cheese can be made from blends of 40% fresh (<2weeks) + 50% medium ripened (2-3 months) + 10% fully ripened (4-6 months) Ras cheese or from 30% fresh and 70% medium ripened Ras cheese.

Abdel Baky *et al.* (1987) prepared Ras cheese by direct acidification and cheese ripening was accelerated using 2 levels (20 and 30 g/ 100 kg curd) of a mixture of Fromase and Picantase (1:1). Ras cheese ripened for 4-6 weeeks using the low level of added enzymes or ripened for 2-4 weeks using the high level of added enzymes gave good quality processed cheese spreads. The use of less ripened cheese gave a product with flat flavour while over ripened cheese imparted rancid flavour in the product. The composition of cheese spreads was almost unchanged during storage while the bacterial and sporeformers counts increased especially when stored at room temperature.

El-Neshawy *et al.* (1987) used accelerated ripened cheese slurry to replace 25 to 100% of mature Cheddar cheese used in the preparation of processed cheese spread. Processed cheese spreads with up to 100% replacements were highly acceptable immediately after manufacture and during storage at room temperature or in refrigerator. The chemical composition and microbiological quality of prepared spreads were almost unchanged when stored at 4-5°C but

slightly changed during storage at room temperature.

Tamime *et al.* (1989) prepared a cheese base from reconstituted skim milk by ultrafiltration/diafiltration and retentate was coagulated using Alcurd machine. A part of the cheese base was treated with Savorase-A to accelerate its ripening. A good quality processed cheese was made by using 75% cheese base, 25% cheese base treated with Savorase-A and anhydrous milk fat. They said that the chemical composition of processed cheese met the Egyptian statutory regulations.

Dawood *et al.* (1989) suggested new processed cheese blends by replacing young and mature Cheddar cheese with cheese base or enzyme treated cheese base. The prepared processed cheeses were stored at temperatures up to 30°C and 6 months. They concluded that processed cheese can successfully made by replacing partially Cheddar cheese up to 75% with cheese base without any deffects.

Tamime *et al.* (1990) manufactured processed cheese from young and mature Cheddar cheese (control) and experimental blend of cheese base (CB) and cheese base treated with Savorase enzyme. The cheeses had moisture content that ranged from 47.63 and 49.66% and fat in dry matter from 48.29 to 49.64% respectively when fresh and after 6 months of storage at different temperatures (10-30°C). All the processed cheeses exhibited a similar pattern of consistency during storage, but experimental cheeses were firmer than the control. The microbiological quality of all samples was very good and overall scores for the organoleptic properties indicated no significant differences between them.

Younis *et al.* (1991) made processed cheeses (14 different types) from Cheddar cheese and cheese base (CB) or accelerated ripened cheese base by adding Savorase-A (CBII). After 6 months of storage at 10°C, the moisture loss in the processed cheese was approx. 0.5% compared with a moisture loss in excess of 1.2% for samples stored at 20 and 30 °C.

Abeid (1996) prepared processed cheese from fresh Ras cheese with the addition of 5% of *Lb delbreukii spp bulgaricus* (T1), *Lb casei* (T2) or *Lac lactis spp diacetilactis* (T3) after cheese processing and before packaging. The cheese was stored at room temperature for 4 weeks. The addition of starters improved the organoleptic properties of the processed cheese in a descending order T2>T1>T3> control.

Abdel Hamid *et al.* (2002) prepared cheese slurry using a mixture of lipase and protease. The cheese slurry was used in different ratios in the blend of processed cheese spreads. Increasing the level of ripened curd slurry in the cheese blends tended to decrease the oil index and gave good melting properties. Processed cheese spreads containing 15 or 20% slurry gave products of good organoleptic properties.

Abd Rabo *et al.* (2004) found that low fat processed Cheddar cheese spread of good physical and organoleptic properties can be made from blends of 25% full fat mature Cheddar

cheese (from mixed buffalo and cow milks; 1:1) and 75% low fat green Cheddar cheese curd and 0.2% pectin.

3.The use of milk protein preparations in processed cheese

Gouda *et al.* (1985) used calcium caseinate to replace mature Cheddar cheese in the manufacture of processed cheese spreads. Complete replacement gave a poor spreadability, but partial replacement improved the spreadability and a pronounced improvement was obtained when 6-8 skim milk powder was added.

Gouda and El-Shibiny (1987) used UF skim milk retentate (24% total solids) to replace 60 and 40% of fermented skim milk slurry (bascee) in the blend of processed cheese spreads. They found that the 40% replacement gave processed cheese spread of acceptable properties and composition.

Abd El-Salam *et al.* (1996) added variable concentrations of whey protein concentrate (up to 40%) and emulsifying salts (1-3%) in processed cheese spreads and followed changes in the composition and organoleptic properties during storage for 4 months. Good quality processed cheese spread can be made with 40% WPC and 3% emulsifying salt.

