

CUBED LUCERNE HAY, OATS AND GRAIN LEGUMES AND PELLETS
AS DIETS FOR EXPORT SHEEP

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SUMMARY

Two hundred and eighty Merino wethers were adapted to five experimental diets over four or 11 days. The five diets were (1) lucerne cubes, (2) oats, (3) 3:1 oats:lupins, (4) 3:1 oats:peas and (5) a pelleted diet. The sheep were then moved to intensive indoor pens and fed the diets for a further 21 days.

Sheep fed lucerne cubes and pellets maintained live weight but sheep fed grain diets lost weight. Increasing the duration of adaptation significantly reduced liveweight loss in sheep fed oats (-2.36 vs -6.27 kg, $P<0.001$) and oats-grain legume mixtures (-2.30 vs -3.88 kg, $P<0.05$) but did not affect the performance of sheep fed lucerne cubes or pellets. The inclusion of grain legumes reduced liveweight loss in sheep introduced to oats over four days (-3.88 vs -6.27 kg, $P<0.05$), but not over 11 days. There was no difference between peas and lupins.

It is concluded that lucerne cubes but not oat based grain diets may have potential as an alternative feed to pellets for export sheep. (Keywords: Lucerne, oats, grain legumes, pellets, adaptation, sheep).

INTRODUCTION

Australia currently exports 6.5-7.2 million sheep annually by sea to the Middle East. The sheep, mainly 2-4 year old wethers, are fed pelleted diets during shipment and are adapted to these diets in feedlots for four to eight days preceding shipping. The industry currently uses around 150,000 tonnes of pellets each year.

Two of the main problems associated with the use of pellets in the industry are poor durability during pelleting and difficulties sometimes met in adapting sheep to this diet (Grandin 1983). The industry has expressed interest in alternative feeds to pellets, the main possibilities being grains and cubed hay.

This paper reports the effects of lucerne cubes, oats, oat and grain legume mixtures and pellet diets on the performance of sheep, introduced to these diets over 4 or 11 days. The sheep were held in yard and pen conditions simulating the commercial assembly and sea shipment of sheep.

MATERIALS AND METHODS

Five diets and two periods of adaptation were compared in a 5 x 2 randomized block design of two replicates.

Experimental animals Two hundred and eighty Merino wethers, 3-4 years old, and weighing (mean \pm s.e.) 46.3 ± 0.2 kg, were randomly allocated to 20 groups of 14 wethers, treated with injectable anthelmintic, tagged and fasted overnight. The sheep had access to little or no feed for 48 hours prior to the fast, being driven, shorn and transported 80 km by road during that time.

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Experimental diets The five diets were (1) lucerne cubes, (2) oats, (3) 3:1 oats:lupins, (4) 3:1 oats:peas and (5) pellets. Composition of the feeds is shown in Table 1.

Table 1 Chemical composition (dry matter basis), estimated metabolizable energy (ME) content, bulk densities and bulk energy densities (both as air dry basis) of the feedstuffs used in the five experimental diets

	Lucerne cubes	Oats	Lupins	Peas	Pellets
Moisture (%)	9.3	8.7	7.5	7.4	8.9
Acid detergent fibre (%)	25.4	10.6	18.4	7.2	24.1
Crude protein (%)	18.5	12.5	33.0	27.2	12.6
Starch (%)	0.6	29.6	0.2	24.5	14.8
ME (MJ/kg DM) *	10.5	12.0	13.2	13.4	10.5
Bulk density (kg/m ³)	438#	568	807	793	610
Bulk energy density (10 ³ MJ of ME/m ³)	4.19#	6.22	10.37	9.82	5.75

* Method of Oddy *et al.* (1983)

Value given for cubes as received, not mixed and augered - see text. This value probably underestimates bulk densities obtained during bulk handling of large tonnages.

The lucerne cubes (31 x 31 mm cross-sectional area) were passed through a Grasslands MO Mixall and augered into bags. This broke up the majority of cubes making them more suited for eating by sheep. The oat-grain legume diets were mixed daily in the ratio 3:1 oats:grain legumes during indoor feeding. During outdoor feeding, these diets consisted for 30% grain legumes.

Feeding management The sheep were first held in outdoor yards (5 m²/head) for 4 or 11 days and then moved to indoor pens (0.35 m²/head) for a further 21 days. The diets were fed in uncovered galvanized steel troughs. Indoors, sheep fed through a rail and had 12 cm trough length/sheep.

On the first four days of outdoor feeding, sheep were offered either 1000 g/day lucerne cubes or were progressively introduced to the grain and pelleted diets to reach 1000 g/day on day 4. Oaten hay was fed to sheep during adaptation to grain and pellets, being reduced from 800 to 200 g/day over the four days. Sheep held in the outdoor yards for 11 days were fed 1200 g of lucerne cubes or 1000 g of the pellets or grain diets daily for the remaining seven days. Sheep on the grain and pelleted diets also received 200 g hay/day during this period. During indoor feeding, the sheep were offered up to 1200 g/day of each of the diets and no hay was fed. Residues greater than 500 g in the mixed grain diets were fed back to counteract sheep selecting within their diets.

Measurements taken and statistical analysis Fasted live weights were recorded at the start and end of the experiment. Dry matter intakes were determined daily throughout the experiment. Accumulated mixed grain residues were removed each week and sieved to calculate the separate intakes of the different grains. At the end of the experiment, the total faecal dry matter output during indoor feeding was determined for each group. Digestive adaptation to the diets was estimated by scoring the consistency of rectal grab samples on the last day of feeding. Faeces were scored from 1 (pellets formed) to 4 (diarrhoea).

