

AUGMENTING MILK SUPPLY THROUGH TONED MILK

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In most countries in the warmer regions of the world, the *per caput* consumption of milk is very low. For instance, in India it is less than 5 ounces (about 140 g) per day as compared to many times that quantity in some western countries. There are several reasons for this state of affairs, one of them being that the price of milk is high in relation to the earning capacity of the consumers. Whereas, for example, in New Zealand, Australia, Great Britain, the USA or Canada, it takes a manual worker only 8-12 minutes of his working time to earn sufficient to purchase a litre of milk, in India it would take him about 1 hour and 20 minutes. He is therefore unable to consume as much as a worker elsewhere. Indeed, in many instances, milk is a luxury purchase and unless something can be done to reduce its price substantially there is little hope of increasing its consumption.

The poor quality of the dairy cattle is the main difficulty. Scientific breeding, feeding and management on the one hand, and availability of cheap and plentiful fodder on the other, influence the cost and volume of milk production in any country. But in a number of warm countries these favourable conditions are absent, and in many others their development is a slow process.

It is generally observed, however, that where the yields are low, the milk contains rather a high proportion of fat. For instance, although approximately 28 million Indian buffaloes produce only about 2 lb. (0.9 kg) of milk per head per day (there are, of course, many breeds which produce 10 lb. (4.5 kg) and more per head per day), the fat content in the buffalo milk is very high and ranges from 7% to 8%. The content of solids-not-fat is also between 9% and 10%. For consumption as fluid such rich milk is not necessary.

A permanent solution might be to take advantage of the milk with a high fat content by blending it with cheap reconstituted skim milk, which would help not only to reduce the price considerably (and thereby to raise the consumption), but also to increase substantially the quantity of the blended

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product while still maintaining a good over-all quality. The making of such a product presents no difficulty, as will be seen from the description given below.

Fat can also be reduced, of course, by partial removal or standardization, but these methods lead to the problem of the disposal of the surplus fat, and the residual product is not as cheap as that obtained by blending the surplus fat with reconstituted skim milk powder.

Introduction of the New Product in Bombay

During the Second World War, the price of buffalo milk rose to be very high in the Bombay area. There was little that could be done about it, except through subsidization. A subsidized milk distribution scheme was introduced in 1944 for the benefit of women and children, but it was not possible to extend the scheme or to carry it on for any length of time. The Government Milk Scheme in Bombay therefore introduced in 1946 a new blended milk, which was called "toned milk". This led to a rapid increase in the quantity of milk available and lowered the price to the consumer by about half, while supplying a wholesome product.

A word of explanation is necessary as to why the product has been called toned milk. By merely adding water to whole buffalo milk both the fat and the solids-not-fat are reduced. But by adding skim milk to the mixture, the solids-not-fat is "toned up" to the original level in pure buffalo milk—that is, 9%. As the product was neither whole milk nor standardized milk, a new name, "toned milk", was given to it. Although this term was coined by the Bombay Milk Scheme, it has not been registered and all milk schemes throughout the world are free to use it—in fact, the term is now used freely in discussions and in technical papers in many parts of the world.

Preparation of Toned Milk

Only low-heat spray-dried skim-milk powder is recommended for reconstitution, as it has a higher solubility than the roller-dried product. Small quantities of toned milk can be made without the use of any mechanical mixing device, but for larger quantities mechanical mixing is necessary.

For small quantities, say, up to 200 gallons (roughly 900 litres) per hour, there is no need to use any mechanical mixing device. Here the method would be to line up 10-15 8-gallon (about 36.4-litre) milk cans in the dairy. After determining the average composition of the whole milk and of the product to be made, the further quantity of skim-milk powder and the whole milk required in each can of 8 gallons (or any other size) can be worked out. Clean potable water should then be poured into the can to the required level. This can be done with the help of a dip-stick. The quantity of skim-milk powder required for each can should then be weighed or measured out

and dumped into the can. With the help of a simple hand plunger (a perforated disk fitted to the end of a rod) the milk powder can be fully dissolved in the water within a few minutes, resulting in reconstituted skim milk. Whole buffalo milk of a known quality should then be poured into the can to a given level. The contents must be mixed again with the plunger. The product (toned milk) is then ready for distribution in a raw condition or for pasteurization. The entire bulk of 100-150 gallons (about 460-680 litres) can also be made in a vat or a tank, using a hand plunger. With this method, the composition of fat and solids-not-fat can be regulated to vary only by plus or minus 0.2 %, provided constant care is taken. Two or three operators can prepare about 200 gallons (900 litres) of toned milk per hour.

