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Crop Residues and Agro-industrial By-products in Four Pacific Island Countries: Availability, Utilisation and Potential Value in Ruminant Nutrition

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ABSTRACT : Large quantities of crop residues and agro-industrial by-products are generated each year in Fiji, Samoa, the Solomon Islands and Vanuatu agricultural crops. These are large raised Island countries with great potential for the development of ruminant livestock (cattle, sheep and goats). The potential value of crop residues and agro-industrial by-products in ruminant livestock nutrition is well known, but little information has been published on their actual utilisation as livestock feed or their availability to smallholder farmers in these countries. Where they are available most of them are haphazardly used because farmers lack storage facilities and knowledge on how to use them effectively in animal diets. Efforts being made to help farmers solve their feed problems are focused on improving methods of harvesting, handling and processing and incorporating crop residues into year round feed budgets.

Key Words: Crop Residues, Agro-industrial By-products, Pacific Island Countries, Feeds, Animals

INTRODUCTION

Fiji, Samoa, the Solomon Islands and Vanuatu are the four large raised Island countries with the greatest potential for ruminant livestock production in the South Pacific region The present ruminant livestock population in these countries comprises about 346,000 and 79,000 beef and dairy cattle, respectively, 128,300 goats and 6,200 sheep. In these countries, malnutrition is the major constraint to animal production especially during adverse weather conditions (dry/drought period) or during disasters like hurricanes and cyclones when grazing animals lose weight drastically. These countries produces enough feed resources, in the form of crop residues and agro-industrial by-products, to make them potentially capable of supporting a much larger animal population.

The role of crop residues and agro-industrial by-products for animal feeding is thus becoming even more important in marginal environments and in most countries in the South Pacific due to the competition for land and other resources for crop production (Amoah 1985). Animal producers in these countries already utilise these crop residues and agro-industrial by-products to a limited extent, however, these resources may not be readily available to smallholder farmers, or are not used effectively. The present trend is to match livestock production with locally available feed resources. It is the objective of this paper to discuss the availability, utilisation and potential value of some crop residues and agro-industrial by-products in ruminant livestock agriculture in four Pacific Island countries (Fiji, Samoa, the Solomon Islands and Vanuatu.

CROP RESIDUES AND AGRO-INDUSTRIAL BY-PRODUCTS IN THE FOUR COUNTRIES

Production

These four countries produce a variety of food and other cash crops. It was observed that in Fiji, the Solomon Islands, and Vanuatu and internally in Samoa that when crops are harvested and processed, various residues and by-products remain. At present no accurate data have been published on the quantity of crop residues and agro-industrial by-products generated in any of these countries. However, based on annual crop production in these countries about 32,000 – 38,000 tons of crop residues and by-products are generated from both annual and perennial crops agriculture every year (Aregheore, 1999 unpublished field data). These represent crop residues and potential agro-industrial by-products are generated from locally grown crops and imported ones (barley and wheat).

Residues from cassava, breadfruit, taro, banana/plantain, yams and sweet potato and from grains and cereals can be used in rations for livestock. The major residues from the processing of rice and maize in Fiji and the Solomon Islands are straws, stovers and brans. The straws and stovers are bulky and of poor quality due to a high concentration of lignin (36.4 - 45.3 % crude fibre), but are medium energy sources (12.2 – 13.4 GE MJ/kg) in ruminant rations. They are also low in protein (4.6 – 5.0 % CP), vitamins and minerals.

Several thousand tons (16,000 -18,000 t) of malt screenings, brewery yeast wastes and brewers' grains are produced annually by breweries in the different countries. These by-products are high in protein and of medium energy and their value in ruminant nutrition is well documented (Aregheore, 1989; Bovolenta *et al*, 1998). Also milling by-products such as bran, wheatlings and screenings are important by-products which along with palm kernel cake and copra meal could form important raw materials in the production of formulated ruminant diets in the four countries.

Generally, agro-industrial byproduct are listed as energy, protein and combined protein/energy sources (Aregheore, 1998). Energy sources are rich in fermentable carbohydrates and low in protein. An example is molasses (75 % DM, 4.1 % CP and 12.7 GE MJ/kg DM) - a by-product of the sugar industry. Protein sources are derived from oilseeds after oil extraction. Their cakes are valuable sources of protein

in livestock diets. Examples are palm kernel meal (18.0 %, CP) and copra meal (18.8 %, CP), respectively from palm oil and coconut processing. The combined energy/protein is from cereals by products such as brewers' grains (barley), wheatlings from wheat; and bran from rice and maize. While some of these can be fed directly, others have to undergo processing to make their nutrients available to livestock.

Table 1. Dry matter content (%) and proximate chemical composition (% of dry matter) of some crop residues and agro-industrial by products

	Nutrients						
By-products	Dry matter	Crude protein	Crude fibre	Ether extract	Ash	Organic matter	Gross energy (MJ/kg DM)
Breadfruit peels	91.9	7.4	11.5	1.0	16.5	83.5	14.9
Banana peels	88.4	6.4	13.0	1.8	9.6	90.4	13.5
Banana leaf	82.3	12.5	15.6	5.9	38.8	61.2	15.8
Banana pseudo stems	94.0	7.0	63.2	3.5	18.5	81.5	13.5
Cassava peels	93.2	4.5	18.3	2.5	3.8	96.2	15.4
Cocoyam peels	86.7	4.4	9.4	0.5	7.2	92.8	16.3
Potato peels	87.2	5.5	19.5	1.5	5.1	94.9	14.1
Rice straw	92.4	4.6	36.4	0.3	15.8	84.2	13.4
Rice bran	89.0	10.6	18.2	0.8	6.3	93.4	10.3
Maize stover	90.0	5.0	45.3	0.2	8.3	91.7	12.2
Wheatlings	86.3	19.5	10.3	4.8	5.7	94.3	10.4
Bagasse	93.1	4.1	47.0	1.3	3.9	96.1	14.5
Fresh brewers' grains	27.6	23.8	17.5	8.0	3.0	97.0	13.6
Brewers' dried grains	92.0	23.5	38.3	8.5	5.6	94.4	18.5
DCWM*	89.6	18.8	31.2	16.8	4.8	95.2	21.3
Cocoa shell	97.5	16.0	58.0	19.0	7.5	92.5	23.4
Cocoa dust	94.5	13.8	61.0	22.0	3.5	96.5	22.6
Copra cake	90.0	18.8	30.2	17.5	4.0	96.0	21.2
Palm kernel meal	82.0	18.0	33.6	41.0	2.0	98.0	26.2

