

SELECTED ARTICLE

Indian Indigenous Milk Products.

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The total annual value of the milk and milk products produced in India has been estimated as Rs. 300 crores, of which liquid milk accounts for 107, ghee 100, *khoa* 40, *dahi* 20 and other products about 33 crores of rupees. The total annual production of milk in India is about 700 million maunds. Ghee accounts for 53, *Khoa* 7.6, *dahi* 3.8 and other products 5 per cent as milk equivalent of this production. The amount of milk product manufacture is enormous, especially ghee. The energy value of this milk is sufficient for 30 million adults for one year (10 per cent of the population) without taking into account the special value of milk as a protective food due to its fat, protein, ash and vitamins. The energy value of the milk produced in England is sufficient for 7 million adults (15 per cent of the population) for one year. There is thus considerable scope for greater milk production in India so as to raise the percentage of milk and its products used in the diet of the people from 10 per cent nearer to the 15 per cent level found in western countries.

Indian Milk Products. The main reason for the manufacture of milk products is to concentrate and preserve all or some of the nutritive value of milk in time of plenty for use in a future time of scarcity. Ghee is an outstanding example. Another reason is to prepare solid products which can form the basis of food confections and so add variety to the diet, e. g. *Khoa* and *channa*. In the case of fermented milk products such as *dahi* and *lassi* we have products of uniform quality prepared by a natural lactic acid fermentation of milk. In the case of these two products, the property of milk to become sour is made use of for the production of wholesome milk drinks.

Other milk products result from the effect of heat on milk either by the separation of clotted cream (*malai and sar*) or as concentrated milk, sweetened or unsweetened, e. g. *rabbri* and *khoa*. These are looked upon as delectable confections and require considerable skill to manufacture.

Indian milk products have their counterparts in western dairy products. Ghee is similar to butter oil and butter, *desi butter* to butter, *channa* to cheese, *rabbri* and *khoa* to condensed milks and *dahi* and *lassi* to buttermilk and other fermented milks. The main difference is that except in the case of ghee, all Indian products have a low keeping quality, due mostly to recontamination of the product with micro-organisms from the air and packing material after manufacture. All by-products are also made from small batches of milk. It is in the westernizing of methods e. g. in the manufacture of butter from cream, that milk is bulked in any quantity.

Liquid Milk. The production of most of Indian milk is fragmentary; that is, the units of production are only a few seers. The collection of these small quantities adds greatly to the cost of obtaining milk in bulk for retail as such or for manufacture. The hygienic quality of all milk is low owing to ignorance of the producers of even the rudiments of hygiene. Then there is the possibility of after-contamination of milk all along the line of handling. All milk must therefore be taken as of the same poor hygienic quality and will have to be boiled as soon as received in the home in order to preserve its keeping quality. No milk must be taken as of better quality on the word of the retailer. No

objection should be taken to the commendable practice of boiling as this ensures a safe milk which will keep without seriously impairing its nutritive value.

The *skin* which forms on the surface of milk which has been boiled is a small amount of coagulated cream and consists of fat, casein and some ash; it is highly nutritious. The texture of this skin can be varied at will in the heating process, as is exemplified in the preparation of *malai* or *sar* (clotted cream) or in the preparation of *rabbri*.

Loose milk is sold at so many seers to the rupee and there does not appear to be any sale on a compositional quality basis i. e. on fat content. Three classes of milk are recognized for the setting of presumptive standards: buffalo, cow and mixed milk. A considerable amount of adulteration of milk either by abstracting fat or adding water is to be expected in loose milk sold haphazardly. A realization of the value of the freezing point test for detecting the latter would tend to lessen the practice. Other practices such as the addition of sugar, *gur*, rice, water, etc. should also be detected and dealt with through the usual procedures.