For larger quantities, mechanical mixing is recommended. There are several methods of reconstituting the powder with water, but at the Aarey Milk Colony (Bombay), the equipment consists of two simple circular stainless steel mixing vats with conical bottoms, of 1200 gallons (about 5500 litres) capacity each. These vats pass through the floor, projecting only about a foot above it, and at their sides are fixed two stainless steel hoppers, each of which holds 400 lb. (180 kg) of powder. The conical bottom of the tank is connected to a plate filter on the floor below, and from there the product is pumped to the balance tank of the pasteurizer.

For making 1000 gallons (4550 litres) of toned milk of 3 % fat and 9 % solids-not-fat content from buffalo milk of 7.5 % fat content, the mixing vat is filled with 560 gallons (2545 litres) of water from the municipal mains, through a meter. Alternatively, a calibrated dip-stick may be used. To this quantity of water is added 515 lb. (234 kg) of spray-dried skim-milk powder (medium heat), which is allowed to drop gradually into the water below. Powder is received in 56-lb. (25.4-kg) bags, and its handling and weighing is therefore easy. From the roof of the top floor, over the centre of each vat, hangs a Silverson mixer, which can be lowered or raised by a cable pulley. It takes about eight minutes to drop the powder gradually into the vat. Thereafter, 400 gallons (1818 litres) of whole buffalo milk (about 7.5 % fat content) are pumped in through a separate pipe, and the Silverson mixer is switched on again for about two minutes. The product is now ready for filtration and pasteurization, and its composition is 3 % fat and 9 % solids-not-fat.

The provision of two mixing vats permits the continuous preparation of toned milk, and in about nine hours the dairy is able to make 19 lots, each of 1000 gallons (4546 litres). The time schedule is such that between the actual preparation and consumption of toned milk there is a time-lag of approximately 12 hours.

Hygienic Control in Preparation of Toned Milk

In the preparation of toned milk all possible rules of hygiene must be observed. Cleaning and sterilizing of the plant must be to the same

standards as those which apply to milk processing plants. There are other factors, however, that have to be very carefully considered.

Firstly, the water used for powder reconstitution must naturally be free from harmful bacteria and, therefore, any doubtful water supply must not be used.

The powder used should be bacteriologically tested to ensure that it is free from dangerous bacteria; for example, streptococci, staphylococci, other pathogenic organisms. The powder should be of the best quality, fresh (not more than a year old), and free from taints or off-flavours; and its moisture content should not be more than 2.5%-3%. Any container in which any of the contents are caked should be discarded. (See chapter by Crossley, page 347; the American Dry Milk Institute, Inc. (1954, 1955) has prescribed standards.¹)

The method of storage of powder prior to use is extremely important. It should be kept in original containers and stored in rooms that have been properly constructed for hygienic storage; walls should be free from dampness and the room maintained at a moderate temperature.

The temperatures for the pasteurization of toned milk should be not less than that for pasteurized milk—that is to say, either pasteurizing at a temperature of 145°F (62.8°C) for 30 minutes and cooled down to at least 40°-42°F (4.5°-5.5°C), or at normal HTST temperatures which entail heating at not less than 161°F (71.5°C) for 15 seconds and cooling to 40°-42°F (4.5°-5.5°C).

It has been recognized for a number of years that there have been outbreaks of food poisoning in several countries when skim-milk or whole-milk powder have been reconstituted. In a number of instances these outbreaks have been traced to the presence of staphylococci and their toxins. In some cases staphylococci have been found in the original powder, and although these organisms may have been destroyed during the pasteurization process, the toxins of the staphylococci, being relatively heat-stable, were carried through to the end product, resulting in the outbreak of food poisoning. In other instances a mix has been allowed to stand overnight at a warm temperature, and may either have contained small numbers of staphylococci, or become contaminated after mixing, with the result that a rapid growth of this organism took place and on use the following day caused food poisoning (see chapter by Crossley, page 398-399). It is therefore recommended to follow normal processing procedures, such as pasteurization, immediately with any reconstituted mix or toned milk before distribution.

