THE POTENTIAL VALUE OF CULTURED DAIRY PRODUCTS FOR CHILD NUTRITION

Ernst J. Siegenthaler

The University of Michigan, Ann Arbor, Michigan, USA

SUMMARY

The author suggests that under certain conditions cultured milk, rather than fluid milk, can be used for infant and child nutrition as well as for school milk programs. Some of the major problems with fluid milk, fresh or reconstituted, are discussed. A review of the literature indicates that the assumption of lactose intolerance among many populations is exaggerated. Inappropriate handling of pasteurized milk very often is responsible for a high bacterial count and organoleptic defects. Such quality defects are more pronounced in countries with a warm climate. The use of polluted water in the reconstitution of milk powder, is probably more often responsible for diarrhea than lactose intolerance.

For these reasons it is suggested that under appropriate conditions a cultured milk product such as yogurt or quark, be used for infant and child nutrition. The advantages are: 1) the low pH caused by the high lactic acid content detrimentally affects food spoilage and pathogenic organisms in milk; 2) longer shelf life of the fermented product at ambient temperature; and 3) fermented milk products contain the enzyme lactase which facilitates digestion of residual lactose even after ingestion.

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1 Human Nutrition Program, School of Public Health, University of Michigan, M5170 Thomas Francis, Jr., Public Health Bldg., 1420 Washington Heights, Ann Arbor, Michigan 48109, USA.

INTRODUCTION

In considering milk as a component of children's diet, it is only appropriate to say a few words about breast-feeding, infant formulas and animal milk. "Milk plays such a dominant part in present-day infant feeding in Europe and North America, that it is difficult for anyone brought up in those parts of the world to realize that it is not a necessary foodstuff for any age group... Despite the danger of an excessively emotional attitude towards the use of animal milk in infant feeding, it must be clearly stated that it is, of course, an excellent source of protein of good biological value and is probably the best protein weaning food" (2). Kon (3) further states that local milk preparations (fermented milks) also can be usefully employed in infant feeding.

On the other hand, the importance and advantages of breast-feeding recently have received an increased emphasis. "Human milk is the natural food for the infant... In lower economic groups, breast-fed infants have a consistently lower mortality rate, probably because there is no problem of sanitation. As a rule, there are fewer and less serious illnesses and feeding problems among breast-fed infants; constipation also occurs less frequently. On a practical basis, breast-feeding eliminates preparation of a feeding; the milk is available at proper temperature; and errors in calculation and in formula preparation are avoided" (7).

If the mother, however, for whatever reason (lack of milk, illness, other pregnancy, etc.), is unable to provide the newborn baby with enough nutrients, then alternative sources of food are indispensable. In this case, an infant formula is an appropriate substitute. Nevertheless, it should be pointed out that with all our scientific and technical knowledge, it is probably not possible to manufacture a formula equal in quality to human milk, especially as regards to its immunological properties. And the better the product, the further it is economically beyond the reach of the majority of people in the Third World groups of low socioeconomic status. Moreover, the marketing and advertising of mother-milk substitutes by multi-national corporations has caused great concern in the international nutrition communities.

Delegates from about 150 nations met in Geneva, in May 1981, to discuss guidelines on infant formulas. The conference was called because of complaints from various groups that breast-feeding in poverty stricken areas is being deterred by the selling of infant formulas with allegedly aggressive and misleading promo-

tional tactics. It is beyond the scope of this paper to discuss nutritional, legal, and ethical ramifications of formulas, but it seems only logical and natural not to impose a formula on any mother who is able to breastfeed her baby. It makes much more sense to use the limited financial resources to improve the nutritional status of the lactating woman so she can do what is most natural. (As a matter of interest, it might be pointed out that Papua, New Guinea, began to control the sale of infant formulas by passing legislation which requires a prescription from a pediatrician to buy either nipples or baby bottles.) After weaning and up to the first year in school, properly prepared milk and milk products supply balanced and valuable nutrients.

