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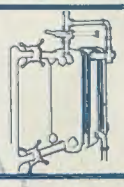
MINNESOTA DAIRY PRODUCTS PROCESSOR



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We've been studying the literature on mother's milk the past several months, trying to get a handle on those factors that make it unique. Knowing these, one can possibly consider ways of improving formula. And possibly the greatest potential lies in methods of building into infant formula a higher level of immune potency.

TWO KINDS OF IMMUNE PROCESSES

Immunity to disease is either active or passive. Active immunity is the process by which the human body activates or forms disease-fighting immune agents. You get over a cold or strep throat because your own body defenses, mobilized to the task, kill off the invading virus or bacteria. The system is a wondrous, highly specialized one, working at all times in the adult human body. Infants, though, especially the newborn, are not geared up quite so well. Their immune system is weak and impotent. And, of course, they are vulnerable to disease during those days and weeks during which they gather strength. For this reason, they need help. And help is as close as mother's milk, which contains a number of immune factors. But this type of defense, not of the infant's own making, is termed passive. And it can be delivered either by the mother through her milk supply, or by an infant formula formulated to contain one or more of the same immune agents.

IMMUNE AGENTS OF MOTHER'S MILK

A number of components of human milk have been identified as having some kind of immune potency. Lysozyme is perhaps the most well known. It is a protein, an enzyme, with ability to break down (lyse) certain bacterial cells. Eggs contain lysozyme, but it is not as potent as the lysozyme of mother's milk or cow's milk--at least not as a disease fighter for the human infant.

Then there are a variety of immunoglobulins, abbreviated Ig. They differ, one from the other, and thus are designated by the same abbreviation, but with a letter following; i.e., IgA, IgG, IgM, etc. Call them antibodies, if you will. They are protein in nature, and they are found in largest concentrations in colostrum (first) milk. Presence of immunoglobulins is one of the major reasons for the very high protein content of colostrum milk.

Lactoferrin and transferrin are two milk proteins with the ability to tie up iron. In so doing, iron is withheld from certain germs, E. coli for one. Without iron, the germs are unable to metabolize; they die off.

In addition to the above, human milk also contains a large number of body cells, like the white blood cells of cow's milk. There are several different types present in the milk, and most of them appear to play a role in defense against infant disease. Many of this type simply wrap themselves around various germs and literally consume them whole. Some are more or less specialized in the particular diseases they are able to thwart.

There are other factors in mother's milk that have immune potency. No doubt still more will yet be discovered. For now, though, let's focus on the immunoglobulins. And the question is this: Can infant formula be prepared containing immunoglobulins with specificity for attacking human diseases? The answer is yes, and the mechanism by which it is done revives and verifies the concepts stated years ago by a visionary dairy scientist. Many of you will remember him: Dr. William E. Petersen ("Doc Pete") of the Department of Dairy Husbandry of the University of Minnesota.

MAKING COWS PRODUCE "HUMAN" ANTIBODIES

As early as 1955, Doc Pete was suggesting that the cow's udder ought to be considered a specialized gland with the ability to produce antibodies active against viral and bacterial diseases. In later years, he was active in inducing cows to produce a variety of immune factors. At question, though, was whether or not such antibodies could pass through the human stomach and into the body, there to perform their cure. Where infants were concerned, however, there would be no need for such transfer. That is, the immune presence could serve an infant's needs primarily inside the stomach and intestines--if it could survive the acids and digestive enzymes. No longer is there doubt in this matter. Not only can cows be induced to produce specialized antibodies against infant disease, but research proves that such antibodies do survive and do carry out their disease-prevention function in human infants per se.

HOW IT IS DONE

The concept is simple and straightforward, though the science is relatively complex. What you do is "immunize" cows during pregnancy. Suppose you want to produce antibodies against several different strains of disease-causing E. coli (one of the most common causes of infant diarrhea). You prepare a "vaccine" from the organisms and then inject it into cows during pregnancy. The cows respond by producing highly specific antibodies (immunoglobulins)--the very kinds of antibodies a mother might produce in her own milk. These immune agents show up in the milk when the cow(s) freshens. But they are present in sizeable amounts only in colostrum milk, the milk produced during the first five or six days following calving.

In an elegant series of researches, Nestle and collaborating scientists have proven beyond reasonable doubt that these antibodies are specific for the disease agents against which the cows are immunized. They function precisely as "human" antibodies even to the point where the antibodies actually break down defenses of E. coli to attack by body cells. This process is called opsonization and is one of several steps in "proving" specificity of the antibodies. But of course the final word is whether or not the antibodies inhibit disease. They do. They do so in test-tube experiments. They do so in feeding trials of mice. They have done so in clinical trials of human infants suffering intestinal distress.

GETTING THE ANTIBODIES OUT OF MILK

Immunoglobulins are protein. They are sensitive, therefore, to harsh conditions of extraction or processing. Thus, new technologies--gentle processes--could only have made it possible to extract them from milk in their native state. You start by separating skim milk from cream. The immune compounds are in the skim milk. Casein is removed using rennin and acid at pH 4.6, followed by centrifugation. The casein is literally spun out of suspension. The leftover liquid, as in cheesemaking, contains whey proteins, among them the immunoglobulins. The liquid is clarified by both centrifuge and filtration. Then comes the new technologies for treating whey. Somehow the immune proteins must be separated from lactose and minerals. This is done by ultrafiltration and diafiltration (both processes of reverse osmosis). At this point, then, the liquid is sterilized, not by heat, which would destroy the antibodies, but by filtration. And finally the water is removed by freeze-drying under sterile conditions. You end up with a powder that contains about 40 percent highly active, highly specific, disease-fighting immunoglobulins.

It's neat, it works, and it holds great promise for bottle-fed infants. And we thank you, Doc Pete et al.

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