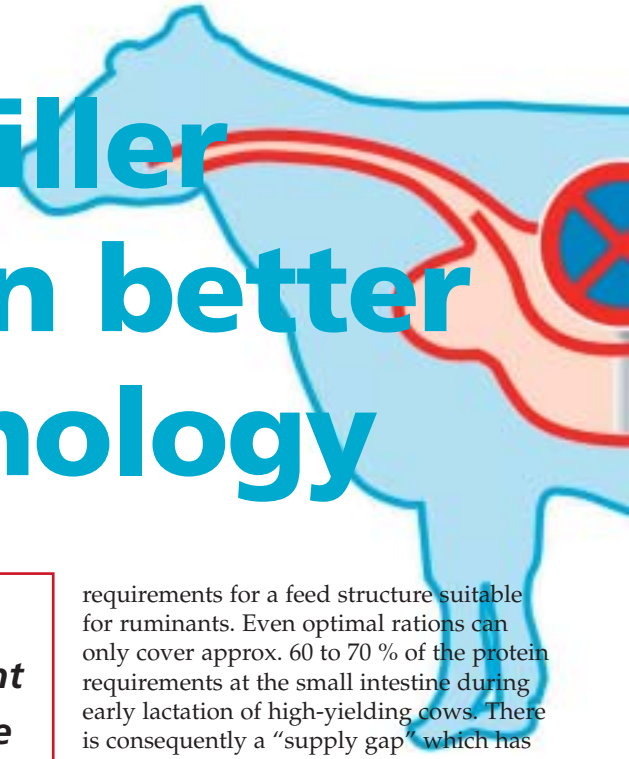
German feedmiller protects protein better with new technology



How to earn an extra €45 per dairy cow per year, without quota costs? Increasing the protein content of the milk could do it, but then the ration must be adjusted. At deuka in Germany, technology was developed to avoid a breakdown of protein into unwanted components due to energy shortage in the rumen.

By Dr. Heinrich Kleine Klausing and Dr. Katharina Pfeil,
deuka Deutsche Tiernahrung, Düsseldorf, Germany

Milk yields have improved on many farms and are continuing to rise. To do this the quality of the basic diet, optimising the dry matter intake and taking into consideration the most recent findings on carbohydrate and protein metabolism are particularly important. These aspects put high requirements of basic ration supplements in line with performance. During recent years research has paid special attention to protein supplies for high-yielding dairy cows.

In feeding high-yielding cows the milk protein content achieved represents a particularly important criterion under milk quota conditions. If a farm can increase the milk protein content at a constant milk fat content by just 0.1 % on average, for example by optimised feeding measures, this means extra earnings of €45 a year for a dairy cow with an annual yield of 9000 kg (at €0.005 per kg milk for +0.1 % protein). Moreover no additional quota costs are incurred for this.

Microbial protein most important

The most important source of protein – even at peak lactation – is and remains microbial protein. Optimal fermentation in the rumen means a correspondingly strong microbial population. Highly digestible protein mass with an amino acid pattern that is almost optimal for the cow is conveyed towards the rennet or fourth stomach and small intestine via the constant flow of rumen fluid and feed particles with adherent rumen microbes.

The amount of microbial matter and hence highly digestible protein, which is formed, depends on various parameters. These are headed by the supply of rumen-available energy and corresponding nitrogen to the dairy cow. The most important basis for optimal energy and nitrogen supply is the highest possible intake of dry feed matter. This is influenced to a large extent by the quality of the basic feed and the balanced design of the total ration.

The largest quantity of rumen microbes per time unit is formed when fast-fermentable carbohydrates such as sugar and quickly degradable starch are fed. However, the share of these carbohydrates in the ration is distinctly limited by the requirements for a feed structure suitable for ruminants. Even optimal rations can only cover approx. 60 to 70 % of the protein requirements at the small intestine during early lactation of high-yielding cows. There is consequently a "supply gap" which has to be balanced via the total ration.

