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Module – 07: Types of market cream

INTRODUCTION

The fat contents play an important role in pricing of milk. Cream is the fat rich portion of milk; it is extracted from milk as part of milk processing. At household level it is obtained as *Malai* from boiled and cooled milk. In the market, the cream is available with varying fat levels - low fat, medium fat, and high fat. Different types of cream are required for different purposes. All the commercially available cream is obtained by mechanical separation. Cream is used for making ice cream, butter, ghee and butter oil in the commercial dairy plant. Some portion of cream is utilized for dressing the products in bakery and coffee making. Cream is one of the important dairy products. If milk is allowed to stand undisturbed, the portion that rises naturally to the surface and forms a layer is known as cream. Separation produces two fractions. The fraction, which contains fat in highly concentrated form, is called cream. Another fraction, which is a non-fat fraction, is termed as skim milk. Cream is rich in butterfat. It also contains other constituents of milk but in lower proportion than milk. Milk can be separated either by gravity separation method or by mechanical separation method. In the dairy industry, cream is separated by mechanical method employing centrifugal cream separator.

DEFINITION, CLASSIFICATION, LEGAL STANDARDS

Definition

Cream is defined as the fat rich portion of milk obtained by gravity or mechanical method of separation. It is the light weight portion of milk which still contains all the main constituents of milk, but in different proportions. The fat content of cream varies widely in the range of 18- 85 % depending upon the method of separation.

Malai is obtained by hand skimming of heated and cooled milk. Usually it is prepared by housewives at home and by *halwais* in shops.

Classification

Cream contains all the milk constituents but in varying proportions. The milk fat in cream may vary from 18 to 85 percent; the solids-not-fat constituents in lower proportions than in milk. Cream may be broadly classified as:

a. Market cream:- which is used for direct consumption, and

b. Manufacturing cream:- which is used for the manufacture of dairy products.

The various types of cream and their fat content are as follows:

i. Table cream, ii. Light cream, and iii. Coffee cream	...	20-25% milk fat.
iv. Whipping cream and v. Heavy cream	...	30-40% milk fat.
vi. Plastic cream ...	...	65-85% milk fat

LEGAL STANDARDS

Food Standards Safety Act (2006)

Cream including sterilized cream means the product of cow or buffalo milk or a combination thereof. It shall be free from starch and other ingredients foreign to milk. It may be of following three categories, namely:-

1. *Low fat cream*-containing milk fat not less than 25.0 per cent by weight.
2. *Medium fat cream*-containing milk fat not less than 40.0 per cent by weight.
3. *High fat cream*-containing milk fat not less than 60.0 per cent by weight.

Note: Cream sold without any indication about milk fat content shall be treated as ñhigh fat creamò.

Malai means the product rich in butter fat prepared by boiling and cooling cow or buffalo milk or a combination thereof. It shall contain not less than 25.0 per cent milk fat.

United Nations Food & Agricultural Organization &World Health Organization (1977)

The United Nations Food and Agricultural Organization and World Health Organization (1977) have suggested the following standards for market cream:

a. Pasteurized, sterilized & UHT treated cream		...	18% milk fat
b. Half-cream	...	...	10-18% milk fat
c. Whipping cream	...	...	28% milk fat
d. Heavy whipping cream	...	...	35% milk fat

e. Double cream ... ... 45% milk fat

According to FAO standards

According to *FAO standards*, the following classification is made according to the fat content:

a. Cream ... 18-26%

b. Light cream (or coffee cream) > 10%

c. Whipping cream > 28%

d. Heavy cream > 35%

e. Double cream > 45%

COMPOSITION OF CREAM

Cream is basically an emulsion of fat in water. This means that milk fat globules are dispersed as small droplets in a continuous medium of skimmed milk containing protein, lactose, minerals and some vitamins. Typical composition of cream varieties is given in Table 1.

Table 1: Chemical composition of cream

Constituents	Average composition (Value in %)		
	Half-and-half cream	Table cream	Whipping cream
Moisture	80.3	73.8	57.7
Protein	3.0	2.7	2.0
Fat	11.5	19.3	37.0
Carbohydrate	4.3	3.6	2.8
Ash	0.7	0.6	0.5

In addition, vitamins, enzymes, trace elements and acids are present in cream.

