Al-Samn, Pure Clarified Concentrated Milk Fat Product: An Over View

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ABSTRACT

Al-Samn is the traditional pure clarified concentrated milk fat product in Egypt. It is produced using the primitive manufacturing method by direct boiling off of salted sour butter.

This review considers the definition of Al-samn and similar products such as butter oil or butter fat produced in different countries, samna making by the Egyptian method, chemical composition, physical rheological and organoleptic properties, packaging, storage, keeping quality and nutritional value of Al-samn. The importance of morta, the by-product of Al-samn are also considered.

Key words: Al-Samn, masli, butter oil, butter fat, triglycerides, polymorphism, antioxidants, autoxidation, morta.

INTRODUCTION

The pure clarified concentrated milk fat products are very well known in all worldwide countries. This products can be classified into two main groups according to method of making.

1- Traditional methods by direct boiling off of salted sour butter or cream; this group including or Al-samn or masli produced in Egypt and some Middle East Arab countries, Ghee produced in India and other Indian Peninsula countries and Roghan produced in Iran.

2- Mechanical methods by melting sweet butter at 50-70°C, centrifugation, and the clear fat is collected. This product is known as butter fat or butter oil, and also dry or anhydrous butter oil or fat. This products is produced since the second world war (1939-1945) to decrease costs of butter storage and cooling.

The butter oil is known in England, Australia, New Zealand, USA with the name butter oil or butter fat, in France, Beurre fonda or Graisse de beurre, in Germany, Butter Schmalz, in Italy, Burrofuso, in Spain Mantiquella fundida and in Russia, Taplonni Masla (heated butter).

This article specifically deals with Al-samn, the pure clarified concentrated milk fat product. It is generally prepared from buffaloes' milk or cows' milk which constitute 63.5% and 35% respectively of total milk output in Egypt (Abou-Donia and El-Agamy, 1993 & 2003), while small amounts of Al-samn are prepared from sheeps' milk and goats milk, which constitute 1% and 0.5% (El-Sokkary & Zaki, 1953, Fahmi, 1961, Abou-Donia & El-Agamy, 1993 & 2003, and El-Agamy, 2003).

The main object of the primitive dairy industry in the rural districts of Egypt is to separate milk fats for making butter, and to make the remainder into products which are consumed a such or after storage throughout the year. In lower Egypt, farmers put fresh milk in shallow or deep earthen ware pots, matrad or shalia, and leave of undisturbed in a warm, dark place till the cream rises and the rest milk coagulates. The cream layer is removed and beaten into butter, which is boiled and therefore converted into samna, (known as Al-samn Al-fallahi), while in upper Egypt the fresh milk poured into skim bags (Kerbah), left to sour, then closing tightly and shaking until fat globules coalesce, then resultant butter converted to Al-samn (known as Al-samn Al-saidi). The presence of earthen ware pots, such as used in cream making in the tombs of king Horaha of the first dynasty (3200 BC), indicates that the art of Al-samn making was known to the Ancient Egyptians (Abou-Donia 1984 & 1999, and Abou-Donia & El-Agamy, 1993 & 2003).

Al-Samn making by the Egyptian Traditional Method

Al-Samn is usually made from butter produced from ripened cream, however, nowadays in some cases, it can be made using cream prepared from salted or unsalted whey. The resulting Al-samn is called whey cream Al-samn. Many authors described in detail method of Al-samn making by the Egyptian traditional method (El-Sokkary and Ghoneim, 195 , El-Sokkary and Zaki, 1953, Fahmy, 1955, Fahmi, 1961, Fahmi *et. al.*, 1973, Ahmed, 1968, Helal, 1970, Abou-Donia & El-Agamy, 1993 and 2003, and Abou-Donia, (1984 & 1999).