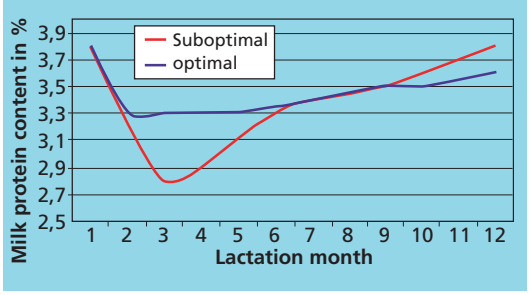
Negative energy balance

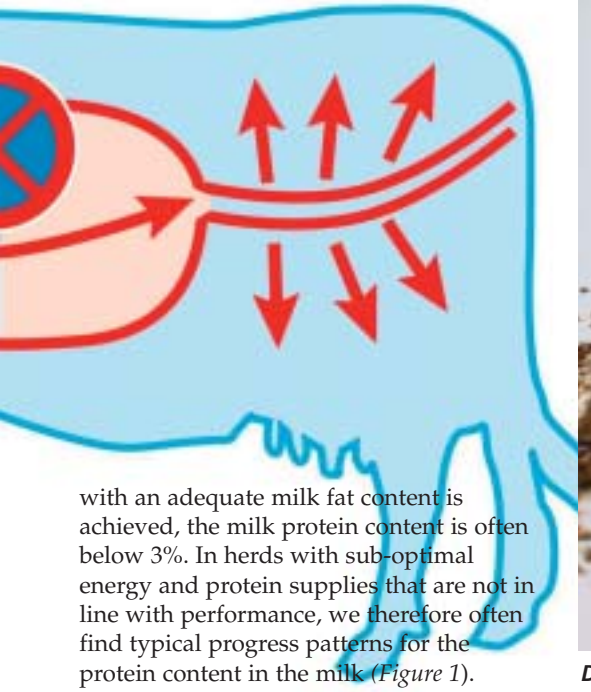
A further important aspect is milk protein content at the start of lactation in high-yielding cows. At the start of lactation many cows with a peak performance rate go through a negative energy balance for several weeks, and in some cases for several months – the energy output with the milk is well above the energy intake with the feed.

These cows mobilise their body reserves built up during the preceding late lactation in order to balance the deficit. Since these mainly consist of body fat that is released, the energy shortfall can only be balanced in this way too. And this balance is "effective", since energy for about 6 to 7 kg milk can be released from one kg body fat.

The consequence of this for milk production is that although sufficient energy can be made available at short notice, the protein supply does not keep pace. Although a corresponding quantity of milk

Figure 1 - Course of the protein content in milk at sub-optimal and optimal supply with energy and protein





with an adequate milk fat content is achieved, the milk protein content is often below 3%. In herds with sub-optimal energy and protein supplies that are not in line with performance, we therefore often find typical progress patterns for the protein content in the milk (*Figure 1*).

In practice attempts have been and still are being made today to counter this circumstance by a distinct "advance supply" of protein in the ration. However this is "normal" feed protein, and a correspondingly high share is released in the rumen. Due to the limited energy quantities in the rumen this protein cannot be converted into microbial protein practically. The consequences of this energy undersupply and nitrogen oversupply in the rumen are, for example, elevated urea content in the milk. Fertility problems are often already programmed in this lack of harmony in the nutrient supplies for dairy cows.

Rumen protected protein

The logical conclusion is that more protein should be allowed to "flow" through the rumen directly into the small intestine. In other words, the share of "flow-through protein" in the ration should be increased. The "UDP share" in the protein (i.e. the share of the Undegraded Dietary Protein in the rumen by comparison with the total protein) varies substantially in the customary feed components available.

Deukalac UDP 39 with 50% rumen protected protein.

To be able to supply the fresh-lactating, high-yielding cow with sufficient useful protein (nXP) in the small intestine to meet needs, the content of rumen-resistant protein ("UDP share") must be about 35% of overall protein in the total ration.

This cannot be achieved with the customary ration components available today, i.e. untreated matter. Since even the best qualities of basic feed have relatively small UDP shares, customary mixed or total rations only contain about 25% UDP for balancing/supplementing conventional protein feeds. Thus soybean meal that was held to be the protein component for dairy cows for many years in practice is now considered to have a UDP component of only 30% - just as much as rape-seed meal.

To achieve the necessary 35% UDP in the total ration for high yielding cows, silage-rich rations must therefore be upgraded with protein components whose UDP share is well above 40%, and of course, which then still remain highly digestible in the small intestine.

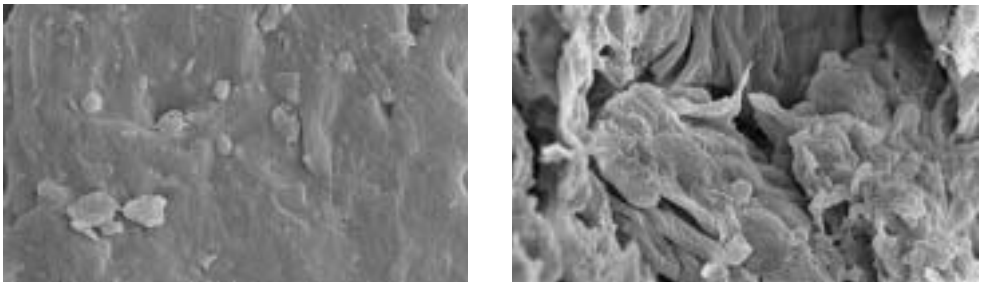
Extrusion technology

So far various processes are known for reducing the degradation of plant protein by rumen microbes, such as chemical and physical processes or addition of fishmeal (not allowed in Europe).

