Milk Protein Research Reveals Potential

NEWARK, Del. — A few years ago, here at the University of Delaware, we conducted a research project on the protein composition of milk and its relationship to blood type in Guernsey and Holstein dairy cattle.

We identified the distribution of the many different proteins in milk among genetically different cow families and found relationships useful for selection.

The study, which would not have happened without the foresight of dairy industry leaders such as Dr. James Deubler, Newtown, Atherton Hobler, of Princeton, N.J., Frank Brown of Port Deposit, Md. and Harry Haskell, of Chadds Ford was conducted cooperatively between the Delaware, Ohio and New Jersey experiment stations.

Now, new research in Canada and Europe has found that these different protein types in milk influence the making of cheese, which has immediate commercial interest.

Overall, we can recognize at least four major milk protein families that make cheese, including Alpha-s-1-casein, alpha-s-2-casein, beta-casein, kappa-casein; and at least four major milk protein families that do not make cheese-beta-lactoglobulin, alpha-lactalbumin, immunoglobulin, serum albumin, which remain in the whey on cheese making, unless a whey cheese, such as ricotta, gjetost or mizithra, is made.

Each of these protein families, except the last two, are subdivided into at least two and as many as six genetic variants and their combinations.

These are based on small but significant differences in their amino acid composition, which cause them to behave differently on contact with digestive enzymes in the gastro-intestinal tract as well as under cheese-making conditions with the rennet enzyme.

Kappa-casein, for example, has the genetic variants A, B, C and E; therefore, cows or goats or sheep can have in their milk the following 10 protein genotypes: AA, AB, AC, AE, BB, BC, BE, CC, CE. These genotypes are actually found in the various cattle breeds and families in different frequency.

Among these 10 types, the BB seems to have specific commercial value. When eight European dairy cattle breeds were tested, it was discovered that they differ significantly in the BB type: French Normandy, 44 percent; Jersey, 38 percent; Brown Swiss, 28 percent; Tyrolian, 23 percent; Gelbvieh, 23 percent; Danish, 11 percent; Simmental, 6 percent; and Holstein, 2 percent.

The type AA was distributed with opposite frequency among these breeds. This is commercially interesting, because milk not only has differences in fat, protein, lactose, mineral contents, but varies in the percentage of casein in total protein, which determines how many pounds of cheese are possible form 100 pounds of milk. Furthermore, during cheese making, significant factors include the time it takes to precipitate the casein, the time it takes to firm the curd, the degree of curd firmness and the overall yield.

It has been determined that the kappa-casein BB cows, as compared to AA, have milk that has a 24 percent shorter cheese precipitation time, 51 percent shorter curd firming time, 85 percent better curd firmness, 0.2 percent units higher casein content and 5 percent higher cheese yield. The other types of C and E also are inferior to BB.

It has also been found that beta-lactoglobulin BB cows have 3 percent more casein in their milk and a higher cheese yield compared to AA type cows, thus making beta-lactoglobulin as interesting for cheese making as kappa-casein.

Again, the distribution for these BB types among European dairy cattle breeds differs significantly: Danish, 74 percent; Jersey, 40 percent; Holstein, 35 percent; Brown Swiss, 34 percent; Gelbvieh, 31 percent; French Normandy, 27 percent; and Simmental, 26 percent. The other milk protein families and their genetic types are still waiting for research to be better understood.

There is some discussion under way to include these genetic types in herd sire-selection programs and in milk payment plans. But routine rapid testing methods need to be developed first. Meanwhile, it is because of these long-year studies, including the one here at the University of Delaware, that we now have milk payment and sire proofs that include protein or solids-not-fat and somatic cell counts. These factors have served as a reward and incentive for dairy farmers to select in a specific direction, which also benefits processors and consumers through a better product.

The combination of protein and somatic cell count is especially important, because with low somatic cell count, the cheese yield is higher than it is from the same milk, when the somatic cell count is high. Paying critical attention to the types, not just the amount of protein in milk, means differences in profitability for the cheese maker and, ultimately, for the dairy farmer.