Thyroprotein for Cows

by L. A. MOORE and J. F. SYKES

The THYROID gland affects milk production. If the gland is removed from a cow, her milk decreases 75 percent. If it is put back, in the form of dried thyroid tissue or the synthetic hormone, thyroxine, her yield returns to normal. Both substances stimulate normal cows to give more milk and fat. The difficulty has been that dried thyroid tissue is too costly to feed cows, and if the total supply of the tissue were made available for feeding cows, we would have enough for only a few animals. Lately, however, scientists have found a substitute.

German scientists in 1938 found that the addition of iodine to proteins under certain chemical conditions makes a product that acts like dried thyroid tissue. The next step was taken by E. P. Reineke and C. W. Turner of the dairy department of the University of Missouri; they ascertained that iodine could be added to skim milk or casein, the protein contained in milk, under certain conditions, with a similar result. Further work disclosed that the actual hormone, thyroxine, was produced by the process.

This material can be produced more cheaply and is even more active than dried thyroid. It does not lose potency in storage. It is known variously as iodinated casein, iodinated protein, thyrocasein, thyrolactin, thyroprotein, and by the trade name Protamone. Here we shall call it thyroprotein. Until recently it has been supplied only to experiment stations and similar research organizations for experimental purposes.

Professors Reineke and Turner tested thyroprotein on 9 cows in their herd. When they fed 50 to 100 grams (3 to 6 ounces) of thyroprotein to each animal for 3 days, they had increases of 6.09 to 22.6 percent (an average of 8.59 percent) in milk production. In six of the nine trials in which fat analyses were made, an increase in the fat percentage was
obtained, which, together with an increase in milk production, produced a 13.9 percent increase in fat yield. In similar tests at the West Virginia, New Jersey, and Louisiana stations, 10 to 15 grams daily were fed. These amounts produced increases of 5 to 20 percent in milk production, 0.32 to 0.98 percent in fat percentage, and 25 to 50 percent in total fat yields. The most extensive work with thyroprotein has been carried out in England by K. L. Blaxter and his associates. Some of their findings are given in the accompanying chart.

Extra feed favorably affects weight and production of cows getting thyroprotein.

A review of the data collected thus far indicates that on the average and within narrow limits the response in milk production is proportional to the quantity of thyroprotein fed. Because of limitations in the animal itself, naturally this relationship would not hold where one feeds much larger amounts of thyroprotein than shown in the chart for an extended period. As a matter of fact, excessive amounts will lower milk production. The amount used must be carefully controlled.

The response of cows to thyroprotein feeding in terms of milk and fat production appears to vary from cow to cow. Most of these variations we cannot yet explain. Several scientists, however, have found no response if the material is fed to a fresh cow and none is noted until lactation begins to decline. Likewise, very little response is evident during the last month or two of lactation; as a matter of fact, thyroprotein may tend to cause a cow to dry up late in the milking period. For best results, therefore, the thyroprotein should be fed for only the middle 5 or 6 months of the lactation period.

Professor Blaxter and his colleagues suggest that in midlactation the proportional response goes up as lactation declines, while the greater
the initial yield at the beginning of the feeding the greater the response in pounds per day. It seems likely, therefore, that good producers will generally give greater increases in milk and fat than poor cows. Whether a poor cow can be converted into a good producer merely by feeding thyroprotein is problematical, because the response obtained depends partly on her inherent ability to produce. Furthermore, increases in milk follow increases in the amount fed only within narrow limits.

Although thyroprotein can raise yields of milk and fat markedly, it also can create a condition of hyperthyroidism, with a higher heart rate, respiration rate, and body temperature, and a loss in body weight. These effects are to be expected, because the extra supply of thyroxine taken into the body steps up metabolism, or the rate at which the body of the cow utilizes food nutrients. In other words, she is using up food nutrients and the nutrients stored in her tissues somewhat faster than normal. We do not know whether these effects will harm the cow's health and reproduction if thyroprotein is fed from lactation to lactation. In the short feeding trials carried on at the various experiment stations, no permanent bad effects have been reported. The Bureau of Dairy Industry has started a long-time trial to learn more about this.

In the short-time tests carried out thus far, it appears that the heart rate increases approximately in proportion to the amount of thyroprotein fed. Similarly, as we have said, milk production increases in proportion to the amount fed. Thus, we may conclude that if a cow responds in milk production to thyroprotein feeding, the heart rate will be increased, and, conversely, if the heart rate is not increased, there will be no increase in production. Observations at Beltsville seem to substantiate this speculation.

Further data collected at Beltsville indicate that the heart rate of cows given thyroprotein is related to the level of feed intake. When the level of thyroprotein feeding is kept constant, the heart rate can be accelerated markedly by increasing the total feed intake 25 to 50 percent. If the high amount of feed is reduced, the heart rate then decreases. Also, after cows have been receiving thyroprotein for 4 to 8 weeks and there has been a considerable loss in body weight, and milk production has declined sharply, the heart rate will also decline.
would appear that the heart rate is governed by the amount of energy the body has available for use, whether from the body tissues or from feed, or both. These observations are preliminary; we are gathering further information on them.