In the physical processes the protein components are treated by " hydrothermal pressure" and this causes a structural change in the protein. The disadvantage of the hydrothermal pressure methods known so far ("extrusion technologies"), which also result in a detectable degree of substance change, is the need for energy-intensive and hence costly drying of the product after treatment. Furthermore, with all methods the question of how to retain high digestibility of the undegraded ("protected") feed proteins in the small intestine must be considered - regrettably this has not yet been answered comprehensively.

Deuka has in recent years looked intensively within its own research and development at new technologies for refining single and compound feed by natural means, if possible without using additives. The result of these research efforts is the opticon technology, patented for deuka, and the rumen-protected protein-rich special feed for high-yielding cows deukalac UDP 39, produced using this process.

Opticon is a hydrothermal pressure process technology aimed largely at refining single and compound feeds for productive livestock in agriculture. The machine used is an extruder, which is a barrel wherein feed material is pushed



Electron microscope image of untreated (left) and opticon treated (right) rapeseed meal (magnification X1,000).

Table 1 - Practical results with deukalac UDP 39 (2001)

Farm	Cows	kg milk/ year 2000	kg milk/ year 2001	Fat %	Protein %	FPK*	Ration type Maize: Grass silage	deukalac UDP 39 kg/cow + day	% UDP in crude protein
Da.	140	11,300	12,300	3.49	3.30	839	74:26	4.5	33
Di.	130	10,100	10,400	4.20	3.44	789	0:100	2.8	27
M.S.	400	10,500	10,700	3.89	3.33	775	63:37	4.6	35
St.	1,000	9,700	10,000	4.17	3.36	750	72:28 +beet pulp	2.0	32
G.R.	460	8,800	9,800	4.16	3.48	749	74:26	3.0	34
F.	1,500	9,000	9,800	4.04	3.37	724	79:21 + hay	4.5	35

*FPK = Fat Protein Kilogram

Opticon production facility at the deuka plant in Höltlinghausen, Germany.

forward by a screw under high pressure and specific temperatures and moisture content. The extruder used at deuka is characterised by an invention-specific configuration of the screw geometry in the barrel and the appropriately developed process parameters (temperature, moisture content, pressure, shear forces, dwelling time, energy dissipation, expansion and product structure). These form the crucial basis for the uniqueness and high degree of improvement achieved in the product.

What is deukalac UDP 39?

deukalac UDP 39 is made up of 50% HP soybean meal and 50% 00 rape-seed meal. The components are ground and mixed in the usual fashion. After this the mixture is treated in the opticon production plant and the content of rumen-stable protein ("UDP share") for supply covering the needs of high-yielding cows is increased to 50% (basic passage rate 5%/h from the rumen). The content of sulphurous amino acids in the product is secured via the share of rape-seed meal.

This protein protection is achieved by purely physical means without the addition of chemical substances. The product also contains per kg: 7.0 MJ NEL (net energy for lactation), 390g crude protein, 300g nXP (usable protein in the duodenum, the first part of the small intestine) and 14g RNB (ruminal nitrogen balance).

A change in the protein structure can be shown with the aid of photos taken with the scanning electron microscope with 1000-fold magnification.

By means of the opticon treatment the product acquires a unique crumbly structure. Treatment also lends the product a pleasant, baking-type odour and taste; the reason high-yielding cows absorb it well.

deukalac UDP 39 is used directly on the farm for targeted upgrading of the basic feed ration, as a protein supplement in mixed rations (MR) and total mixed rations (TMR), and as an additional protein supply for high-yielding cows in the "top dressing". In compound feed plants the product is used in special compound feed varieties for high-yielding cows. The exact quantities and processes are customised to the individual on-farm feeding situation.

Results in practice

The high performance capability of deukalac UDP 39 was tested comprehensively in practice. A selection of the performance testing farms that used the product in 2001 is set out in *Table 1*. The farms had stocks ranging between 130 and 1,500 cows and a yield range between 9,800 and 12,300 kg milk per cow and year. The shares of deukalac UDP 39 in the rations (all farms feed TMR) were oriented to the relevant basic feed situation.

The rumen-protected protein carriers used so far on the basis "nXP", "RNB" and "MJ NEL" were replaced with deukalac UDP 39 and adaptations in the total ration equivalent. Depending on the ration composition between 2 and 4.5 kg of the product per cow and day were thus used. By comparison with the year 2000, all farms were able to increase yields. □