It can be observed from the above composition that the higher the fat percentage in cream, lower the solids-not-fat content. The formula for determining the percentage of solids-not-fat in cream is:

%SNF in cream = [(100 - %fat in cream) / (100 - %fat in milk)] x [%SNF in milk].

NUTRITIVE VALUE

Fresh cream contains all the constituents of milk, but will invariably contain at least 5 times more fat than milk. Hence the energy value of cream will be several times higher than that of milk. The energy value can be calculated by assessing the composition of cream and taking into consideration the individual contribution of the constituents to the energy value as given below:

Milk Fat 9.3 k cal/g

Milk Sugar 4.1 k cal/g

Milk Protein 4.1 k cal/g

In addition to the calorific value, the cream is richer in fat- soluble vitamins like A, D, E, and K than milk as it has more fat content.

PROCESSING OF CREAM

The processing of cream depends on the purpose for which it is required. In general, following processes are involved for different types of cream.

i. Standardization

The fat content of cream is adjusted to the desired level either by the addition of calculated quantity of water or skimmed milk. This step is referred to as standardization. The use of water or skim milk depends on the purpose for which the cream is required. If the buttermilk is to be used for drying or standardization of milk for products making or for beverage preparation the standardization is done with skim milk. The cream after standardization is subjected to homogenization and appropriate thermal processing prior to packaging for retailing.

ii. Homogenization

Cream is an oil-in water emulsion. Therefore the cream standardized to various fat levels with skim milk must be homogenized to reduce the fat globule size and increase the stability i.e., prevent fat separation. Homogenization is a process whereby cream is forced through a narrow orifice under considerable pressure. This breaks up the fat globules to smaller size and ensures they are evenly distributed throughout the cream. By homogenization, various grades of viscosity in cream products can be obtained. Usually, lower pressures are used for cream than that used for milk products. Whipping cream is rarely homogenized as this process greatly reduces the whipping ability of cream. Stabilizers such as mono-glycerides are added to improve whipping ability. On the other hand, homogenization of high fat cream is utilized in the production of easily spreadable whipped cream products, which are used as dessert toppings. Homogenization is employed for UHT pasteurized whipping cream in order to prevent fat separation, which increases with UHT pasteurization.

iii. Thermal Processing

The thermal processing of cream involves either pasteurization or sterilization. The cream could be pasteurized by either batch or continuous method. The sterilization could also be done by either of the two methods, i.e., by batch method using counter pressure autoclaves referred to as retorts or by continuous method, followed by aseptic packaging. The time-temperature combination for cream is higher in comparison to milk processing. This is simply, because it contains more total solids than milk. The possible time-temperature combinations are indicated below.

Batch Pasteurization: 74°C/30 minutes

Continuous Pasteurization: 85°C/25 seconds

Batch Sterilization: 115-120°C/15 minutes

UHT Processing: 135°C/1-3 seconds

As soon as the heat processing of cream is completed it is cooled to less than 10°C to avoid the survival/growth of heat resistant micro-organisms during storage. In practice it is cooled to 4-5°C.

iv. Packaging and storage

The cream after processing is packaged in suitable containers and stored at low temperature (below 5°C). If the cream is sterilized or it is a UHT cream, then it can be stored at ambient temperature.

CREAM PRODUCTS

Coffee Cream

Coffee cream is a shelf-stable product with a fat content of >10%. It is homogenized and UHT processed, filled aseptically or sterilized in the container. Its shelf life is longer, similar to UHT milk. Its key function is to whiten coffee, but it is also used in the preparation of food products and beverages that are meant for direct consumption. The important quality criteria are taste, whitening power and stability in hot coffee.

Method of Manufacture

First, the fat content must be standardized as required. Coffee cream treated by the UHT process, is filled aseptically into one-way containers of standard net volumes [10 ml (portion pack) up to 0.25 ml. When preserving coffee cream by the sterilization process, it is first fat standardized, then pasteurized at 90°C, homogenized, filled into bottles, closed by crown corks and finally sterilized in retorts.