*Desiccated coconut waste meal

Value in livestock nutrition

Data on basic chemical composition and nutritive value of crop residues and agro industrial by-products available in the four pacific island countries are scanty. However, there are now efforts to analyse locally available ones for their chemical composition. Table 1 presents chemical composition of some crop residues and agro-industrial by-products available in the PIC (Aregheore, unpublished field data). The pulp and peels of cassava, potato and taro; pineapple (peels), and bananas (peels, pulp and pseudo stems) provide energy and are source of fibre in ruminant nutrition. The husk and cocoa bean waste (cocoa); palm oil slurry or effluent and palm kernel cake (oil palm); copra cake, fresh coconut meat or desiccated coconut waste (coconut); molasses and bagasse (sugar) are produced locally and can be used in ruminant nutrition. For example desiccated coconut waste meal, a by-product from coconut cream production when dried, provides a high source of energy (21.3 GE MJ/kg) for growing goats (Aregheore and Tunabuna, 2000). Elsewhere, many of these materials are used in ruminant nutrition (Cantner, 1987; Balock *et al*, 1988).

UTILISATION IN RUMLNANT NUTRITION

Except for two studies (Amoah, 1985, Naidu, 1987) little information is available on the extent to which smalholder farmers in these countries utilise

crop residues and agro industrial by-products as livestock feed. During my visits, it was observed that subsistence farmers underutilise these resources. Of the four countries, it is only in Fiji that available agro-industrial By-products such as brewers' grains, wheatlings and molasses are mixed with other feed ingredients in the production of commercial livestock feed (Crest Feeds, Fiji). In Samoa, the Solomon Islands and Vanuatu, where there are no commercial feed-millers, it was observed that brewery, cocoa, oil palm, rice and brewery by-products are dumped far away from factory sites to waste away. Meanwhile, other By-products from coconut (copra cake) and oil palm (palm kernel meal) are exported. Further observation showed that where these crop residues and agro-industrial by-products are available and utilised, farmers do not incorporate them effectively into their year round livestock feeding programs due to lack of storage facilities and technical know-how on treatment and processing methods and on formulating rations with them. Most farmers that collect these by-products from the site where they are dumped use them as emergency feed for goats and sheep; beef and dairy cattle. For example, it was observed in the sugar cane belt of Fiji, that after the harvesting of canes, farmers lead their goats, sheep and cattle to graze *in situ* on the bagasse instead of harvesting and processing them for future usage. This is also the practice after the harvest of rice farms in Fiji and the Solomon Islands. A benchmark survey has shown that many crop residues and agro-industrial by-products are potentially available in the Pacific Island countries (Table 1). The challenge before the animal nutritionist is how to improve the utilisation of these residues and hence assist smallholder farmers to solve feed problems.

Constraints on the use of crop residues and agro-industrial by-products include bulkiness, poor nutritive value and the unsuitability of some for direct animal use. Research has shown that supplementation with molasses, non-protein nitrogen sources, chemical and physical (grinding) treatments could improve the nutritive value and intake and hence response of animals to these by-products (Aregheore, 1998; Makkar *et al*, 1999; Leng, 199; Reddy and Reddy, 1992; Preston, 1986; Sundstøl *et al*, 1979). Physical treatment would be more useful in improving the nutritive value of the coarse products and more economically feasible than the chemical treatment in the Pacific Island countries. At present there is evidence in the Pacific Island countries that ruminant livestock production could be substantially increased if more efficient methods were introduced to use available crop residues and agro-industrial by-products (Aregheore and Susumu, 2000; Aregheore and Tunabuna 2000).

In the Pacific Island countries, present research is now focused on:

-improving methods of harvesting, handling and storing of crop residues so as to reduce wastage
-developing treatment methods that could increase the availability of nutrients
-introducing supplementation techniques that can correct nutrient deficiencies
-determining seasonal availability and nutritional values of residues and by-products with a view to formulating adequate year round feeding systems.

The tremendous potential of crop residues and agro-industrial by products in upholding the aims of livestock production has been indicated in this paper. Judicious use of these in conjunction with the grass/pasture carryover from the wet season in the form of hay and silage will definitely reduce the dry season weight loss in ruminant livestock and encourage acceptable weight gains while reducing mortality. However, there is a need for more research to arrive at the optimal utilisation of these products for livestock production in the Pacific Island countries. Also the investigation and alternative legumes and browse species for supplementation of crop residues and agro-industrial by products (Devendra, 1985) should be emphasised. It is ideal to match ruminant livestock production with locally available feed resources (Leng, 1986; Dargie, 1989). In conclusion, efforts should me made for the development of rations based on readily available resources in these Pacific Island countries where ruminant livestock population is greater and feed availability is seasonal, in order to assist the smallholder farmers.

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