

Milking supplements for all they are worth

Low productivity means Indian farmers struggle to turn milk production into income. Whitney Macdonald reports on projects to bring about change

India is the world's largest dairying country, producing more than 90 million tonnes of dairy products a year, but this figure disguises the low productivity at village level. The problem is the diet of the dairy cattle. A joint Australia-India research project supported by ACIAR has been working on the delivery of a new technology that will help cattle extract much more nutrition from their daily roughage.

The technology will also be useful for dairy cattle in northern Australia.

India has 300 million head of dairy cattle, but they belong to small village farmers whose entire herds are usually only two or three animals. And despite the vast national figure for dairy production, each animal contributes minimally to the total yield, producing just four to five litres a day – less than a quarter of the Western average.

So ACIAR is funding a project to increase the productivity of ruminants including dairy cattle and buffalo. An increase in milk productivity translates to a significant increase in economic gain for village farmers.

Ruminants in India – and also in northern Australia – often exist on a diet of poor-quality roughage. Digestion of this roughage begins in the rumen, one of the four compartments of the ruminant's stomach. Here, the fibre is broken down by symbiotic micro-organisms, a process known as rumen fermentation. Some of the digestive by-products are used for synthesis of microbial proteins. Once the food has passed through the remaining three stomach chambers, the digested product passes to the small intestine, where the remaining nutrients are absorbed into the ruminant's bloodstream.

Unfortunately, the particular micro-organisms that exist in the rumen of these animals often lack the specific nutrients to make rumen fermentation a more efficient process. Thus fibre and protein are not digested well, leaving the animals with a low nutritional intake.

Scientists at CSIRO Livestock Industries in Queensland, in collaboration with the National Institute of Animal Nutrition and Physiology in India, are working on a way to improve digestive efficiency in the rumen. This three-year ACIAR project has already had significant economic outcomes.

The research project, headed by Dr Chris McSweeney, has aimed to increase the productivity of ruminants by improving fibre digestion in the rumen. To do this, researchers investigated two approaches.

The first involved identifying and supplementing cattle feed with fungal inoculants that were superior in their ability to break down fibre compared to the fungi that naturally colonises the rumen.

“While often the dairy animals exist on a diet of poor quality roughage, it is high in fibre. If the function of the naturally occurring rumen fungi can be improved, or superior fungi can be identified for breaking down fibre, more nutrients will be available from the roughage,” explains Dr McSweeney.

The second approach entailed adding nutrient supplements to stimulate the fungi to work more efficiently, thus increasing the digestive capacity of the existing rumen fungi.

“Ruminant diets in India and northern tropical Australia are often quite low in essential nutrients such as sulfur,” Dr McSweeney says. “By supplementing their feed with sulfur compounds, we are able to better stimulate the rumen fungi to digest fibre more effectively.”

Nutritional trials, conducted at the CSIRO in Queensland, assessed the effects of the fungus-specific nutrient mercaptopyruvic acid (also known as MPA), as well as sulfur supplements, on digestion in the rumen.

When the diets of cattle were lacking in sulfur and nitrogen, the trials found that administering these supplements resulted in the transport of more microbial proteins to the small intestine. In addition, an increase in feed intake was noted.

As nitrogen is a key factor in protein synthesis by the micro-organisms that colonise the rumen, overall rumen function was enhanced through the inclusion of nitrogen and sulfur compounds. To make complete use of the added sulfur, the trials also highlighted the benefit of urea supplements. Responses occurred to levels of supplementation not previously predicted to be of benefit. The overall gains in digestive efficiency that were observed in the trials translate to a five to 10 per cent increase in cattle productivity.

The dietary changes that would need to take place to achieve these gains are well within the normal price range for dietary supplements already bought by farmers. Thus, farmers would not incur any extra costs. They could simply switch to buying more effective supplements.

Improving the efficiency of digestion through the addition of nitrogen and sulfur supplements was not the only successful finding of the nutritional trials. ACIAR-funded researchers also identified superior fungal organisms that, when used to inoculate the rumen, are able to more effectively break down fibre.

“Our nutritional trials using fungal treatments as dietary supplements for cattle in Australia proved promising. We are currently continuing this research on dry animals in India, to verify the gain in productivity translates to cattle in a different environment,” says Dr McSweeney. “Once we have confirmed the results on dry ani-



A large output but low productivity: a woman churns milk in the Thar Desert, Rajasthan.

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mals, we will move on to dairy cattle in India.”