Recently, El-Shibiny Safinaz *et. al.*, (2005) summarized Al-samn making as follows; Al-samn is traditionally prepared by direct heating of salted sour butter until most of the water evaporates. Care must be

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taken during this stage to avoid frothing by continuous stirring and slow heating rate. When foams reces, the rate of heating is increased with continous stirring until the aggregated l utter solids not fat (SNF) aquire a creamy colour ı nd temperature reaches 118-120°C. Heating is then d scontinued and Al-samn is left to cool at room temperat ıre to allow setting of the aggregated SNF (termed mo ta) and the clear fat is separated by decantation. The : low cooling of Al-samn allows for the formation of fat c ystals which characterize Al-samn.

Fahmi *et. al*, (1973) reported that Al-samn is characterized by pleasant flavour that arises from various compou ds which are formed during the manufacturing pr cess i.e, fermentation and heating.

Abou-Donia and El-Agamy (1993 & 2003) enumerated the g od quality Al-samn characteristics as follows; color o cow's milk Al-samn has a golden yellow color (owi ıg to the high content of β-carotene), while in case of b ıffaloes' milk Al-samn, it has a white, slightly greenish c)lor, the Al-samn should be of cooked flavour, slight, sw et flavor and free from rancidity, the fat content should be not less than 99.5%, the moisture content not more t ıan 0.3%, the main flavor compounds in Al-samn are me hyl ketones, 2-enals, and 2,4 dienals.

Chemical comp sition, physical, rheological and organoleptic pro erties of Al-samn

Chemical compos tion:

Abou-Donia and El-Agamy (1993&2003) summarized the :hemical composition and the fat constants of Al-sa mn made from cows and buffaloes' milks in the two fo lowing tables:

Table 1. Chemic al composition of Al-samn made from cows' m lk and buffaloes' milk (according to Abou-Donia and El-Agamy, 1993 and 2003).

Constituen t	Cow's milk Al-samn	Buffaloes' milk Al-samn
Water	0.3-1.0%	0.3-1.0%
Fat	98-99%	98-99%
Solid not fat	0.2-0.3%	0.2-0.3%
Phospholipids (mg $100g^{-1}$)	93-2	76.6
Sterols (mg $100g^{-1}$)	241	316
Cholesterol (mg 10 $)g^{-1}$)	33.05	42.66

Table 2. The fat constants of Al-samn made from cows' milk and buffaloes' milk (according to Abou-Donia and El-Agamy, 1993 and 2003).

Constant	Cow's milk Al-samn	Buffaloes' milk Al-samn
Reichert-Meissl value	≥ 22	≥ 25
Polenske value	≤ 2.7	≤ 2.7
Kirschner value	≥ 19	≥ 22
Saponification value	≥ 220	≥ 222
Iodine value	29.65	37.90
Butyro refractometer reading	40-44	40.43

Fahmi (1961) summarized some fat constants of Al-samn made from sheeps' and goats' milks as follows.

Table 3. The fat constants of samna made from sheeps' milk and goats' milk (according to Fahmi, 1961).

Constant	Sheeps' milk Al-samn	Goats' milk Al-samn
Reichert-Meissl value	31.09	26.16
Polenske value	7.27	7.38
Iodine value	43.08	35.55

Effect of seasonal variations and feeding on chemical composition.

Ahmed *et. al.*, (1979) found that Iodine value, peroxide value, refractive index and conjugated dienoic fatty acids contents of Egyptian buffalo milk butter oil and Al-samn increased during the months of green feeding (winter season) and decreased during the months of dry feeding (Summer season) in Egypt.

Distribution of triglycerides: El-Shibiny, Safinaz *et. al.*, (2005) investigated the distribution of triglycerides in buffaloes' and cows' milks butter oil and Al-samn. It was found that butter oil and Al-samn from sour buffalo butter were characterized by slightly higher long chain fatty acids and lower medium chain of triglycerides than that obtained from sweet buffalo butter.

Polymorphism: Helal *et.al.*, (1977) found that when samples of summer and winter buffaloes' and cows' butter fat were kept overnight or over ten nights after cooling to 3-4°C it was possible to identify A and B forms in whole fat, or its fraction II and fraction III.

Sterols: Ghaleb and Elhami (1983) reported that local market natural Al-samn had near values of esterified, free sterols ratio.

