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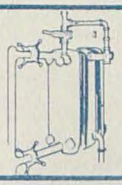
# MINNESOTA DAIRY PRODUCTS PROCESSOR





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The lastest USDA Nationwide Food Consumption Survey indicates dramatic changes in infant nutrition between 1965 and 1977. While the data have not been finally evaluated, clear trends strongly suggest some marked improvement in the simulation of mother's milk.

## WHAT HAPPENED

Protein and calcium intake of infants dropped 40 percent between 1965 and 1977. Fat level went down 45 percent and food energy 34 percent. Iron intake was up, however, to more than twice the amount consumed in 1965. Not all but some of these changes reflect use of infant formulas more nearly like human milk in nutrient make-up. This appears to be especially true for protein and calcium.

## PROTEIN AND CALCIUM

Human milk differs from cow milk in a number of ways. Of special note, protein content runs considerably lower at just over one percent; cow milk averages nearly 3.3 percent protein. Level of minerals, of which calcium is a part, likewise is lower in human than cow milk (0.2 percent compared with 0.7 percent). In calcium content specifically, human milk averages about 32 mg and cow milk 119 mg per 100 grams of fluid product. Averages, of course, are deceiving, with wide individual variations. Nonetheless, a formula prepared to substitute more perfectly for human milk would average one third the amount of protein and calcium found in cow milk.

But there are also qualitative differences in protein. Human milk protein consists of 60 percent globulin/albumin (whey proteins) and 40 percent casein. For cow milk, those percentages are 80 and 20 respectively. Thus, amino acid content differs, with relatively less methionine and relatively more cystine in human milk. A formula that more closely follows human milk in cystine content places less stress on the liver, especially in premature infants. And for this reason whey proteins of cow milk, lactalbumin particularly, find value -- importantly so -- in infant formula preparations. Also for this reason, lower levels of protein than those naturally occurring in cow milk serve better the needs of infants. Soy formulations usually contain more protein than cow milk formulations to compensate for somewhat poorer biological value.

## MINERALS

The need to reduce overall mineral content of cow milk ingredients used in infant formulas is likewise important. Some amount of minerals are, of course, necessary as nutrients, but excessive quantities stress the immature kidneys. High levels of minerals can in fact cause death.

This is why cow milk, as such, is not a good substitute for human milk. This is why improper (too strong) dilution of dry formula is a serious health hazard.

Yet the need to lower mineral content of natural milk or milk products (like whey) must be tempered by an equally important need to provide adequate amounts of minerals. Sodium, potassium, and chloride, for example, must be present in proper amounts to maintain an appropriate balance of electrolytes (which serve essential physiological functions). Lack of chloride in itself may cause alcolosis, a state in which blood or tissue fluids rise to abnormally high pH levels. The body becomes too alkaline.

Both human milk and cow milk lack iron. Iron deficiency anemia is one of the most common infant diseases in the U.S. But the iron in human milk is bound to protein, which makes it readily available. Breast milk alone can serve an infant's need for iron through perhaps three months of age. Formulas often come fortified with iron, and a number of new technologies or forms of this mineral guarantee good availability. The fact that intake of iron is up in U.S. infants perhaps reflects that fact, at least in part. But it also likely means that more infants are being fed iron-fortified formula. Solid food (containing iron) is perhaps being started at an earlier age, and iron supplements are also being given. Taken together, more iron--much more--is finding its way into the infant diet. Note, however, that it is possible to overfeed iron, with intestinal disorders a potential risk.

LACTOSE

Lactose and minerals are the most constant components of milk. But cow milk and human milk are not alike in lactose content. Where the former runs perhaps 4.7 percent on an average, the latter approaches 7.0 percent, one of the highest among all mammalian species. Yet lactose is not a required ingredient of infant formula and is often replaced with corn syrup solids. Both carbohydrate sources share glucose as a common component. And while at first glance it might appear necessary to raise lactose levels in formulas prepared of dairy ingredients, most such ingredients range so high in lactose content (whey products, as example) that the process actually calls for technologies capable of lowering the level of lactose.

FAT

There are both quantitative and qualitative differences in fat of human and cow milk. On an average, human milk contains 4.4 percent fat, cow milk 3.7 percent fat. Obviously, very wide variations occur among individuals. Human milk is known to vary in composition from time to time throughout the same day. It even varies from one breast to the other. And first milk runs relatively lower in fat level than last milk withdrawn.

Fatty acid composition varies between human milk and the milk source most often used as a substitute. Of note, cow milk contains more short chain fatty acids. Human milk runs higher in oleic (a monounsaturated fatty acid). It is about equal in saturated and unsaturated fatty acids. Ratio in cow milk approximates 65:35, respectively. However, vegetable fats more often than not serve as sources of fat in infant formulas; differences between cow and human milkfat become moot issues.

As for the apparent reduction in fat (and energy) intake in infants in recent years, a number of factors may have been at work. On formula, infant obesity can be a problem. A mother can overfeed. No doubt better precautions are now being taken. At the same time, it is more than likely that infant formula is now being formulated with less fat than in years past, and for the above reason.

## IMPACT OF NEW TECHNOLOGIES

If infant formula now more closely resembles human milk, thanks no doubt must go to a number of relatively new technologies. Count among the more important ones (1) electrodialysis, (2) ion exchange, (3) ultrafiltration, and (4) gel filtration. These processes may be applied to milk as such; more often they are used to modify whey, an excellent source of formula ingredients. Ultrafiltration concentrates the product; it also allows some reduction in lactose and minerals. Electrodialysis can rid whey of as much as 90 percent of its mineral matter. Lactose can be removed by crystallization. Combined, electrodialysis and lactose crystallization provide an end product high in whey protein content, and low in minerals and lactose. To go one step further, whey proteins can be separated into albumin and globulin fractions by gel filtration. Immune globulins and other immune factors also can be segregated.

## IMMUNE FACTORS

A number of substances in human milk provide a form of passive immunity. They are most important to the infant during the first few days or months of life. Thereafter, the infant's body itself must take primary responsibility for generating immune responses. Identification of immune factors continues with greater emphasis these days. Thus far, human milk has been found to contain immunoglobulins ($I_gA$, $I_gM$, $I_gG$), lactoferrin, lymphocytes, interferons, macrophages, and leucocytes. Another agent, called the bifidus factor, provides for growth of *Lactobacillus bifidus* in the infant's intestines, where this organism competes favorably with less desirable, even disease-producing bacteria, and mainly through lowering of the pH. *Lactobacillus acidophilus* can do much the same and may one day find its way into infant formula. Many of the above immune factors will no doubt become a standard part of the ingredients of infant formula. Some now find such use. As a matter of perspective, however, no immune factor is as important as proper kinds and amounts of nutrients, if a choice must be made.

## THE MEANING

Infant formula can be made with more nearly the composition of human milk. It will be better formulated in the future, with both nutritional and certain immune requirements being met. Products now on the market already achieve many of the needs, as the latest USDA survey seems to confirm.

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