Liveweight change and feed intakes were tested by analysis of variance. Liveweight change classes and faeces scores were tested by Chi-square analysis of contingency tables and Log-linear methods.

RESULTS

Liveweight change No deaths occurred during the experiment. Sheep fed lucerne cubes or pellets maintained live weight while sheep fed grain diets lost considerable live weight (Table 2). There was a significant interaction ($P<0.05$) between diet and adaptation. Longer adaptation in outdoor yards had no effect on the performance of sheep fed lucerne cubes or pellets but significantly improved the performance of sheep fed grain diets ($P<0.001$). Sheep fed mixed grain diets tended to perform better ($P<0.05$) than sheep fed oats alone when adapted to these diets over four days but not when adapted over 11 days. There was no difference between the two grain legumes.

Differences in frequency distributions of liveweight changes were significant between diets ($\chi^2 = 50.5$, $P<0.001$) and adaptation ($\chi^2 = 15.0$, $P<0.001$). Twenty-eight per cent of the sheep lost >4.0 kg and 90% of these occurred in sheep fed the grain diets. Longer adaptation reduced the number of sheep losing >4.0 kg by half.

Feed intake During outdoor adaptation, sheep ate more ($P<0.001$) lucerne cubes than other diets (Table 2). Low intake of pellets during this period appeared to be partly due to rain (10 mm) that fell during days 2 to 4 of outdoor feeding, making the pellets unattractive to sheep.

During indoor feeding, intake of lucerne cubes and pellets was significantly higher ($P<0.001$) than the intake of grain diets (Table 2). Mean dry matter intake during indoor feeding was marginally higher ($P<0.10$) for sheep given longer compared with shorter adaptation (648 vs 576 g/day). There was no significant interaction between diet and adaptation. Observations and sieving data showed that sheep selected in favour of peas (7.9% peas in accumulated residues) and tended to discriminate against lupins (20.7% lupins in residues).

Table 2 Mean liveweight change during the entire experiment and mean dry matter intakes during outdoor adaptation and indoor feeding, of sheep fed five experimental diets and adapted over 4 or 11 days

Adaptation Diet	Liveweight change(kg)		Dry matter intake (g/d)			
			Outdoors [#]		Indoors	
	4 days	11 days	4 days	11 days	4 days	11 days
Lucerne cubes	-0.33 ^a	0.50 ^a	768 ^a	857 ^a	884 ^a	959 ^a
Oats	-6.27 ^d	-2.36 ^b	555 ^c	565 ^c	302 ^c	468 ^b
3:1 Oats:lupins	-4.37 ^{cd}	-1.85 ^{ab}	564 ^c	588 ^c	426 ^{bc}	471 ^b
3:1 Oats:peas	-3.39 ^{bc}	-2.74 ^b	564 ^c	572 ^c	444 ^b	438 ^{bc}
Pellets	-0.16 ^a	-0.04 ^a	495 ^d	630 ^b	834 ^a	906 ^a
S.E.D.	1.02		82		87	

Means in both columns and rows within parameters having different superscripts differ significantly. [#]Values do not include hay intake.

Faeces scores Observations made at the end of feeding showed that while no sheep were scouring (Score 4), 44% of sheep fed grain had wet and unformed faeces (Scores 2 and 3). All sheep fed lucerne cubes and pellets had properly formed faecal pellets (Score 1) at this time. These differences were highly significant ($\chi^2 = 91.3$, $P<0.001$). Longer adaptation reduced the incidence of wet and unformed faeces ($\chi^2 = 7.1$, $P<0.05$).

DISCUSSION

In the live-sheep export industry, a feed-lotting period is generally considered necessary to familiarize the sheep to the shipboard ration and also to adapt sheep to starch fermentation if diets high in cereal grains are to be fed. In the present experiment, four days adaptation was adequate for sheep fed pellets and lucerne cubes while eleven days was insufficient to promote satisfactory intake and growth rates in sheep fed the oat-based diets.

Scouring was observed in grain-fed sheep during outdoor feeding. In these sheep, differences in liveweight loss between adaptation treatments were greater than would be expected from differences in feed intake (Table 2). No completely satisfactory explanation can be given, however differences in the incidences of digestive disturbance between these treatments, as indicated by differences in faecal scores assessed at the end of indoor feeding, may partly account for this effect. Grain legumes are generally considered a safer feed than cereal grains possibly due to their lower starch content (Table 1). Probably for this reason their substitution for oats improved the performance of sheep in the four day adaptation treatment. However, the intake and performance of sheep fed the mixed grain diets was still poor.

In the present study, lucerne cubes broken up in a feed mixer were fed since previous experience demonstrated that sheep had difficulty eating the whole cubes. In a separate study (unpublished data) individually penned sheep offered whole or broken lucerne cubes ate (mean \pm s.e.) 1009 ± 101 and 1406 ± 52 g/day ($P < 0.05$) respectively. At this level of intake, approximately 20% of the cubes offered were wasted, being either spilled or rejected. Cubes of smaller dimension than those used in the present experiment can be produced and might be more readily eaten by sheep without prior treatment, but their higher cost may prohibit their widespread adoption by the export industry.

Shipboard environment may be affected by the type of diet fed. For example, sheep fed lucerne cubes and pellets had total faecal outputs three to four times higher than that of sheep fed grain diets. However sheep on the grain diets were heavily soiled with faeces compared with other sheep. Higher ambient concentrations of ammonia may also occur in high protein diets such as lucerne cubes and diets high in grain legumes. In the present experiment, maximum levels of 15 and 23 ppm ammonia were recorded over pens where oats and lucerne cubes were fed respectively.

It is concluded that cubed lucerne hay is a possible alternative feed to pellets for export sheep provided its lower density can be accommodated on live-sheep export ships.

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