EFFECTS OF FEEDING GRAIN ALCOHOL FERMENTATION BY-PRODUCTS TO MERINO SHEEP

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SUMMARY

Distillers wastes (stillage) from cereal grains produced in a pilot small scale ethanol production plant were fed to young Merino ewes for two months during October-December, 1981. Liveweight changes, wool production, ovulation and daily consumption of feed were recorded. Animals in control groups fed on oaten hay lost 40 g/day while those supplemented with stillage or with formalin treated stillage gained 36 g/day and 46 g/day, respectively. Significant improvements were also recorded in wool production in supplemented ewes.

INTRODUCTION

Distillers wastes (stillage) from cereal grains have been tradiationallyused for livestock fodder in many overseas countries (Koivurinta *et al.* 1980). The results are inconsistent (Mathison 1981) although stillage appears to be particularly suitable for ruminants, and less for pigs or poultry (Stewart et *al.* 1979, Anon 1980).

Little *et al.* (1964) reported that corn distillers dried solubles contained rumen stimulatory factor(s) which increased cellulose digestion. Hatch *et al.* (1972) confirmed that diets fortified with low levels (2.5%) of condensed distillers solubles improved daily gain, feed efficiency and urea nitrogen utilization in experiments with steers. However, these workers also reported that the inclusion of higher levels (5%) of distillers solubles resulted in smaller improvements in gain and feed efficiency than with the 2.5% level and had a detrimental effect on nitrogen utilization.

The reduced animal performance appears to be caused by inhibitory effect of fat and fatty acids. This was suggested as early as 1957, and again in 1961 by Grainger *et al.* who recommended the use of calcium supplementation to counteract the bacteriostatic action of long-chain fatty acids on the cellulolytic bacteria in the rumen. The original hypothesis has been subsequently confirmed in studies of El Hag and Miller (1972). Acidity has been also identified as a major factor limiting the palatability and storage of stillage (Anon 1980).

In absence of reliable Australian data on the nutritive value of stillage from cereal grains, severalexperimentswereconducted at Muresk Agricultural College during 1980-1981, as part of a comprehensive evaluation of small scale ethanol production. Some of the results recorded with sheep are presented in this paper.

MATERIALS AND METHODS

Young Merino ewes (17-19 months old) from the College flock were conditioned on a diet of oaten hay (16 animals) and oaten hay and stillage 32 animals) for nine days, starved of feed and water for 18 hours, weighed and then allocated to three treatments. Ewes were placed in groups of four in 2 x 2 m pens and offered one of the following diets (sampled and analysed on a weekly basis).

Control	Chopped oaten hay (8.1%CP, 55.2%DMD).
Stillage	Chopped oaten hay plus distillers solids (21.2%CP, 50.2%DMD) and residues (36.2%CP, 64.4%DMD).
Formalin Treated Stillage	Distillers solids and residues listed above treated with 40% w/v commercial formalin (at approx. 1.5 g formaldehyde per 100 g crude protein).

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All diets were offered *ad libitum*, and daily intakes of all solid and liquid components were recorded for each pen. Calcium was added at levels ranging from 0.25% to 0.75% on a dry matter basis to improve the pH and palatability of the stillage.

Further information on the origin of distillation by-products is given in Figure 1.

After 49 days teaser rams were introduced in a neighbouring enclosure and kept there for the remaining ten days. On completion of the experiment all ewes were starved for 18 hours, weighed and laparoscopy was used to determine if the ewes had recently ovulated. Wool growth was also measured in 132cm^2 midside samples to evaluate the effects of supplements and formalin treatment on the production of greasy fleece.

RESULTS

Liveweight changes after 59 days are shown in Table 1 and the information on the average daily intake of dry matter (DM) and crude protein (CP) is given in Table 2.

Sheep readily accepted distillers stillage and voluntary intake increased with increased calcium supplementation throughout. Distillers residues containing 4.5%DM were also consumed in preference to water (4505 kg and 4040 kg v. 2433 kg) given to controls.

Oaten hay failed to satisfy the maintenance requirements of ewes in the control group but modest gains were recorded in supplemented groups.

Even more pronounced differences were recorded in the production of greasy wool (Table 3). No trends in ovulatory responses were apparent.