High melting fraction: Rifaat *et.al.*, (1973) found that both of infrared absorption analysis and X-ray analysis confirmed the existence of α, β and B phase in high melting fraction in buffaloes' butter fat fraction

Hydrogenation: Ibrahim et. al. (1975) found that hydrogenation of buffaloes' milk butter oil resulted in rasing the melting point but lowering the refractive index and iodine value.

Autoxidation: Ahmed *et.al.*, (1975) concluded that samples of buffaloes' butter fat containing high levels of phospholipids which oxidized less rapidly.

Antioxidants used in Al-samn making: Abou-Donia and El-Agamy (1993 & 2003) reported that the most common cause of deterioration in Al-samn is oxidative rancidity resulting from exposure to light. To prevent rancidity anti oxidants are added.

El-Emary *et. al.*, (1974) found that both of nordihydroguiaretic acid (NDGA), and Dihydroxy methyl-Cresol (DHMC), the most promising antioxidants which can inhibit autoxidation in buffaloes' milk butter oil.

Helal *et. al.*, (1979) reported that ascorbic acid is a better synergistic antioxidant as compared to lecithin when mix with propylgallate (PG), Butylated hydroxyl toluene (BH toluene) (BHT) and Butylated hydroxyl anisole (BHA) for retarding buffaloes' milk fat oxidation.

Mahran *et. al.*, (1991) found that adding of Al-samn residue to butter or in combination with butylated hydroxy toluene (BHT) 0.01% or propylgallate 0.005% showed the greatest protection factor during storage at room temperature. It is well known that samna residue rich in protein and then during the heat treatment process of Al-samn making, sulfhydryl groups (-SH groups) are developed.

Emara & Abdel Kader (2001 & 2004) reported that orange (*Citrus sinensis*) peel extract (0.12% W/W) was superior than methanolic black cumin (*Nigella sativa*) extract as natural antioxidant of buffalo Al-samn. The crude methanolic extracts of both materials were identified as active components as shown by Gas chromatography Mass spectrum (GC-MS).

Phospholids: Mahran *et.al.*, (1975) found that Al-samn from sweet buffaloes' milk cream by melting and separation by gravity had the lowest phospholipids content of 2.7 mg/100g. Al-Samn from ripened cream by the boiling-off method had the highest phospholipids content of 76.6 mg/100gm.

Free fatty acids: El-Shabrawy *et.al.*, (1981) when isolated cows' and buffaloes' milk fat by preparative thin layer chromatography found that the pattern of free fatty acids varied in volatile acids, while palmitic, oleic, and myristic acids were the major free fatty acids in both cow's and buffaloes milk fat.

Carbonyl compounds: Ahmed *et.al.*, categorized the average values of the 3 classes of free-monocarbonyls, saturated, ALK-2 enals and ALK2, 4 dienals in buffaloes' butter oil were 5.621, 18.961, and 1.15 U mol/kg respectively. Their values in cows' milk butter oil were 3.96, 16.00 and 1.5 U mol/kg respectively.

Rheological properties:

El-Nimr *et.al.*, (1979) observed that rheological properties of buffaloes' milk butter oil have been affected by season and repuring; were more remarkable at stress rates from 3.27 $sec.^{-1}$. There were a relationship between plastic viscosity and yeld value till 3.5×10^5 dyne cm^{-2}, 0.25×10^2 poise in summer and 8×10^3 dyne cm^{-2}, 0.55×10^2 poise in winter.

El-Nimr *et.al.*, (1980) found that there were no significant correlation between plastic viscosity and high melting glycerides and conjugated dienes in buffaloes' milk butter oil.

Packaging of Al-samn: Both of the two Egyptian types of Al-samn (Fallahi of lower Egypt, and saidi of upper Egypt) are packed in barany (a primitive earthenware pot with glazed inner surface), (Abou-Donia, 1999). Now different packages can be used for packaging Al-samn, but in all cases too hot ambient temperature and direct light should be avoided.

Mansour *et.al.*, (1987) investigated the effect of plastic, glass and paper containers as compared with tin cans on the keeping quality of Al-samn and butter oil. Results revealed that glass justified itself as the best of all examined containers. On the contrary, tin was the worst of them all. Plastic and paper containers gave nearly similar results, being between glass and tin.