Al-Kkamy *et al.* (1997) used whey protein concentrate (WPC; 28-32% total solids) to replace 50% of the acid coagulated soft cheese in processed cheese blend. Nine simple and combined commercial emulsifying salts were added at the ratio of 3% to different batches. The chemical composition, meltability and organoleptic properties of experimental spreads were evaluated during storage of 4 months. A combination of emulsifying salt Joha S9S and Joha NO (1:1) was recommended.

Fayed and Metwally (1999) used succinylated denatured whey proteins in the manufacture of processed cheese. They found that the obtained cheeses had better spreadability than the control processed cheese.

4.The use of vegetable and oil seed proteins and potato starch

Abou-Donia *et al.* (1983) added variable percentages of gossypol-free cottonseed flour in the manufacture of processed Ras cheese (fresh/mature 1:1). The organoleptic properties of processed with or without cottonseed flour were similar except for a slight brownish colour in product containing high amount of cottonseed flour.

Ghaleb *et al.* (1983) used soy flour in partial or complete replacement of Ras cheese or bashkeek in processed cheese blend. They found that replacement up to 50% Ras cheese or up to 66% bashkeek with soy flour gave products of acceptable organoleptic properties. Also, they found the up to 75% of samna used in processed cheese blend can be successfully replaced with soy oil.

Guirguis *et al.* (1985) prepared processed cheese spread from a blend of Ras and Cheddar cheeses and basceec, butter oil and emulsifying salt. They used peanut curd to replace partially or completely basceec in the processed

cheese blend and followed the changes in the chemical composition and organoleptic properties of the experimental cheeses during storage. They concluded that replacement of up to 50% of the basceec with peanut curd improved the organoleptic properties of both fresh and stored spread.

El-Neshawy *et al.* (1988) manufactured processed cheese of high protein content from blends of Cheddar cheese, whey protein concentrate (WPC), soybean protein concentrate (SPC) and chick pea flour (CPF). They found that the most acceptable product was that obtained from blend supplying 25,20,27.5 and 27.5% of solids not fat from Cheddar cheese, WPC, SPC and CPF respectively.

Awad (2003) found that replacing up to 30% of the cheese base with potato puree improved the body and texture and enhanced the flavour of block processed cheese. The addition of potato puree increased the pH, oil separation and firmness of the obtained processed cheese.

Low Fat Processed Cheese and Spreads

The terms "non-fat"/fat free", "reduced fat" and "low fat" processed cheese and processed cheese spreads have been defined according to the level of fat in these products (FDA, 1993). The terms "non-fat" and "fat free" are intended to mean processed cheese that contains less than 0.5 g total fat per 30 g serving. The term "reduced fat" is intended to mean processed cheese having greater than or equal to a 25% reduction in fat compared to the full fat cheese. The term "low fat" means processed cheese that contain 3 g total fat per 30 g serving. However, these terminology are not well defined in most of the published papers.

Salem *et al.* (1987) made processed cheese by adding denatured whey proteins (DWP,79.48% total solids) and milk protein coprecipitate (CP, 76.12% total solids) at the ratios of 10, 20 and 30% of the cheese blend. These additives reduced the fat and moisture contents in the resultant cheese However,they found that cheeses with added DWP and CP were less hard and more elastic than the control cheese. They said that processed cheeses from the different treatments were of good organoleptic quality and that cheese containing 20% DWP was the best treatment as compared with the control.

Awad *et al.* (2003) used low-fat mozzarella cheese (LFMC) as a base for the manufacture of low-fat processed cheese spread. They used LFMC to replace 20,40 or 60% of full-fat Ras cheese in the blend. Incorporation of LFMC resulted in cheese spread with lower oil separation and meltability but higher firmness. Oil separation and meltability increased during storage while firmness increased first and then decreased. The LFMC increased the viscosity of the cheese spread and improved appearance and flavour. Incorporation of 40% LFMC gave a spread of highest sensory scores among treatment. Also scores of spreads containing LFMC improved during storage

Kebary *et al.* (1998) used a protein-based fat replacer (Dairy-Lo®, and two carbohydrate-based fat replacers; a mixture of Maltrin M040 and Maltrin M100, and Cerestar C*DeLight 01970 in processed cheese spreads. The replacers were used to replace 50 and 100% of butter in the blend of the cheese spread, stored for 3 mo at 6±1°C, and samples were analysed monthly for their chemical composition and, meltability, oiling off and sensoric properties. The protein-based fat replacer gave processed cheese spread of good quality and that it it is possible to replace up to 40% of cheese fat with Dairy-Lo without determinal effect on cheese quality.