The fact that most Third World countries are in tropical and sub-tropical climatic zones contributes to problems which are not easily solved. The high ambient temperature is only one of the aggravating factors. Others are the hygienic conditions in production and handling methods. All these points must be considered in recommendations for an increased use of milk.

PROBLEMS WITH MILK

Lactose Intolerance

In food supplementation programs to Third World countries, objections are often raised to milk and milk-containing foods because some sources report a high incidence of lactose intolerance, particularly in non-Caucasian ethnic groups. This is a very complex problem, but investigators generaly agree on one aspect. If children do not receive milk after weaning, they gradually lose the capability to produce lactase, the enzyme which hydrolyzes lactose (the carbohydrate of milk) into glucose and galactose. If, at a later stage, they are again fed milk, an excessive amount of unhydrolyzed lactose reaches the lower intestinal tract. Here the lactose is used as a nutrient by the colon bacteria, producing carbon dioxide, which in turn leads to flatulence, eructations, abdominal pain and diarrhea. These signs and symptoms may increase as a child grows older.

A review paper by Torun, *et al.* (11) summarizes the problems. These authors base their conclusion on their own clinical experience at the Institute of Nutrition of Central America and Panama (INCAP), and on their review of 195 research papers on the subject. The review paper shows that the high proportion of lactose intolerance reported in very different societies is partly due

to the fact that most researchers have used aqueous solutions of lactose in their experiments, and few studies have been reported which actually used milk. The test dose of lactose should be mixed with other nutrients, particularly protein and fat, both of which are found in milk. The pertinent conclusions are: "The poor correlation between lactose malabsorption and intolerance to the amount of milk ordinarily ingested in a meal, indicates that the assumption of milk intolerance among many populations is exaggerated. ...Milk-fed children from population groups with a high prevalence of lactose malabsorption grow well or better than their non-milk consuming counter parts. ...The use of cow's milk should not be discouraged in the treatment of malnourished children unless cheaper, practical sources of high-quality protein are available. When the recipients are undernourished children, other foods must accompany the milk or other ingredients must be added to it. ...Many malnourished children regain their ability to tolerate lactose with protein re-feeding."

Handling of Pasteurized Milk

Too many consumers still do not realize that pasteurized milk is not sterile and some of the microorganisms in this milk can grow even at refrigerator temperature. This is the reason that there are problems with the shelf life of pasteurized milk, even in highly developed countries in the temperate and cool zones where they have a closed cooling chain, from the producer to the consumer, including home refrigerators for the latter. Published research (9) has shown that the storage life of pasteurized milk kept at a temperature not higher than 2°C remains generally good for ten days or even longer. If the same milk is kept at an only slightly higher temperature, 6°C, it is spoiled due to the growth of microorganisms which may reach millions per milliliter. In warm climates it is virtually impossible to prevent milk from warming up close to ambient temperature.

A few years ago, the quality of school milk in the State of New York was judged (12). Of 693 samples, 80% or 554, showed flavor and taste defects due to lack of proper refrigeration. Other investigators (5) confirmed similar conditions in other parts of the country. If a country with relatively strict and enforced food legislation has such problems with pasteurized milk, is it not to be expected that under semi-tropical and tropical conditions the situation with pasteurized milk must be worse? For this reason the

trend is towards ultra-high temperature treatment (sterilization) of the milk so that it need not be kept under refrigeration. Obviously this milk is more expensive, but in warm climates it is the only solution for marketing a fluid milk with a satisfactory shelf life under the given conditions.

Reconstitution of Milk Powder

One of the most difficult problems in the handling of food in many Third World countries is the quality of the water. Clean well water is a rarity. Rain water collected from the roofs is normally contaminated with bird droppings, and in surface water there are additional sources of contamination. (On an assignment in a tropical country we visited a number of villages in the same river valley to observe the reconstitution of milk in schools. In all of them we were informed by the local teachers, "No milk for the children today; the river is too dirty.") People have been using contaminated water as a matter of course; the older people have built up a resistance, and its effects on the younger people are partially responsible for the high child morbidity and mortality rates.