Whole milk products. These consist of highly condensed milks such as *kheer* which is milk condensed to a quarter of its volume, and *khoa*, which is the solid product obtained by condensing milk to $6\frac{1}{2}$ times its total solid content. Both products may contain cane sugar, and *rabbri* always contains it. *Kheer* may be considered as the most delectable of all Indian sweets; *Khoa* is used for food either as such or as the base for the preparation of many types of sweets.

Both are made by direct evaporation of milk in shallow iron pans over open fires. For *khoa*-making not more than two seers of milk are taken in the pan; this is boiled vigorously while stirring with an iron ladle to prevent burning of the milk. After concentration to about a quarter of the volume the milk takes on the consistency of honey and later, as more water is driven off, attains a doughy consistency. The material is thoroughly stirred at the end of the evaporation process and the viscous product is collected as a circular pat. The product must be white or creamy and should show no brown colour due to burning. The flavour must be clean and not show evidence of excessive heat treatment. The texture should be dry and caseous and should not show sweating drops of water or films of free fat. *Khoa* contains about 30 per cent moisture.

Kheer is made in the same way except that condensing is stopped at the honey consistency, at which sugar to the extent of a quarter of the weight of the product is added.

Rabbri is made by evaporating milk slowly over a small fire. After the initial frothing the milk is boiled without stirring, the skin which forms being skimmed off with wooden splints and laid on the cool pan surfaces above. This is done until the liquid is condensed to one-eighth its volume. Sugar may then be added and the skins well beaten into the condensed milk. The product contains about 30 per cent moisture. These products contain all the total solids of milk and have lost little, if any, of their nutritive value in their preparation.

Fermented milk products. These are fermented whole milk, *dahi*, and fermented skim milk, *lassi* (or more commonly, buttermilk from buttermaking from *dahi*); the difference in these two products lies mainly in their fat contents.

Dahi is cooled boiled milk in which lactic acidity to a titratable value of 0.7 to 1.1 per cent has been developed either by natural souring or by the agency of an artificial lactic acid bacterial culture (a starter). The ensuing liquid is used either as a beverage as such or churned into *desi* butter, the buttermilk being drunk as *lassi* and the butter collected and used for ghee-making.

Dahi is prepared by taking fresh milk, bringing to the boil and cooling to blood heat, and then keeping the milk at that temperature until it sours naturally or sours after the addition of a starter. The use of a special starter is rare; a small quantity of the previous day's *dahi* may be stirred into the cooled milk. There is usually enough lactic acid bacteria in the pores of the earthenware pots to carry on the fermentation. The milk sets to a soft curd when the *dahi* is ripe; this coincides with an acidity of 0.9 to 1.1 per cent lactic acid. The curd can be beaten up to a good-bodied liquid drink of appetizing acid flavour.

The step of ripening the milk is almost universally used in the making of *desi* butter from milk. The fermented milk is churned in the usual *desi* churn until the fat separates out either as a liquid layer (hot weather) or a lump of solid butter (cold weather). The crude butter is carefully separated by hand. The liquid is *lassi*, and contains some unchurned butter-fat and the casein of milk in a fine state of division. The liquid has a full bodied, acid flavour with the aroma of butter-milk and serves as an appetizing and valuable drink to the cultivator's family. A similar drink made by the fermentation of skim milk is not so uniform in texture as butter-milk *lassi*. Such a liquid should be churned for five minutes to simulate buttermilk in aroma and flavour.

Acid and heat-precipitated curd. A mixture of butter fat and milk protein is prepared from boiling milk by the addition of lime juice, lactic acid or lactic acid liquor (ripened whey). The protein of milk is precipitated as a stringy curd under these conditions, and is separated as a solid, *channa*, by filtering in a cloth and pressing. It does not require much acidity to precipitate curd from boiling milk (it occurs at pH 6.0–6.2). Most of the skill enters into the completeness of precipitation and preparing a product of as low a moisture content as possible. Too little acid for coagulation gives a curd which holds on to its water too much and requires pressing before a satisfactory product is given; too much acid gives a sour product. *Channa* is used mostly as a base in sweet making. It is usually frothed up by beating before use. *Channa* can be made either in small batches, or in large batches commercially by the same principles of acid coagulation.

