THE EFFECTS OF ALKALI PROCESSING OF DIET COMPONENTS UPON DIETARY CHANGES, LIVE WEIGHT AND WOOL PRODUCTION OF MERINO SHEEP

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SUMMARY

This experiment was aimed to investigate the effects of alkali treatment on roughage component in diets and wheat grain. *Forty* five Merino wethers were fed *ad libitum* on one of three diets which *were* alkali pretreated at 0%, 3.4% or 5.4% (w/w) respectively. In four successive periods, each of six weeks, the sheep were fed on roughage pellets (period I), roughage pellets and wheat grain (50:50, period II), alkali pretreated wheat grain (buffered 6% sodium bentonite, w/w) and 200 g lupin supplement (period III) or roughage pellets and lucerne chaff (60:40, period IV). Alkali pretreatment of roughage in pellet diets increased the intake, live weight gain and wool growth of wethers ($P<0.05$). However, alkali pretreated wheat grain with sodium bentonite clay (at 6% of wheat) decreased the intake and caused live weight loss in the treatment groups. The mean intake, live weight gain and wool growth did not differ significantly on diets of period IV. Wool growth rate and wool characteristics closely reflected the patterns of intake and live weight gains.

INTRODUCTION

Feed shortage is often a limitation in extensive grazing animal systems, in the arid and semi-arid regions of Australia especially during a prolonged drought. In co-operation with the Australian Wool Council Drought Feeding Research Project the effect of various physical and chemical treatments of *poor* quality roughages, grain feeding and supplementation for wool growth were studied (Wuliji 1988). This paper reports the effects of mixed alkali treatment of component of diets on the intake, live weight and wool production of Merino wethers in a simulated drought feeding situation.

MATERIALS AND METHODS

Forty-five Merino wethers averaging 50 kg live weight were selected from a commercial property in southern N.S.W. and transported to the Sheep Research Unit of the University of New South Wales, at Little Bay. Sheep were allocated to one of three treatments by stratified randomization and each group was well balanced for live weight and midside fleece fibre diameter, there being two replicate subgroups of either seven or eight sheep in each, Each subgroup occupied a separate sheltered yard fitted with slatted wooden floors. Three roughage basal pellet diets were formulated, namely, control pellet (c,: 0% alkali), low alkali pellet (t,: 3.4%) and high alkali pellet (t,: 5.4%) diets. Oat hull was used as the main roughage source at dry matter ratios of *58.5%* (c_0), 55.1% (t,) and 53.1 (t,) in the diet respectively. In each diet 18% lupin, 16% wheat, 3% molasses, 1.5% urea were used and remainder was mineral premix. The chemical composition and digestibility of the diets were determined by conventional procedures, The chemical composition of four main feedstuffs used in this experiment was given in Table 1. An equal proportion of calcium hydroxide ($Ca(OH)_2$) and sodium hydroxide (NaOH) were used as alkali sources in pellet processing. The dietary formulation, alkali processing and digestibility of roughage basal pellets used in this experiment have been published previously (Wuliji and McManus 1987). A diet of lucerne chaff was fed to all groups until the experimental diets *were* introduced, Sheep were fed

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in groups daily from a hopper feeder. Dry matter content of feed was measured at every feeding and feed residues were collected weekly. Sheep were adapted initially to experimental diets over 10 days. This was then followed by four successive periods, each of *six* weeks of *ad libitum* feeding with different diets. The dietary transitions were the roughage basal pellets (period I), roughage basal pellets and wheat grain (50:50) with 200 g lupin supplements (period II), alkali treated wheat grain and 200 g lupin supplements (period III), and in period IV, roughage basal pellets and lucerne chaff (60:40). The control sheep initially experienced a serious weight loss and therefore 200-400 g wheat grain supplement was gradually introduced from the fourth week of period I to all groups. Alkali treatment of wheat grains was carried out daily 24 hours prior to feeding. The pre-liquidised 40% alkali ($NaOH + Ca(OH)_2$) solution was sprayed onto the wheat grain in a feed mixer at 3.4% (t,) and 5.4% (t,) dry matter (w/w) equivalent respectively. For control diet (c,) the same volume of water was used instead of alkali solution. An addition of 6% sodium bentonite was mixed with wheat grain as a buffering agent for all groups in period III diets. In each period the intake ratios of basic diets and supplements were recorded.