Reconstituted milk is not only an excellent source of nutrients for humans but also for microorganisms, and the ambient temperature in warm climates is usually that of an incubator. A time lapse of a few hours leads to such an increase of the microflora that the milk is intolerable even to those who are used to drinking the contaminated water. Hard-to-clean vessels of various materials, shapes and sizes, generally without lids, together with the lack of knowledge of the most elementary hygienic principles are further contributing factors to the problem. All this is probably more often responsible for diarrhea after consumption of reconstituted milk than lactose intolerance.

FERMENTED MILK: A POSSIBLE SOLUTION TO THE PROBLEMS

During the first months of the infant's life, human milk is the best source of nourishment. When the energy needs of the baby begin to exceed those which can be provided by breast-feeding, an alternate source of food is required. This is more easily recommended than carried out among low income groups of the Third World. Jelliffe (2) discusses there problems in a WHO monograph.

Fermented milks have several advantages over either pasteur-

ized fresh milk or reconstituted milk, both of which have problems that were discussed earlier. First, fermented milk is particularly valuable nutritionally because it not only is made from one of the most complete foods known, but in addition, it contains a variety of metabolites which are more easily digestible than the original milk constituents (1). Moreover, it has been estimated (4) that microorganisms constitute about one per cent of the cell mass of yogurt, and this bacterial protein is a rich source of essential amino acids.

Second, during the lactic acid fermentation, 30 to 50% of the lactose in the milk is hydrolyzed into glucose and galactose (in certain cheese it is 100%). Lactase, the enzyme which is synthesized by the living lactobacilli, is responsible for this breakdown of milk sugar. Since enzymes, after the alteration of their specific substrate, return to their original condition, they are free to catalyze still further chemical changes. After ingestion of the fermented product, the hydrolyzation process of lactose continues in the intestinal tract. This explains why many lactose sensitive people can tolerate sour milk products without detrimental aftereffects, but cannot tolerate fresh milk.

Third, the shelf life of fermented milk is much longer than that of fresh milk. Extended storage at an elevated temperature leads to more acid production and finally to contraction of the gel and wheying-off (separation of liquid). The product is perfectly edible but it has lost some of its consumer appeal. In fact, the separation is easily taken care of by stirring the product. The other point to mention here concerns pathogenic microorganisms in cultured milks. From Speck's review paper (10), we can conclude that in the fermentation process, besides lactic acid, there are a number of bacterial antibiotics and inhibitors produced (nisin, diplococcin, acidophilin, lactocidin, lactolin, etc.), and they have a detrimental effect on pathogens. Indeed, the great majority of the pathogens are eliminated. While some do survive, a *raw* milk is safer after fermentation, even if there is no guarantee of complete elimination of pathogens. To accomplish complete elimination, commercially cultured milk products are always made from heated milk. This is a factor to be considered in any dairy development project, particularly when such fermented products are used in child nutrition or school milk programs.

Products to be Considered

What kind of fermented milk products could fill a need in

child nutrition and school milk programs? What are the options? Almost every country where animals are kept for milk production has its own specific fermented milk. It is amazing how many cultured milk products originated, most of them accidentally, in the course of the centuries. A few examples of fermented milks with practically the same moisture content as milk are: Yogurt (Bulgaria), Mazun (Armenia), Kefir (Turkey), Kumys (Russia), Dahi (India), and Leben (Middle East). White cheeses, with a relatively high moisture content are equally widespread: Chhena in India, Jibbneh among the Bedouins, Feta in the Balkans, Mascarpone, Petit Suisse, Neufchatel, and Quark mainly in European countries, and close to a dozen varieties of Queso blanco in Latin America. All of them have in common that lactobacilli, originally in the milk or added, play the dominant role. They are easy to produce under household conditions, are low in cost, have significant nutritional value and an acceptable taste. Some of these products can be kept at ambient temperatures for days or even weeks. While numerous local varieties could be recommended, the discussion in this paper is limited, for simplicity, to only two products: Yogurt and Quark.