Abou-Donia and El-Agamy (1993 & 2003) reported that the packaging of Al-samn is considered a vital process, samna should be filled into storage cans with sufficient tempature to expel air bubbles inside the cans.

Storage of Al-samn:

Mehanna et.al., (1987) and Mansour et.al., (1987) concluded that storage of Al-samn at 5°C prolonged its keeping quality to more than six months. The refrigeration also improved the organoleptic properties of cooled Al-samn. Khalifa and Mansour (1988) and Ibrahim *et.al.*, (1989) confirmed the above results.

Hassan *et.al.*, (1989) reported that no viable organisms were detected in A-samn when tested for total count, yeasts and moulds and coliforms. This results may due to the very low moisture content (0.3-1.0%) of sama, therefore the decrease of water activity, and then the microbial activity.

Factors affecting the keeping quality of Al-samn:

Abou-Donia and El-Agamy (1993 and 2003) cleared the factors which leading to the decrease of keeping quality of Al-samn as follows; the increase of heat

treatment of the fat during Al-samn processing to more than 125°C, the increase of acidity in the utilized butter or cream, the presence of traces of heavy metals e.g iron and copper, the presence of oxygen or air inside pots or cans, the increase of storage temperature, the exposure of Al-samn to light during storage, high level of moisture or non fat matter in Al-samn, the absence of natural antioxidants, and finally the summer produced Al-samn. This is presumably due to the lower phospholipids content in summer milk in Egypt.

Nutritive value of Al-samn:

Abou-Donia and El-Agamy (1993 & 2003) reported that Al-samn is mainly composed of pure milk fat and thus it is considered a good source of energy. Moreover, Al-samn provides significant quantities of fat-soluble vitamins (table 4), the use of Al-samn in cooking improve the taste of meal, and hence overall intake may be increase.

Table 4. the vitamin content of Al-samn from cows' milk and buffaloes' milk (according to Abou-Donia and El-Agamy, 1993&2003).

Vitamin ($\mu g\ g^{-1}$)	Cow's milk Al-samn	Buffaloes' milk Al-samn
Carotenoids	4-15	0.2-1.0
Vitamin A	3-8	3-8
Vitamin D	7-10	7-10
Vitamin E	30-45	20-30
Vitamin K	Traces	Traces

Morta, the by-product of Al-samn making:

Abou-Donia and El-Agamy (1993 & 2003) reported that morta is a by-product of Al-samn making and if butter rather than cream is used, the amount of morta is usually equivalent to 5% of the weight of butter. During boiling of butter, more than 85% and 75% of cows' and buffaloes' butter cholesterol were separated with morta respectively. The composition of morta depends primarily upon the steps and condition of Al-samn making but is generally as follows: water 10-18%, fat 40-65%, non fat solids 10-25%, ash and salt 10-15%, and cholesterol in buffaloes' milk Al-samn 131.6 mg $100g^{-1}$ versus 193 mg 100^{-1} in cows milk Al-samn.

The nutritive value of morta is mainly attributable to the high content of phospholipids. Morta is consumed as is, or used in making Domiati cheese.

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الملخص العربي

السمن، الناتج اللبنى الدهنى النقى الصافى المركز: نظرة شامل

سمير أحمد أبو دنيا

السمن هو الناتج اللبنى الدهنى النقى الصافى المركز الذى ينتج فى مصر باستخدام الطريقة التقليدية وذلك بالغليان المباشر للزبد المخمر المملح.

ويعنى هذا المقال بتعريف السمن ومشابهاته زيت أو دهن الزبد المعروف فى دول كثيرة. وكذلك طريقة صناعة السمن فى مصر بالطريقة التقليدية وكل من التركيب الكيماوى والخواص الفيزيائية والريولوجية والحسية والتعبئة والتخزين المقدرة الحفظية والقيمة الغذائية للسمن.

كذلك أخذ فى الاعتبار أهمية المورته كناتج ثانوى لصناعة السمن.