Benefits of Storing Fibrous Feed Residues for Ruminant Livestock – and Human Health

Simple measures to improve the storage of fibrous crop residues can reduce contamination by fungal mycotoxins, such as aflatoxin, thereby improving the quality of livestock feeds. This leads to increases in animal productivity and improvements in the incomes of resource-poor smallholder farmers.

Background

One of the main constraints to ruminant livestock production in developing countries is scarcity of feed, particularly during the dry season. There is therefore a need to maximise the efficiency with which available feed resources are utilised. Fibrous crop residues, although inherently of low nutritive value, are of particular importance as sources of nourishment for ruminant livestock in the dry season. Maize, sorghum and millet residues are especially important in sub-Saharan Africa while rice straw predominates in South-East Asia.

In most situations, it is advisable to cut, gather and store crop residues (stovers) after harvesting. It also makes economic sense to store such feed for use during periods of shortage or when the animals' requirements are greatest. There is, however, concern that some storage conditions favour fungal growth, resulting in mycotoxin contamination of the feeds. During fermentation of cellulose matter in the stover (in the animal's rumen), gas is produced from microbial activity. This activity is suppressed by mycotoxins. This causes adverse effects on animal performance and, potentially, on human health from consumption of livestock products contaminated with mycotoxins.

In Zimbabwe, maize and sorghum stover samples were stored for up to four months during the dry season, using methods appropriate for use by resource-poor farmers on small farms, such as standing in the field, or cut and storing on raised platforms – in the open air or roofed. In laboratory-based *in vitro* gas production studies (using sheep rumen liquor), production of gas, which is strongly correlated with digestibility of feeds, was reduced during the first 60–90 days of storage. Comparing storage methods, significantly more gas was produced by samples stored on a raised platform than those left standing in the field. These preliminary *in vitro* studies suggest that the presence of specific mycotoxins (aflatoxin B_1) depressed microbial activity in the rumen. This could be expected to result in decreased digestibility of feeds and, hence, decreased animal productivity. Different conditions and lengths of storage change the nutritive values of maize and sorghum stovers. Samples left in the field produced significantly less gas in the *in vitro* assay compared with other methods of

Local cattle feeding on maize stover; the background shows typical raised storage for cereal stovers in southwestern Zimbabwe.

Research highlights

Milk samples from cows consuming feed contaminated with aflatoxin B_1 in eastern India showed concentrations of aflatoxin M_1 of up to 0.34 ug/litre. In Europe the maximum permitted (safe level) in milk is 0.05 ug/litre. Aflatoxins are a complex of mycotoxins produced by three species of the fungus *Aspergillus*; they may cause liver disease and may be carcinogenic. Although significant levels of aflatoxin have been found in animal feeds sampled in eastern India, no aflatoxins were found in samples of stored rice straw from India or Bangladesh.

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Crop residues of maize (seen here being chopped), sorghum and millet are important in sub-Saharan Africa for use as animal feed when other feed is scarce.

storage, indicating that harvesting of stovers is recommended.

The project showed that mycotoxin contamination of ruminant feeds in developing countries is a serious problem in terms of the effects it may have on ruminant performance. The transmission of these compounds – or their metabolites – into the milk of ruminant livestock has serious consequences for human health. Several mycotoxigenic fungi (genera *Fusarium, Phoma, Alternaria, Penicillium, Aspergillus*) were isolated from stored stovers in Zimbabwe.

Uptake

Adoption of appropriate livestock feed management measures, such as improved methods of storage, chemical treatment of feed and dilution of contaminated feed with 'clean' feed, would minimise the scale of contamination of animal products and the potential hazard to human health. In India, where 20% of milk produced is consumed by infants and children, contamination of feed could result in chronic exposure to mycotoxins at an age when children are most susceptible.

Linkages

The nutrition of cattle during the dry season in sub-Saharan Africa is largely dependent on a limited supply of maize and sorghum stovers. Project results indicate the need to improve storage and feed allocation strategies in resource-poor smallholder systems in developing countries. Further research is needed on the effects of processing on contaminated milk and whether this is a practical and cost-effective method of reducing the health hazard of aflatoxins to humans. An investigation into the incidence and toxicity of selected fungal isolates from ruminant fibrous feeds in India and Bangladesh has been proposed. This could lead to improving the performance of livestock in semi-arid crop/livestock and livestock production systems. Other Livestock Production Programme projects have outputs that are relevant to this project, for example, R6993 on stover storage and quality in Zimbabwe, and that on rice storage in Bangladesh (R7859).

Relevance to sustainable livelihoods

Development of simple measures to improve post-harvest handling of crop residues and agro-industrial by-products will reduce contamination by mycotoxigenic fungi. Improvement in the quality of ruminant feeds will increase animal productivity and so improve the incomes of resource-poor smallholder farmers in the Indian subcontinent and in sub-Saharan Africa. Also, improved storage will reduce the hazards to human health caused by the consumption of contaminated animal products. This will significantly improve the quality of life for poor communities in developing countries where milk and milk products form an important part of their diet.

Selected project publication

- Phillips, S.I., Wareing, P.W., Dutta, A., Panigrahi, S. and Medlock, V. (1996) The mycoflora and incidence of aflatoxin, zearalenone and sterigmatocystin in dairy feed and forage samples from eastern India and Bangladesh. *Mycopathologia,* **133**: 15–21.

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