A disturbing factor connected with the increased metabolism is the loss of body weight of cows fed grain at the usual level. Men at various experiment stations report definite losses of body weight where thyroprotein was used; such a loss may be particularly severe in hot climates and in summer.

The following changes appear to take place when thyroprotein is given for extended periods to cows fed at the usual level according to milk production: Milk production is markedly increased at the expense of body weight; after a period of 4 to 8 weeks, depending on the condition of the cow at the start of the feeding period and the amount of stimulation produced, milk production, and heart rate decrease, and when milk production drops to about 10 pounds a day, she will gain weight.

It would also seem probable that, if the cow were not able to make up the losses in body weight before the succeeding lactation started, milk production in the subsequent lactation might be adversely affected.

The English workers have therefore stated that for the best results, thyroprotein should be fed at a level that will raise milk yields about 20 percent, and that for this increase feed intake should be enlarged by about 20 percent. This practice largely eliminated the loss in body weight when thyroprotein was fed at the 15-gram level (one-half ounce). In one experiment these workers incorporated the thyroprotein into a grain mixture, which was cubed. Four pounds of these cubes contained sufficient thyroprotein to produce a 20-percent rise in production and at the same time supplied approximately the extra 20 percent of feed necessary to maintain body weight. The cubes were fed in addition to the regular allowance of grain.

In the Beltsville experiment, where the amount of thyroprotein fed for several months varied from one to one and one-half grams per 100 pounds of body weight, severe losses in body weight were noted. Because of the extremely poor condition of the cows and because it had been planned to continue the feeding of thyroprotein up to the last month of the lactation period, the total feed intake was increased 25 percent by grain feeding. As a result, the condition of the cows improved greatly. They gained weight, and their rapid decline in milk production was halted.

Obviously, if more feed must be fed to maintain body weight and milk production, the question arises as to whether the extra milk will pay for the extra feed. It is hard to give a definite answer on the basis of the data we now have. The Department's Technical Bulletin No. 815 points out that a 20-percent increase in the feed intake of a normally fed cow not receiving thyroprotein will increase milk production about 13 percent.
If by feeding thyroprotein, 20 percent more milk could be produced with 20 percent more feed, that would leave an increase of 7 percent in milk production to pay for the thyroprotein and the extra trouble of feeding it.

A few men have studied the effect of thyroprotein on the composition of milk. One effect we have mentioned: The percentage of fat is raised. Some investigators have noted a slight increase in the percentage of solids not fat, although others have not. J. G. Archibald, at the Massachusetts station, reported a decrease in casein and a roughly proportional increase for lactalbumin and globulin, with no change in total solids, ash, or lactose. Workers at the West Virginia station found that the ascorbic acid content of the milk was lowered to 33 percent below normal. English workers reported a considerable decrease in the phosphatase content.

It will also be necessary to settle the question as to whether sufficient thyroxine is secreted in the milk of cows fed thyroprotein to produce possible harmful effects when the milk is used by humans. Data collected at the Missouri station have shown that when guinea pigs were fed such milk no detectable thyroid effects could be observed, but data on human subjects are needed before this point can be established.

Officials of purebred breed associations express concern over the use of thyroprotein in making records. Such a practice is now banned, because by its use the record would not be an expression of the cow's inherited milk-producing ability. To guard against any possible unscrupulous use of thyroprotein to improve the official records of herds, methods of detection will be needed. Perhaps tests of the phosphatase content of the milk, which drops when thyroprotein is used, might be a tool in detecting the use of thyroprotein. Or, a study of some of the other enzyme systems in milk might be useful in this regard.

It seems doubtful that thyroprotein will ever be mixed into regular dairy grain mixtures, because it should not be fed except during certain periods of the lactation and because of the variation in effects produced in individual cows.

As previously stated, the effect of feeding thyroprotein for several lactation periods on the health and reproduction of cows has not been determined. Experiments are now in progress at Beltsville to answer these questions. Furthermore, when thyroprotein is fed for a long time it appears that extra feed should be fed. The amount of extra feed needed will probably vary with the condition of the cow, the amount of thyroprotein fed, and other factors. Until answers to these questions have been adequately settled, the general use of the material by dairymen is not recommended. If, however, it finally develops that feeding thyroprotein does not shorten the useful life of cows and does not adversely affect reproduction, it seems that this practice could be quite useful for increasing milk and fat production in commercial herds and where milk is sold on a basis of percentage of fat.
THE AUTHORS

L. A. Moore is in charge of the section of Dairy Cattle Nutrition of the Bureau of Dairy Industry. Before joining the Department in 1945 he was successively associated with the dairy departments of Michigan State College and Maryland University. For outstanding research relating to the nutrition of dairy cows, Dr. Moore in 1943 received the Borden Award.

J. F. Sykes is a physiologist with the Bureau of Dairy Industry specializing on problems of reproduction and lactation in dairy cattle. Dr. Sykes is a graduate of the University of Toronto and has been research associate in the physiology department of Michigan State College.

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What To Feed a Cow, by R. E. Hodgson and W. J. Sweetman, page 149.


New Ideas in Feeding, by N. R. Ellis, page 95.