Fat-rich products consists of creams, *desi* butter and ghee.

Reference has already been made to *malai* and *sar*. The word *malai* may be used for a variety of products from the thin skin of milk used for the table to the thick clotted cream made by special methods. The yield of skin on boiled milk can be varied at will by concentrating the milk and or by allowing to occur slowly in milk heated over a slow fire. The latter process is similar to that used in the manufacture of western clotted creams. The high fat and solids contents of Indian cow's and buffalo's milk cause good yields of clotted cream to be given.

The process of manufacture of *malai* and *sar* is fairly simple. A volume of milk is slowly brought to the boil with slow stirring to prevent burning. The heated milk may then either be taken off the fire and allowed to cool of its own accord or kept overnight over a dying fire. The cream together with heat coagulated protein rises as a soft layer to the surface. This layer may be of considerable thickness and is ladled off and eaten with cereals or as part of confectionery. If the milk is allowed to remain overnight over a dying fire, a more solid layer is given. *Rabbri* is a form of clotted cream whisked or soaked in sweetened condensed skim milk. *Malai* may contain 25 to 35 per cent of fat and 100 lb. of milk yields about 20–25 lb. of the product.

Desi butter. This is the term used for the fat-rich fraction churned out from *dahi*, or in some cases, ripened cream, by the method using the indigenous churn. The method used for making *dahi* has been described in the first part of this article. The *dahi* is made in a wide-mouthed jar (*ghara*) and when ready,

churned with a wooden paddle inserted in the liquid the paddle being turned by a cord twisted around a spindle, which is a prolongation of the paddle above the vessel, the cord being pulled with a reciprocating motion. When churned, the butter layer or granules are carefully collected and drained free from *lassi*. Sufficient of this *desi* butter is collected from daily churnings to merit a *boiling* of ghee.

Manufacture of katcha ghee. The butter now collected in batches in a wide-mouthed copper vessel is melted and slowly brought to the boil; the moisture in the curd layer below the fat boils away slowly and completely. A slight scum forms on the surface of the fat. This is carefully skimmed. The curd particles also begin to brown and to circulate in the convection currents in the fat. The fat is now allowed to cool as the boiling process necessary for making *katcha* ghee is complete. The pure fat is decanted as carefully as possible from the solid curd and the last runnings of fat may be filtered through muslin. This is the crude ghee of commerce; the fragmentary production of the product made in this way by cultivators goes towards accounting for a large part of the enormous amount of ghee produced in India.

The crude ghee is collected either in large brass vessels holding 20 to 40 lb. or in tins of the kerosene oil 4 gallon variety which hold about 36 lb. of ghee. The ghee is marketed in such containers.

The next step is the refining of such ghee. Other steps are embraced in the process namely the blending of ghee and its storage in clean containers so as to ensure a reasonable keeping quality. The ghee is now subjected to a *heating* process so as to rid the *katcha* ghee of some residual curd particles and water droplets. The ghee in the tins is melted and poured and according to the required blend into large boilers in which the ghee is heated to 75–85°C. After thorough stirring the clear ghee is poured off through taps (set at different levels in the boiler) and immediately run into tin containers (36 lb. size) using muslin for straining. The contents of the tins are allowed to cool when the ghee crystallizes into a white solid mass.

Large scale boiling. In the boiling of ghee in larger batches special ghee boilers of which there are many types, are used. The *boiling* process, it must be understood, is totally different from the *heating* process. The boiling process is always done at temperatures above 100°C., in order to boil away the water of the serum of the butter. With large boilers the maximum temperature rarely exceeds 116°C. With smaller boilers and good quality *desi* butter the temperature can be raised to 120°C., but not exceeding 123°C. Too high a temperature must be avoided so as not to give the ghee a browned colour or a slightly burnt taste. The ghee boilers can also be used as ghee heaters for blending and purifying crude ghee. Ghee made by the large-scale process may require blending but not purifying.