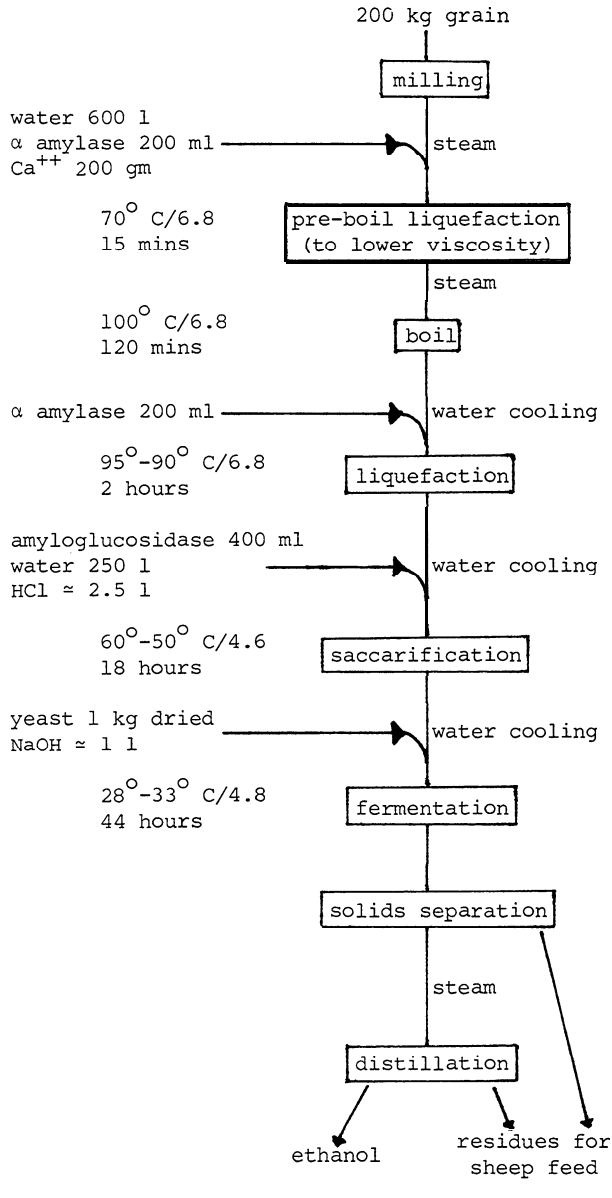

Fig. 1 Process flow chart of Muresk ethanol pilot plant showing heat and material inputs and conditions experienced during production. Full-scale facilities would have a continuous stillage output by operating a number of fermentous, each having a capacity of around 3 tonnes of grain/batch.

TABLE 1 Iiveweight changes after 59 days - Treatment means (S.E.)

Group	Start	Finish	Gain kg	Daily Gain g
Control	35.1 (0.85)	33.1 (0.75)	-2.0	-40
Stillage	34.3 (0.88)	36.4 (0.91)	2.1	36
Stillage & Formalin	34.9 (1.07)	37.6 (0.92)	2.7	46

TABLE 2 Mean daily intakes of dry matter and crude protein (g)

Group			Distillers Solids	Distillers Residues	Total
Control	DM	887	0	0	887
	CP	72	0	0	72
Stillage	DM	791	118	213	1122
	CP	56	25	77	158
Stillage & Formalin	DM	796	114	191	1101
	CP	57	24	69	150

No losses or health problems were experienced during this study.

TABLE 3 Mean -greasy wool production and number of ovulating ewesinexperimental groups

Control	Wool g (S.E.)	Ovulating Ewes
Control	8.9 (0.34)	12/16
Stillage	12.8 (0.72)	13/16
Stillage & Formalin	12.3 (0.64)	14/16

DISCUSSION

The loss of liveweight in the control group was due to insufficient intake of dry matter and crude protein to satisfy the maintenance requirement of these sheep (N.R.C. 1975).

Although there was a slight trend towards higher daily gains in animals fed with formalin treated stillage there was no difference in wool production between stillage treatments. This may be caused by the relatively low protein concentrations in supplemented diets (13.6 - 14.1% CP) (Ferguson 1975) or by the high degree of resistance to protein degradation in the rumen associated with fermentation by-products (Belasco et *al*. 1978).

The ovulatory activityofthe ewes is quite satisfactory for young Merino ewes during November-December in Western Australia.

The economics of farm ethanol production from starch or sugar crops have been continually limited by an inability to offset the opportunity cost of the feedstock. Thus the ability to optimise the use of the by-product of fermentation and distillation is of paramount importance (Buckland and Buik 1980).

Stillage offers a valuable protein and energy supplement for the use in intensive sheep or cattle production units, although the high moisture content and relatively short storage life are likely to reduce its commercial valueorrestrict the potential use to individual farms or co-operative ventures.

In future studies of alternative energy sources, the grain stillage should be regarded as a valuable by-product and not as a pollutant.

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