Importance of homogenization: Coffee cream must be homogenized. This prevents a fat layer or fat plug in the container, thus improving taste, whipping power and stability. Homogenization has a direct influence on the flocculation stability of coffee cream in hot coffee. A double-stage homogenization is optimal for UHT cream. The first homogenization is done before the UHT treatment; the second aseptic one is done after the UHT treatment. For both processes, the pressure in the first stage should be about 200 bar and in the second stage about 50 bar. When sterilizing cream in the pack, homogenization has to take place before the sterilization, which again is a double-stage process using the same pressure (200/50 bar).

Flocculation of cream in hot coffee is due mainly to casein precipitation. For example, homogenized casein-free cream, enriched with whey proteins has significantly improved flocculation stability when it is preheated at 90°C for 5 min because of whey protein denaturation.

Sour Cream

This is a heavy-bodied ripened cream of high acidity (0.6% as lactic acid), clean flavour and smooth texture. It should have following organoleptic criteria.

Appearance:	White to yellowish, slightly creamy.
Flavour:	Clean, slightly acidic, rich.
Taste:	Clean, milk-sour, flavorful.

Method of Manufacture

Take a sweet cream and standardize to get 18-20% milk-fat. It is then pasteurized, homogenized (preferably at low temperature to promote formation of homogenization clusters) and chilled to 15-20 °C, and the final fat content is set. Then, it has to be inoculated with an aerobic starter (i.e.

lactic acid/butter culture) @ 2-4% at 20°C, and allow for fermentation until the desired qualities are obtained. During the acid production, the homogenization-clusters flocculate, resulting in a highly viscous cream. To increase the firmness, thickening agent are sometimes added to the sweet cream. When the pH has reached to 4.5 (or once the cream has reached an SH-value of 25-35), the cream is further cooled with gentle stirring and then chilled to 2-4 °C and packed (by filling into one-way containers or bottles). Alternatively, souring in the package may be applied. Sour cream is mainly used in prepared foods and less often in beverages.

Whipping Cream

Whipping cream is one of the food foam. This contains 35-40% fat cream. It is widely accepted due to its multiple applications in decorating and refining of food. The cream is usually whipped immediately prior to consumption, either by the consumer or in the catering outlets (restaurants, bakeries and others). It is therefore, primarily designed to be beaten into foam, often with sugar added. It is mostly available as a pasteurized product in small bottles, plastic cups, or large cans. It is also sold as in-can sterilized cream, and even supplied with sugar and a driving gas in an aerosol-can that delivers a ready-made whipped cream.

Desirable Properties: The most important specific requirements for the desirable product are:
(a) *Flavour:* The product is consumed for its flavour, which obviously must be perfect. Rancid and tallowy flavours in the original milk should be rigorously avoided; this requirement is even more essential than for coffee cream. Not everybody appreciates a sterilized product flavour or even a pronounced cooked flavour, and partly because of this, the cream usually is pasteurized.

(b) *Keeping quality:* Many kinds of spoilage can occur, but it is often desirable to store the cream for a prolonged time. The original milk should contain not more than a few heat-resistant bacteria. *Bacillus cereus* is an undesirable microorganism in whipping cream (it causes the fat emulsion to become unstable). Nor should growth of psychrotrophs occur in the original milk, because they form heat-resistant lipases. To allow for a fairly long shelf life, the pasteurized cream should be packed under strictly hygienic or even aseptic conditions. Recontamination by bacteria leads to major spoilage defects. Therefore, whipping cream is often heated by in-can or in-bottle pasteurization.

Contamination by even minute amounts of copper causes autoxidation and hence off-flavour. Some coalescence of the fat globules during processing can readily lead to cream plug formation during storage. A cream plug implies that the product can hardly be removed from the bottle; moreover, it will readily churn rather than whip during beating in of air.

(c) *Whippability:* The cream should quickly (i.e. in a few minutes) and easily whip-up to form a firm and homogeneous product, containing about 50% (v/v) of air (i.e. 100% overrun).