Yogurt. Old fashioned yogurt, widely used all over the world, meets most of the requirements and is perfectly suitable for infant nutrition. For Latin America, it is interesting to note that one of the first industrial production of yogurt was undertaken by a Spaniard, Danone, in Madrid in 1922 (6).

To make yogurt more palatable and to introduce variety, all kinds of fruits, jams, jellies and syrups can be mixed into it. With respect to sweetening the yogurt, however, a word of caution is appropriate. Not only children, but many adults as well, like sweet foods. This has sometimes resulted in the addition of so much sugar to yogurt-type products that they are more closely related to "junk food", than to the nutritionally beneficial and valuable cultured milks. Experience has shown that children who receive unsweetened yogurt at a very early age, like it and eat it unsweetened at a later age, while others, already accustomed to sugar, refuse it. Many sour milks containing fruit do taste better with some sugar, but one should not begin the sugar habit at the infant age.

Quark. Quark is a fresh, white, high-moisture cheese. It is made from skim milk, whole milk or even milk to which cream has been added. Coagulation of the milk is induced with a lactic acid starter and a little rennet. After the lapse of a few hours, the curd

is carefully broken up with a fork-like instrument or often by hand, slightly heated and then placed in cloth bags for draining until the desired moisture content is achieved. This takes 8 to 12 hours. To speed up whey separation, pressure is sometimes applied. Quark does not show the popcorn-like curd particles of the American type cottage cheese; quark curd is emulsified. Contrary to commercial cheeses of this type, quark does not contain stabilizers, which, in turn, results in some water leakage during storage. After draining, the cheese is ready for consumption with or without the addition of salt. Detailed information on its manufacture is presented by Wuethrich (13). The same brochure also discusses the preparation of yogurt. Quark can be flavored in the same way as yogurt. Schulz (8) compiled dozens of recipes of quark-based dishes and appetizers, many of them well suited for infants and children.

A commercial operation can very well produce two varieties of quark: one from skim milk, and another from cream-enriched milk. The sales price is then mainly determined by the butterfat content of the products. This makes it possible to offer a high-protein, low-fat food at a very reasonable price to the groups of people who need it most.

Sale of these products. Presenting yogurt and quark for sale is somewhat of a problem in many Third World countries. There is no use in making a nutritionally valuable, safe and price-worthy food if it becomes contaminated between the manufacturer and the consumer. One possibility is to portion out the product at the sales outlet directly into vessels brought by the customers. While custard-like yogurt is normally sold in cups, a stirred yogurt and quark can be sold in plastic bags. The basic requirements are a packaging material which (a) protects the food, and, (b) is inexpensive.

RESUMEN

EL VALOR POTENCIAL DE PRODUCTOS LECHEROS CULTIVADOS EN LA NUTRICION INFANTIL

El autor sugiere que, bajo ciertas condiciones, la leche cultivada puede usarse en la nutrición infantil y de niños más bien que la leche líquida. Se comentan algunos de los principales problemas que presenta esta última, ya sea

fresca o reconstituida. Una revisión de la literatura sobre el tema indica que la suposición generalizada de intolerancia a la lactosa que priva en muchas poblaciones es un tanto exagerada, ya que el manejo inadecuado de la leche pasteurizada, muy a menudo es el factor responsable de los altos recuentos de bacterias y defectos organolépticos que ésta presenta. Los defectos cualitativos en cuestión son más pronunciados en aquellos países con clima cálido, siendo probable que la mayoría de las veces, el uso de agua contaminada en la reconstitución de la leche en polvo sea el responsable de la diarrea y de la intolerancia a la lactosa.

Por las razones expuestas, se sugiere la utilización de un producto de leche cultivada tal como el yogurt o el "quark", bajo condiciones apropiadas, cuyas ventajas son las siguientes: 1) Tiene un bajo pH causado por el alto contenido de ácido láctico, el cual tiene efectos adversos al deterioro del alimento y de los organismos patógenos de la leche. 2) La vida de anaquel del producto fermentado a temperatura ambiente es más larga. 3) Los productos elaborados con leche fermentada contienen la enzima lactasa, y ésta facilita la digestión de la lactosa residual, aun después de ingerida.

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