

Estimating the Nutritive Value of Tropical Forages

A major constraint in feeding systems for livestock in the tropics is the seasonal shortage of dietary protein. Many of the most important dry season feeds, such as cereal crop residues, tend to have low protein contents. An improved laboratory technique for evaluating the nutritive value of low-nitrogen feeds and diets was further developed. Tannins, found in many tropical feeds, bind to proteins, thereby reducing digestibility. The variability of tannin contents and their effects on rumen microbes and digestibility were also investigated.

Background

In many tropical developing countries widespread seasonal shortages of feed for ruminants are exacerbated by the poor quality (low digestibility, low protein content) of the available feed, further compromising the nutritional status of the animals. An accurate estimate of nutritive value is essential in order to make best use of

seasonally scarce feed. The method also has to be able to assess the effects of protein supplementation. Tropical feeds are difficult to assess by conventional means due to the presence of anti-nutritional factors such as tannins, lignin and silica.

Research highlights

A diverse range of activities was undertaken, from the investigation and refinement of analytical techniques to their application in providing information for livestock keepers. The pressure transducer technique (PTT) developed by an earlier project (X0162 on digestion kinetics of forages) was further developed. The PTT measures the gas produced during *in vitro* fermentation; this indicates the fermentability of individual feeds or diets and, thereby, allows an assessment of their nutritive value to be made. The PTT, perhaps uniquely, facilitates the investigation of feed mixtures and interactions between feed components.

In studies conducted on poor quality natural pasture (veld) hay, fermented alone and after mixing with different amounts of relatively good quality Napier hay or groundnut hay in both nitrogen-rich (NR) and nitrogen-free (NF) media, the medium appeared to make relatively little difference to fermentation rates. However, fermentation of the veld hay was much slower in the NF medium due to a shortage of nitrogen for substrate formation by rumen micro-organisms. This illustrates the need for careful interpretation of

laboratory results. Use of the standard PTT technique with poor quality feeds tends to overestimate their nutritive value.

Tree fodders usually have high protein contents, but high levels of tannins can bind the protein making it unavailable to animals. The project found that the inhibitory effects of tannins on rumen microbes could be predicted by simple chemical or biochemical assays (Prussian blue total phenols assay or protein precipitation). However, tannins often have multiple effects on animals, and current knowledge is still some way from being able to predict the nutritive value of tanniferous feeds. The PTT is sensitive to tannins and appears to be a useful technique for investigating such feeds.

A study of the nutritive value of tree fodder (leaves, bark etc. fed to animals) in Nepal provided an example of the benefits of applying laboratory techniques more carefully to field situations. Farmers use two distinct indigenous knowledge systems to characterise the nutritive value of tree fodder – *obanopan*, relates to digestibility of tree fodder (as predicted by the PTT); and

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Using the pressure transducer technique for evaluating the nutritive value of tropical forages.

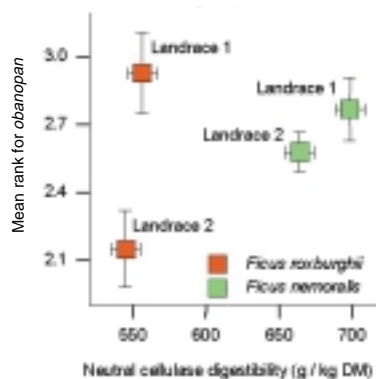
posilopan, an indicator of general nutritional quality, appears to relate to the capacity of a tree fodder to promote the supply of protein at the duodenum of cattle and goats. An exploratory analysis of the complementarity of information provided by farmers' perceptions of fodder quality and that generated in a laboratory was very encouraging for a more integrated approach to assessing fodder quality for the smallholder farmer.

Uptake

The PTT technique (or similar techniques) has now been used in Kenya, Bolivia, India and Zimbabwe as well as in various laboratories in the UK, Holland and the USA. It has been used in more recent Livestock Production Programme projects to evaluate feed quality (R6993 on stover storage and quality in Zimbabwe; R6995 on goat feeding systems in India). Ongoing research interest in the technique was highlighted at an international British Society of Animal Science meeting in 1997, and at a recent international workshop organised by the Australian Centre for International Agricultural Research. This project has made a contribution to scientific developments in this very complex area, while seeking to start to apply laboratory techniques to farmers' problems.

Linkages

The project established a number of long-standing collaborative links with institutions in developing countries. Links with DFID and other bilateral projects in South Asia, Latin America



Farmers' knowledge of fodder quality can complement that generated in a laboratory – their use in tandem offers great potential for research to contribute more effectively to the development of feed resources. When the error bars in the same plane (axis) overlap, discrimination of landraces is not possible. Therefore, for F. roxburghii farmers' knowledge is discriminating; for F. nemoralis the laboratory method is discriminating. (DM = dry matter)

and sub-Saharan Africa were also established and bilateral funding was secured to put a number of the novel techniques developed into practice. The project has participated in the training of several postgraduate students. Further development of the use of indigenous knowledge in association with laboratory-based assessments of nutritive value is being carried out under the bilaterally funded Hill Agriculture Research Project in institutes of the Nepal Agricultural Research Council.

Relevance to sustainable livelihoods

Many interventions generated by research with the aim of improving the nutritional status of livestock in developing countries have failed to realise their apparent potential when implemented on farms. It is now

widely accepted that this is because farmers try to meet too wide a range of objectives in feeding their animals. This project has shown that laboratory techniques, such as the PTT and simple tannin assays, can generate information which adds to the existing knowledge of farmers on the nutritive value of feeds. With appropriate extension, information of this type can help livestock keepers manage feed resources better and thereby improve the productivity of their livestock.

Selected project publications

- Wood, C.D. and Plumb, V.E. (1995) Evaluation of assays for phenolic compounds on the basis of *in vitro* gas production by rumen micro-organisms. *Animal Feed Science and Technology*, **56**: 195–206.
- Wood, C.D. and Manyuchi, B. (1997) Use of an *in vitro* gas production method to investigate interactions between veld hay and Napier hay or groundnut hay supplements. *Animal Feed Science and Technology*, **67**: 265–278.
- Thorne, P.J., Subba, D.B., Walker, D.H., Thapa, B.L., Wood, C.D. and Sinclair, F.L. (1999) The basis of indigenous knowledge of tree fodder quality and its implications for the use of tree fodder in developing countries. *Animal Feed Science and Technology*, **81**: 119–131.

A large number of publications has been generated by this project—selected publications will be on the LPP website www.lpp.uk.com

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