Kebary *et al.* (2001) made low fat processed cheese spread by replacing 50% of butter used in the blend with Dairy-Lo (a protein-based fat replacer) and Karish cheese was substituted with whey proteins precipitated by heating of salted whey at pH 4.6 at ratios of 0, 20, 40, 60, 80 and 100%. Two sets of processed cheese spread (each of 6 batches) were flavoured with either green pepper or hot pepper. Replacement of Karish cheese with whey proteins increased significantly the ash and total nitrogen contents, meltability, elasticity and decreased oiling off, pH and moisture content. Also scores of organoleptic properties increased up to 60% replacement and then decreased. The moisture and fat contents and meltability, elasticity and scores of organoleptic properties of processed cheese spreads decreased slightly during storage. The most acceptable spread was that flavoured with hot red peper and 60% replacement of *Karish* cheese with hot proteins.

5. Processed cheese analogues

Abou El-Nour *et al.* (1996) used total milk protein to replace up to 50% of rennet casein in the manufacture of block-type processed cheese analogue. The products were formulated to contain 50-52% dry matter and 41-42% fat in dry matter. They evaluated the products for meltability, firmness, sliceability, texture profile and sensory properties. Replacement of up to 40% rennet casein with total milk protein resulted in products of satisfactory organoleptic and texture properties.

Abou El-Nour *et al.* (1998) found that replacement of rennet casein with milk protein concentrate increased the firmness and sliceability and decreased the meltability of processed cheese analogues. Also the increase of added NaCl from 1.8 to 2.6% increased the meltability of the obtained analogues. Sensoric analysis indicated that 30% of rennet casein in the blend can be replaced with milk protein concentrate to give processed cheese spread analogue of acceptable quality.

Abou El-Nour *et al.* (2001a) prepared whole milk proteins and native phosphocaseinate by microfiltration and ultrafiltration. They used these preparations in partial replacement of rennet casein in the manufacture of block and processed cheese analogues. The rheological properties and sensoric attributes of the prepared analogues were affected by the type and percentage of the replacer. The phosphocaseinate can be used successfully in the processed

cheese spread analogues up to 30-40% replacement.

Abou El-Nour *et al.* (2001b) prepared spread-type processed cheese analogues (35% dry matter, 50% fat/dry matter) from rennet casein powder, butter and different types of commercial emulsifying salts. The obtained analogues had variable pH, free oil, firmeness, resistance to cutting and meltability depending on the used emulsifying salt. They concluded that Joha C emulsifying salt gave cheese analogue of acceptable rheological properties.

Abou El-Nour and Buchheim (2002) found that the curd from rennet coagulated butter milk (32-41% dry matter) can be used successfully to replace up to 60% of rennet casein powder in the manufacture of processed cheese spread analogues.

Abou El-Nour (2003) found that the source of rennet casein and level of NaCl added had a significant effect on the free fat, firmness, resistance to cutting and meltability of processed cheese analogues. He also found marked differences in the microstructure of processed cheese analogues made with the different rennet caseins.

6. Flavoured processed cheese.

El-Bagoury and Helal (1987) added different levels of Cheddar cheese or Swiss cheese flavours in the blends of processed cheese. These additives affected the free fatty acids in the obtained processed cheese.

Zeidan *et al.* (1992) used tomato juice and pungency mixed pepper in processed cheeses.

Abeid *et al.* (2001) used shrimps to replace successfully up to 50% of Ras cheese used in the blend of processed cheese. Addition of shrimps affected slightly the composition of the processed cheese but improved its organoleptic properties.

Awad *et al.* (2003) in an attempt to produce fruit flavoured processed cheese spreads, added different levels of the pulp of guava, mango and banana in the cheese blends. These additives were found to affect the pH and composition of the resultant spreads. However, these products were not evaluated for flavour attributes

7. Effect of Packaging.

Salam *et al.* (1992) compared the use of 4 different packaging materials namely; polystyrene containers, polyethylene tubes, aluminium foil laminated with cellophan and caton boxes lined with aluminium foil on the composition and properties of processed cheese. They concluded that the best package was the small polystyrene containers sealed with brightly coloured laminated foil.

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دراسات على الجبن المطبوخ بمصر

يمثل الجبن المطبوخ أحد أنواع الجبن الأكثر تقبلا من المستهلك المصري. وقد تناولت كثير من الدراسات التي أجريت في مصر خلال الخمسين عاما الماضية الجبن المطبوخ من نواحي متعددة. وفي هذه الدراسة المرجعية تم تقسيم البحوث التي تناولت الجبن المطبوخ في عدة أتجاهات وهي الدراسات المسحية ، جبن الأساس المستخدم في التصنيع، أستخدام مستحضرات بروتينات اللبن ، الجبن المطبوخ منخفض المحتوي الدهني، مشابهات الجبن المطبوخ، الجبن المطبوخ المدعم بالنكهات وتأثير التعبئة علي تركيب وجودة الجبن المطبوخ.