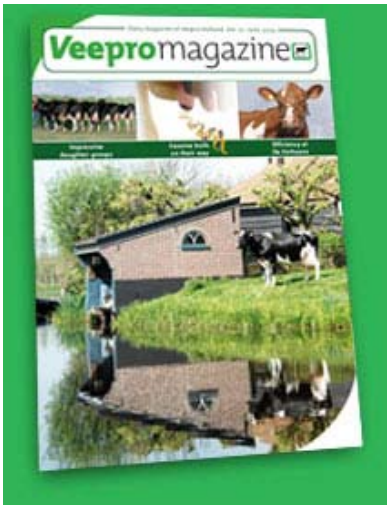

Casein and healthy fat bulls

A new denotation for proven bulls is in the pipeline. They will receive the label casein bull or unsaturated fatty acid bull. This is thanks to research conducted by the Dutch Milk Genomics Initiative. The dairy industry can start working with the results today.

For some time already it has been known that the fat and protein component in milk varies from one cow to the next. Milk fat is made up of a large number of fatty acids. Milk protein consists of a large number of proteins with the largest portion of milk protein (90%) being formed by the caseins and the whey proteins α-lactalbumin and β-lacto globulin. Research in Wageningen has determined that not only the components, but also the composition of the milk fat and milk protein varies from one cow to the next. An important part can be attributed to the differences in genetic make-up. By using specific bulls, the composition of milk fat and milk protein can be influenced. Modern genetics makes it possible to detect such bulls quickly. When farmers use these bulls, they will get cows that give milk which is extremely suitable for cheese production or for dairy products with a modified fat composition. The Dutch Milk Genomics Initiative (see textbox) has conducted scientific research on this subject. "An impressive piece of work," was the compliment which professor Van Arendonk received from colleagues throughout the world. In the area of the genetic 'steering' of milk composition, the Netherlands is regarded as a global leader. But also with regard to the selection of bulls and cows on the basis of genetic markers, the Netherlands is internationally on the leading edge.

Accurate genotyping is part of the work

In practice

Research on the composition of milk has now provided the first results that can be used in practice. Breeding organizations and the dairy processing industry can start using this knowledge already today. Professor Van Arendonk expects that is exactly what will happen. How the dairy processing industry is going to stimulate the production of the specific milk is of vital importance. This could be done, for example, via a higher milk price or via differentiation. In the latter case, farmers in a certain area will exclusively produce milk for a particular product, such as cheese. 'That can result in significant advantages. However, it is very important that in such a case the financial benefits will be fairly divided among the members of the dairy cooperative.' The professor thinks that this can happen quickly, possibly within a year or two. For the near future, the Milk Genomics Initiative will be primarily focussed on how this has to be translated into practice. In addition, the Initiative will continue researching other genes that have an influence on the composition of milk fat and milk protein.
From the current offering of sires, researchers can already indicate which bulls have certain specific traits for milk composition. This will translate into indexes for bulls, where besides milk

production, type and the functional traits, there will also be a designation for milk composition. For example, bull A provides additional casein in the milk, and bull B provides daughters with a greater portion of unsaturated fat in the milk. The researchers call this, concisely: Milk made to order. By the way, the ratio of different fatty acids in the milk can be easily measured, at low cost, at the same time as the fat and protein component is determined.

Composition of fat

By analysing the milk of approximately 2,000 cows, originating from about 400 dairy farms, the researchers have discovered that there is a large variation in the composition of fat. Milk fat consists of saturated fatty acids and of – healthy – unsaturated fatty acids. A significant part of the differences can be explained by the genetics of the cows. The genetic ability factor for fatty acids varies from 23 to 70 percent. Another important component that has a big influence on the fat composition is nutrition.

The fat composition and the ratio of saturated and (single and multiple) unsaturated fatty acids have an influence on human health. It is desirable to produce a milk fat with higher levels of unsaturated fatty acids. The research in Wageningen has identified two genes that exert a lot of influence on the portion of unsaturated fatty acids. It involves the DGAT1 gene and the SCD1 gene. SCD1 is involved with the conversion in the udder of saturated fat into unsaturated fat. Cows with a certain DAGT1 genotype have seven percent more unsaturated fatty acids in their milk. A disadvantage is that this DAGT1 genotype gives a significantly lower total fat component in the milk.

Researchers have calculated that via sire selection, the portion of unsaturated fatty acids in the milk can be increased by 10 percent in the next ten years. With nutrition, another, even greater jump can be made: a plus of 20 percent, so that in total a progress of 30 percent can be obtained. That is significant. All the more because during the last number of years there has been a shift towards the more unhealthy saturated fats. During the period from 1992 to 2005, they increased from 68.2 to 70.6 percent. Whether that is caused by different nutrition or by a different genetic composition of the cattle population (a lot more Holstein blood) is unknown. Together, genetics and nutrition can reduce that portion of saturated fat.

Milk genomics

Wageningen University, the Dutch Dairy Association NZO, and the breeding organization CRV have started the Milk Genomics Initiative in 2004, with the goal of expanding knowledge in the area of milk composition and applying this knowledge in the dairy processing chain. It is under the leadership of dr.ir. Johan van Arendonk, professor Animal Breeding and Genetics. Toon van Hooijdonk, professor of Dairy Processing Science, and his group are also closely involved in the project. There are currently 11 researchers connected to the project. The total budget is approximately 4.5 million Euro and is partly supported by contributions from government departments and the dairy industry. Until now, it has resulted in 11 scientific publications, while there are still another seven 'in the pipeline'. In the meantime, with additional funding, the project has been extended to also include research into minerals in the milk and the implementation of these findings into the milk production chain.

Beta lacto globulin

With milk protein something similar is possible. For cheese production the favourable B variant of the protein Beta lacto globulin still appeared in 58% of the cow milk in 1989. By 2005 that portion had dropped to 42%.

Beta lacto globulin variant B gives more casein in the milk. The portion of caseins in the milk can be increased through breeding. In contrast to milk fat, nutrition has very little influence on the protein composition. It is especially the genetic ability that explains differences between cows. Milk protein consists for more than three-quarters (on average 78%) of caseins. Through breeding – the use of specific bulls that transmit the favourable B variant of the protein Beta lacto globulin – that portion can be increased by more than 2 percent. This may seem insignificant, but it is not. More caseins in the milk means more cheese from the same volume of milk, or the same amount of cheese from less milk. The researchers have carefully translated that in a currency value. More than half of the Dutch milk goes into the cheese vat. For the dairy sector, the additional 2 percent means an annual profit of 25 million Euro, or more than 1,000 Euro extra income from the milk per farmer. The condition is that farmers use bulls with that gene for the favourable variants of the protein Beta lacto globulin. 'There are many of those, also among the top bulls,' says Johan van Arendonk. He cannot mention names, but

that will become clear in the near future when bulls will receive a denotation for healthy fats and for cheese proteins.

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