(d) *Stability after whipping:* The whipped cream should be firm enough to retain its shape, remain stable during deformation (as in "decoration"), not exhibit coarsening of the air cells, and show negligible leakage of liquid. Sometimes carrageenan is added as a thickening agent.

Method of Manufacture

The classical manufacture of whipping cream is fairly simple. In which, cream obtained from pasteurized milk is taken and standardized to 36% milk fat. After adding thickening agent, it has to be pasteurized at 85°C for 30 minutes, and then cooled to 5°C and packed.

The pasteurization of the cream should at least be sufficient to fully inactivate milk lipase. Usually, the heat treatment is far more intense in order to improve the keeping quality. The way of heating, as well as the heating intensity, varies widely; holder pasteurization (e.g., 30 min at 85°C), heating in a heat exchanger (possibly over 100°C), and in-can (bottle) heating (e.g., 20 min at 103°C) are used. Likewise the manufacturing sequence, separation temperature, and so forth vary widely. Sometimes the cream is stirred in an open vat at rather high temperature in order to deodorize it; vacreation is not suited, because it damages the fat globules.

Such damage, especially (partial) coalescence of the fat globules, should be avoided. The milk, and especially the cream, should be handled gently. The cream should not be processed or pumped unless the fat is completely liquid or largely solid, i.e., only at temperatures below 5°C or above 40°C. Hence, bottle filling of hot cream, followed by immediate cooling would be preferable, but it is rather uneconomical.

Sterilization of whipping cream may cause problems. In-bottle or in-can sterilization, often causes coalescence, unless the cream is first homogenized. However, most homogenized cream cannot be whipped. Accordingly, UHT heating is preferred, also because of the flavour (direct

UHT heating causes strong homogenization); the cream should then be homogenized aseptically at low pressure and the composition should be adjusted ("emulsifier" added). A disadvantage of UHT whipping cream is that the temperature fluctuations to which it may be subject (it is often stored un-cooled for a time) can cause "re-bodying". This implies a considerable increase in viscosity that, moreover, strongly impairs the whipping properties (churning rather than whipping).

To be readily whippable on delivery, the cream needs first to be kept refrigerated for a day in order to ensure that all fat globules contain some solid fat. To prevent creaming during storage, a thickening agent is generally added (e.g., 0.01% k-carrageenan).

Whipping Process

When skim milk is beaten, a foam with very rich in air is rapidly formed on top of the liquid. This proceeds more slowly when cream is beaten and the air bubbles stay in the liquid for a longer time. This is partly because of the higher viscosity and also the fat globules directly penetrate the air-water interface, attaching themselves to the air bubbles and spreading some liquid fat onto the bubble surface. Because of this, the films between closely approached air bubbles are rather unstable and initially the bubbles coalesce readily. The fat globules are so highly concentrated that they readily show partial coalescence (clumping). In this way a structure of clumped fat globules formed, enclosing the air bubbles and giving a rigid and stable foam. To achieve this, air cells and fat clumps should be of similar size, preferably 10-100 microns. The foam increases in firmness during whipping, but it also becomes coarser. On prolonged beating, the clumps become so large and few that they cannot stabilize, but a few large air cells are formed, the whipping becomes churning and the clumps become butter grains; the air bubbles coalesce and disappear again.

The balance between foaming and churning partly depends on the way of beating. If this is too slow, the cream may churn prematurely. Vigorous beating causes a high overrun and finely structured and smooth foam. The smaller the air cells, the less clumping are needed to enclose the bubbles and to produce firm foam.

It is also possible to foam an emulsion without clumping occurring. Such a product may be sold in aerosol cans; thus it is not beaten, but the foam forms when the gas pressure is released. Obviously, time does not suffice for sufficient clumping to occur. The fat globules curtail the overrun. They should not destabilize the air bubbles. This may be achieved by considerably reducing globule size. Proteins or other surfactants may cause some foam stability. But since encapsulation of air bubbles with fat globules does not occur, the foam is mostly unstable to manipulation and it soon becomes coarser due to Ostwald ripening of the air cells. On the other hand, these products often have a high overrun, over 200%, instead of around 100% for ordinary whipped cream.