Table 1 Chemical composition of individual feedstuff (%)

Feeds	OM	NDF	ADF	CL	HC	N	PL	ST	GE(kJ/g)
Oat hull	93.2	64.0	31.2	28.3	32.8	0.6	2.9	-	-
Lucerne chaff	91.2	40.0	27.6	21.7	12.4	3.0	5.9	21.5	18.7
Wheat grain	98.4	16.5	2.8	2.2	13.6	2.3	0.6	78.0	18.7
Lupin seed	96.8	23.3	17.6	13.7	5.8	5.3	2.5	41.5	20.1

OM: organic matter; NDF: neutral detergent fibre; ADF: acid detergent fibre; CL: cellulose; HC: hemicellulose; N: nitrogen; PL: permanganate lignin; ST: starch; GE: gross energy.

Dry matter intake (DMI) and live weight (LW) values were recorded at weekly intervals. Mean dry matter intake and live weight gain (LWG) were calculated at the end of each experimental period. The wool growth rate (WG) of each corresponding period was determined by a wool staple dye-banding technique (Chapman and Wheeler 1963) allowing a three day fibre emergence lag period. Wool growth was calculated by dyeband interval ratios and presented as g/d/head. Midside patch wool fibre diameter (FD) was determined on hand-core sampled fibre snippets using a Fibre Fineness Distribution Analyser (FFDA) (Information Electronics Ltd, Canberra), Wool staple strength (Newtons/kilotex) was measured using the Staple Breaker (Agritest Ltd, Australia). Analysis of variance for split-plot procedure and Duncan's new multiple range test were adopted to compare means between treatments and between the experimental periods within treatments.

RESULTS

The ratios of pellet and grain in the intake after introduction of grain supplement from fourth week of period I were 67:33 (c,), 71:29 (t,) and 74:26 (t,) respectively; and in period II were 45:55 (c,), 53:47 (t,) and 55:45 (t,); while in period IV, the ratios of pellet and lucerne chaff were 59:41 for control group and 58:42 for treatment groups (t_1 and t_2). With wheat grain (period I) or wheat grain and lupin supplementation (period II), the ratio of pelletized roughage basal diet eaten was reduced, but to a lesser extent in the alkali pre-treated groups.

The mean DMI, LWG, WG and wool characteristics for all four periods are shown in Table 2. The DMI increased in response to both alkali pre-treatment when roughage basal pellet diets were fed in period I ($P<0.05$), and such a level of significance was true for t_2 in period II. This contrasts with the patterns of intake when groups received grain diets only in period III. The control group had a higher intake ($P<0.05$) than was found for both groups fed alkali pre-treated wheat grain. The mean intake of groups did not significantly differ on the diet of basal pellets with lucerne chaff supplementation in period IV.

Table 2 Mean ($\pm$ s.e.) dry matter intake, live weight gain, wool growth rate and wool characteristics of groups assigned to three different diets pre-treated with 0% (c,), low (t,) and high (t,) levels of alkali in four successive periods