Although incorporating sulfur supplements into the ruminant diet is logistically feasible, the addition of fungal inoculants proves to be more difficult. “Administering fungal treatments requires greater technology to grow and distribute viable and productive organisms. These treatments may be of more use to dairy farmers, where the distance from fungal production to the dairy farm, particularly in India, is not so great,” explains Dr McSweeney.

The benefits of the collaborative research efforts between Australia and India extend beyond the bottom-line increase of cattle productivity. A significant aspect of this work has been the development of cutting-edge techniques to study microbial ecology.

Utilising the latest methods has enabled scientists to better understand the organisms involved in the ruminant digestive process. Australian scientists are passing on this knowledge to their Indian scientific colleagues.

“Our collaborators in India are keen to continue these studies to gather more data on the effects of these supplements on dairy cattle in India. In addition, this primary study has served as the catalyst

necessary for optimal milk production.”

The small amount of protein that is ingested from the poor-quality roughage is mostly broken down in the rumen by micro-organisms. By developing a technology that protects the protein from being degraded in the rumen, more nutrients such as proteins and essential amino acids would be absorbed in the small intestine, effectively increasing the animal’s nutrient intake.

“The challenge is to produce the most effective form of rumen-undegradable protein and demonstrate that inclusion of these supplements in the diet of lactating ruminants produces a worthwhile economic return to dairy farmers,” says Dr Gulati.

The University of Sydney researchers, alongside the NDDDB, have done just that. They have developed a way to supplement the diets of dairy animals with increased amounts of fat and protein from by-products without compromising the nutritional resources available to the public.

This novel technology uses oil seed meals as the source of the protein. Once the oil has been extracted from indigenous seeds such as sunflower, rapeseed and guar bhardo, the remaining proteins and nutrients are treated with a very small level of aldehyde that protects the nutrients from degradation in the rumen.

The collaboration between the CSIRO, the NDDDB and most recently the University of Sydney led to the planning and construction of a semi-commercial ‘by-pass protein’ plant within the existing Indian cattle feed plant at Itola, Vadodara, in Gujarat state. The plant was commissioned in September 2002 and produces 50 tonnes of treated protein meal a day.

High quality-control standards have ensured that at least 75 per cent of this protein meal is ‘undegradable’ by the rumen. Dairy animals receive this optimal ‘by-pass’ protein as one-quarter of their normal feed pellets. Without by-pass treatment to the protein, only 25 to 35 per cent of protein will survive rumen fermentation. Integration of the by-pass protein feed supplements has had a clear positive economic outcome.

“One kilogram of protected protein feed supplement directly results in the production of up to one extra litre of milk per day per animal. With each farm having on average two to three animals, it translates to a net gain of seven to 12 rupees (approximately A\$0.30) per day per farmer,” explains Dr Gulati. “While this may not sound like a lot of money, it is for the small village farmers.”

An analysis of the economic impact of the by-pass protein feed, carried out by Professor P. S. George from the Centre for Development Studies in Thiruvanthapuram, Kerala, India, found that incorporation of the feed would result in an overall net increase in annual income of 4302.42

rupees per farmer.

Perhaps the possible impact of the by-pass protein feed is best summarised by Professor George’s concluding statement: “This has the potential to provide a large increase in disposable income for village farmers.”

Funded by the NDDDB, construction of a second by-pass protein plant is now under way in the Indian district of Godhara in Gujarat state. Australian dairy farmers could also benefit from the by-pass protein technology. Scientists estimate that use of the improved feed supplements could result in milk production rising by 10 to 15 per cent.

As well as increasing the productivity of dairy animals, this technology could have future applications in improving the productivity of dairy products. For now, farmers in India are benefiting from having cows that produce more milk, which means more income. ◀



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A better diet for the cattle, a better diet for the family: a woman tends a cow in West Bengal, India.

for spin-off projects in India,” says Dr McSweeney. “It has been a very productive collaboration, both in the economic and scientific sense.”

In addition to the research tackling poor fibre digestion, ACIAR is also funding research aiming to increase ruminant productivity through more efficient protein digestion.

The project, which utilises a ‘protected’ or ‘by-pass’ protein, was initiated at the CSIRO by Dr Suresh Gulati. Now in the Faculty of Veterinary Science of the University of Sydney, Dr Gulati is in the fifth year of this research, working in collaboration with the National Dairy Development Board (NDDDB) of India.

“Because most of the nutritious grains go to feeding India’s large population, dairy cattle are often left with a diet of straw and the dregs of farming products,” Dr Gulati says. “Such a diet lacks the amount and nutritional quality of protein, fat and other nutrients