It cannot be too highly emphasized that the processing of toned and double-toned milk (see below) should be carried out with extreme hygienic care.

¹ American Dry Milk Institute, Inc. (1954) *Chicago Bull.*, 911; (1955) *Chicago Bull.*, 913.

Control Requirements

Since to the naked eye toned milk and whole milk look alike, and only laboratory tests can indicate the difference, it is necessary to prescribe safeguards in the sale of toned milk. This can best be done by ensuring that it is prepared and marketed only by authorized agencies, which must submit their returns regularly to the authorities. But more important than this is the insistence that the containers should be distinctively marked, and that the composition of the milk be clearly stated. Moreover, its price should be fixed by the authorities in relation to that of whole milk.

Progress of the Scheme

The figures below represent sales of toned milk in the Bombay area, through the Government Milk Scheme. They are evidence of how popular the product has been:

<i>Year</i>	<i>Gallons per day</i> ¹
1947-48	1 430
1951-52	5 040
1955-56	14 200
1960-61	20 200

Toned milk represents approximately 50 % of the total sales under the Bombay Milk Scheme, the other half being whole buffalo milk. It sells at Rs. 0.48² per litre against Rs. 0.96 per litre of whole buffalo milk, both being pasteurized and bottled, with colour-coded caps.

Double-Toned Milk

A UNICEF milk scheme at Bombay, called the Worli-Dairy Scheme, has provided machinery and dairy equipment not available in India and for which foreign exchange is scarce. This aid is to be "matched" by the State Government, which is to distribute, over a period of 5-7 years, free milk to children or low income group consumers equal in value to 1.5 times the UNICEF aid. For this purpose, UNICEF prefers to distribute low-fat-high-protein milk, which is comparatively less costly and yet very nutritious. This milk contains only 1.5 % fat but 10 % solids-not-fat and is prepared in the same way as toned milk, but of course with varying proportions of water, buffalo milk and skim-milk powder. In order not to increase its price, this "double-toned milk", as it called, is not bottled but poured from dippers out of cans into the vessels of the consumers. About 10 000 litres of double-toned milk have been distributed daily since 14 November 1959 to about an

¹ In litres, the range is between 6500 in 1947-48 and 92 000 in 1960-61.

² 1 rupee = 21 US cents.

equal number of families, from some 50 distribution centres in the Greater Bombay area. The scheme is to be expanded to cover about 100 000 families in due course. Because the milk is not bottled it is essential that in its preparation and in its distribution every hygienic care should be taken.

Possibilities of Expansion of the Scheme

A number of milk schemes in India are now based on the preparation of toned milk. It is realized that irrespective of the price of buffalo milk, by using imported cheap solids-not-fat in the form of skim-milk powder, the toned milk is cheaper and therefore more popular. Indeed, owing to the use of cheaper imported skim-milk powder, a rupee-worth of toned milk gives more food-value than a rupee-worth of whole milk (both unsubsidized).

In most of the Western countries there is not as much difference between the various classes in their capacity to purchase food as exists in India and in several other countries in the region of South-East Asia, where the income level of the people varies very considerably. One type or grade of milk is therefore not sufficient, and, as in the case of other food items and goods in general, consumers of milk must be allowed the choice of more than one grade of milk to suit their requirements. Toned milk therefore has a special appeal, as a much cheaper and yet wholesome product, to those who cannot afford or who do not need the expensive and rich buffalo milk. For those who cannot afford even toned milk (and there are many millions) double-toned milk is the answer.

The regulated and integrated use of toned milk in any distribution undertaking also has the possibility of alleviating seasonal or temporary shortages of milk. The summer conditions in warm countries and the severe winters in cold countries are not conducive to milk production, and the yield generally drops. If at that time larger supplies of toned milk could be made and put on the market, the effect of shortages could be minimized. In this connexion, it is interesting to note that for meeting emergency shortages of market milk, the South Australian Metropolitan Milk Supply Act was modified to permit an increase in the volume of available milk, through a "process of toning", with reconstituted skim-milk powder. It is now legal under the Act to use reconstituted skim milk and to blend it with whole cows' milk so that the product contains 3.8% fat and 9% solids-not-fat. Such milk is found to have a high consumer acceptability and has helped in solving the problem of providing cheap good-quality milk, even during periods of natural shortage.