Periods		I		II		III		IV	
Dry matter intake (g/day)	c_0	694^{aA}	46	981^{aA}	87	778^{bA}	28	1199^{aC}	9
	t_1	922^{bB}	2	1158^{abC}	94	581^{aA}	62	1096^{aB}	31
	t_2	936^{bB}	45	1201^{bC}	57	568^{aA}	73	1044^{aBC}	93
Live weight gain (g/day)	c_0	-4^{aA}	5	80^{aB}	4	84^{bB}	4	128^{aB}	8
	t_1	128^{B}	2	152^{bB}	6	-15^{aA}	6	118^{aB}	19
	t_2	97^{b}	8	126^{abB}	2	-1^{aA}	10	110^{aB}	3
Wool growth rate (g/day)	c_0	6.8^{aA}	0.6	7.9^{aB}	0.9	8.2^{aB}	0.9	9.4^{aC}	0.8
	t_1	8.4^{bA}	0.7	8.9^{abA}	0.8	8.5^{aA}	0.6	10.1^{aB}	0.6
	t_2	8.5^{bA}	0.4	$9.1b^{A}$	0.3	8.4^{aA}	0.5	10.4^{aB}	0.3
Fibre diameter (u)	c_0	19.6^{aA}	0.4	20.0^{aAB}	0.9	20.9^{aB}	0.6	22.1^{bC}	0.5
	t_1	19.6^{aA}	0.6	21.2^{aB}	0.6	21.0^{aB}	0.5	21.6^{abB}	0.3
	t_2	19.6^{aA}	0.4	21.3^{aB}	0.5	20.9^{aAB}	0.4	21.0^{aB}	0.6
Staple strength (N/ktex)	c_0	45.1^{aA}	4.6	52.2^{aAB}	4.8	61.3^{aAB}	4.4	63.2^{aBC}	4.8
	t_1	38.8^{aA}	4.4	45.5^{aAB}	4.5	60.6^{aC}	5.7	57.5^{aBC}	5.1
	t_2	40.9^{aA}	2.7	54.1^{aB}	4.0	53.8^{aAB}	5.3	57.8^{aB}	4.2

Different lower case letters denote significant difference between treatments within periods ($P<0.05$); uppercase letters denote significant difference between periods ($P<0.05$).

Sheep fed alkali pre-treated diet showed higher LWG in periods I and II ($P<0.05$), in conformity with their intake patterns described earlier. Conversely, live weight gains reduced significantly ($P<0.05$) in period III between control and treated diets. When groups progressed *to* period IV, the LW values gradually recovered and no significant differences were found for LWG.

A significant increase in wool growth ($P<0.05$) was found for the wethers fed the alkali reated diet groups in period I, but WG did not differ between treatment levels. In period II, WG was only significantly increased by t_1 while in period III wool growth was unaffected by treatments, but there *was* a slight overall reduction in wool growth from period II. In contrast, for the treatment groups WG in period IV was significantly above ($P<0.05$) the previous three periods. For the control group there was an increase in wool growth from period I to II and III ($P<0.05$) with a further increase ($P<0.05$) in period IV over the previous three dietary regimes. Fibre diameter was not significantly altered from dietary treatment in any of the periods. In the control group there *was an* increase FD ($P<0.05$) between the first three periods and period IV. Similarly, staple strength was not altered by dietary treatment in any of the periods, but tended to improve with increased DMI.

DISCUSSION

Alkali pre-treatment of the roughage component in pellets has increased intake, live weight gain and wool growth. Alkali pre-treated wheat grain fed with lupin seed with sodium bentonite clay to minimise dietary upset e.g. acidosis in the period III reduced intake and LWG in the treatment groups (t_1 and t_2). It would appear that sodium bentonite alone, or in reaction with the alkali, was deleterious to intake and general animal performance, but these effects were overcome when the animals were transferred to the next dietary combination. As the control group showed a relative better intake of wheat grain with bentonite it indicates that such buffered grain can be fed safely. Generally, WG and its characteristics were increased with increased DMI and LWG in the progressing dietary periods. Staple strength was significantly ($P<0.05$) improved in later periods; however, incidence of break was higher in period I for control and higher in period III for treatment groups, where reduction of FD along staple occurred (Wuliji 1988). Wool growth and LWG were linearly related to dry matter intake and live weight in this experiment, although feed conversion to wool growth ratios were higher at lower levels of dry matter intake.

It is concluded that a range of poor quality roughages can be uccessfully utilized after alkali pre-treatment and with grain supplement. Alternatively, sodium bentonite clay buffered wheat grain feeding in drought can be practised.

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