Factors for Whippability

Several properties of the cream affect the whipping process.

(a) Fat content has a considerable effect. But the influence depends on the conditions during whipping. The more intensive the beating, the lower the fat content of the cream allowing a stable foam to form, and the higher the overrun.

(b) Crystallization of the fat is essential for clumping. If the amount of liquid fat is high, clumping is too rapid and the foam becomes unstable. Hence, deep cooling and a sufficient cooling time of the cream are essential, as is a low temperature during storage and at whipping. Obviously, the composition of the fat has an effect: There may be more problems in summer than in winter.

(c) For the composition of the cream, presumably protein is needed, especially when beating starts, to form foam cells. Addition of thickening agents hardly affects whipping, but leakage of liquid is considerably reduced.

(d) Homogenization considerably impairs the whippability; the globules become too small to clump rapidly. This may, however, be better than expected, if the fat globules have formed homogenization clusters, because far less clumping is needed in that case. Homogenization at low pressure (1-4 MPa), preferably in two stages (e.g., 2 and 0.7 MPa at 35°C) can give clusters of some 15-20 microns in diameter.

(e) Supplying the surface layers with other surface-active substances decreases the formation of clusters and increases the tendency to clumping; then homogenization at higher pressure may be applied. The surfactant added may be a mono-glyceride or a Tween; the latter drastically affects the whipping properties.

Clotted Cream

Clotted cream is exceedingly rich, containing 60-70% milk fat. This fat is present in the cream in a finely emulsified condition, which renders it usually digestible. The product will have a peculiar boiled taste and rough appearance, and will exhibit a white-flaked surface. The average composition of clotted cream will have: 67.50% milk fat; 4.90% protein; 1.00% lactose, 0.50% ash and 26.10% water.

Method of Manufacture

There is no standardized method of preparing clotted cream. Several systems are used, varying chiefly as regards the method of obtaining the raw cream, and resulting in considerable variation in the texture, flavour and appearance of the finished product. The flavour and physical consistency of cream depends upon:

i. the acidity of original milk,
ii. the temperature of scalding, and
iii. the time allowed for scalding.

The several methods of manufacture in common use are:

a. Earthen bowl method
b. Shallow pan system
c. Scalding over separated milk, and
d. Direct scalding method.

The last two methods make use of cream mechanically separated from the original milk. These methods are used with milk of unknown or doubtful cleanliness. Whereas, first two systems may sour the product during scalding process, when cream will possess a poor keeping quality.

It is prepared by heating cream to 77-88 °C in shallow pans and then allowing it to cool slowly. The surface layer consists of clotted cream, which is skimmed off and strained.

Clotted cream was long considered a luxury product, but it has been widely recommended by the medical profession as an excellent fatty food, particularly for use in the dietary of invalids.

Canned or Sterilized Cream

Canned cream generally possesses a peculiar flavour due to its processing, and high viscosity due to homogenization. Texture should be smooth. It should be free from lumpiness and separation of serum. Sterilization spoils its whipping quality. The fat content is about 20-25%, and solids-not-fat content may vary between 6.5-9.5%.

Method of Manufacture

The various steps are: (i) fresh-sweet cream is first standardized to 20% milk fat, (ii) pre-heated to 80°C without holding, (iii) then, double homogenized at 80°C, using 2500-3000 psi in the first stage and 500 psi in the second stage, (iv) immediately cooled to 16°C, (v) filled into tin-cans or bottles and immediately sealed and (vi) sterilized in retorts (as for evaporated milk) employing 15 minutes for coming-up, 12-14 minutes for holding at 118°C, and 15 minutes for cooling to room temperature.

Plastic Cream

Plastic cream is highly viscous than any other type of cream. Its texture resembles to paste and fat content is between 65 and 85%. It can be used directly for the manufacture of butter-oil.

Method of Manufacture

This is obtained by

i. re-separating normal cream (30-40% fat) in a normal cream separator, or by
ii. separating milk in specially designed 'plastic cream separator'. In both the above cases, the initial product is pasteurized at about 71-77 °C for 15 minutes and cooled to 60-66 °C before separation.