Making ghee direct from cream. Attempts have been made to cut out the churning process in the manufacture of ghee. One of the main points in ghee manufacture is to get as high a yield as possible. The process of churning milk is one in which the fat is concentrated in the resulting butter, which may contain from 50 to 90 per cent butter fat. It is feared that there is an appreciable loss of fat in the *lassi* in the *desi* method of churning. By the use of a cream separator the fat can be concentrated in cream (40–70 per cent fat content). Then this cream can be boiled like butter for the separation of ghee. Experiments have shown that this is possible but only with an 80–90 per cent yield of fat, a yield which can be improved on considerably. The reason is that the cream does not give all its fat up into the free form in the heating process and there is some loss of fat by absorption in the excessive amount of dry curd.

With acid cream the curd tends to precipitate as a large lump in the liquid below the fat, causing difficulties in manufacture and a further loss of fat. Further investigation is necessary to make this method of making ghee satisfactory.

Quality in ghee. Ghee is the pure butterfat of milk prepared by methods which give the highest yields and a product of desirable odour, flavour and crystalline texture when solidified. Buffalo ghee is white, cow ghee from slightly to deep yellow and sometimes light brown, and mixed ghee white to different gradations of yellow according to the amount of cows ghee and the season of the year. The texture should be a fine easy, working crystalline mass (cold weather) or fine crystals in liquid ghee (hot weather). Of great importance is the aroma and flavour which must be acid and full and not bland and tasteless as in freshly-rendered non-acid butterfat. This form of flavour is developed by making ghee from butter churned from ripened cream. Ghee from sweet butter is tasteless and of inferior quality. There are however, a variety of tastes locally for ghee. In commerce these tastes are ensured by the proper blending of small consignments of ghee. As in butter, the acidity of the fat at the time of manufacture is linked up with the keeping qualities of ghee; the more acid the ghee at the fresh stage the shorter the keeping quality, ghee of low acidity which thereby suffers in flavour keeps longer. There should be compromise between initial acidity and length of time of storage. Ghee should be consumed within seven to nine months of manufacture.

It is well known that ghee lends itself to adulteration with cheaper animal and vegetable fats. There is considerable activity among public analysts and workers in research institutes and university laboratories connected with methods of analysis of ghee so as to detect all forms of adulteration. There is no quick, simple, reliable test possible for the detection of adulteration of ghee and one has to be satisfied with the evidence of the usual standard methods of fat analysis. After all the amount of adulteration of ghee is very small considering the enormous amount of ghee manufactured and traded in annually.

Other dairy products. A small quantity of hard, smoked and cream cheeses are made in some parts of India. Surti cheese is a soft cheese of low keeping quality (14 days) Dacca cheese is a small medium pressed cheese which is smoked for preservation. Bandal cheese is a form of cream cheese very much like Surti cheese. Some lactic casein is prepared from skim milk by the natural sour process. The quality is usually low owing to high fat content and a brownish colour. (*Indian Farming* 1: (1940) 534-36 and 583-85).

ABSTRACTS

Report on the marketing of eggs in India issued by the Agricultural Marketing Adviser to the Government of India. I. C. A. R. New Delhi, Price Re. 1-4.

The domesticated fowls of the present day world are descendants of (*Gallus bankiva* (red jungle fowl), (b) *Gallus sonnerati* (grey jungle fowl), (c) *Gallus lafayetti* (the Ceylon jungle fowl) and (d) *Gallus varius* (the Javan jungle fowl).

World's production of hen eggs.

Countries.	Percentage to the world's production.	Average number of eggs produced per hen per annum.
(a) <i>Europe.</i>		
Netherlands	3.8	125
England and Wales	5.7	120
Belgium	3.1	116
Austria	1.4	82