LUPIN GRAIN SUPPLEMENTS FOR SHEEP AND CATTLE

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SUMMARY

Lupins is an ideal feedstuff for both sheep and cattle. It is completely safe to feed and it is rich in both protein and energy having a crude protein value of about 30% and a metabolizable energy value of 13-13.5 megajoules per kg of dry matter.

Lupins is an excellent supplementary feed and can be effectively fed in a whole range of situations. The feeding of lupins has produced significant responses in sheep and cattle in:

* Reproduction
* Fattening of slaughter stock
* Drought-feeding situations
* Milk production
* Weaner growth
* Wool production

Added to this, lupins is easily handled and stored and is very resistant to damage by insects and other pests. It is a commodity that readily appreciates in market value if stored on the farm after harvest.

This paper presents the findings from a range of experiments conducted at Rutherglen Research Institute, Victoria in which lupin grain has been fed to sheep and cattle in a variety of situations.

INTRODUCTION

The Mediterranean type climate of Southern Australia is characterised by mild, wet winters and hot, dry summers. The period of 'summer drought' can last up to 6 months. The predominant forage available to grazing sheep and cattle during this period is dry, mature herbage from annual crops and pastures. This usually provides only a maintenance or sub-maintenance diet for grazing livestock.

During the dry period, farmers often feed supplements to either boost growth rates or reproductive performance of their livestock. Lupin grain has become popular for this purpose due to its: increasing availability; high energy and protein content; competitive price and convenience of handling and feeding.

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An effective supplement for- livestock grazing abundant, dry forage is one that stimulates those stock to eat the forage - rather than substituting the supplement for the forage. Research at Rutherglen Research Institute has examined the influence of lupin grain fed to both sheep and cattle on the intake of poor qualty roughage. Other research has investigated the effect of lupin grain fed to sheep in a range of situations, such as: during the mating of ewes; to lambing ewes; ewes on drought rations; early-weaned lambs; lot-fed lambs.

NUTRITIONAL VALUE OF LUPIN GRAIN

The lupin grain used in all of the feeding research reported here was Lupinus angustifolius. A summary of the nutritional composition of Lupinus angustifolius is shown in Table 1.

TABLE 1 Nutritional composition of lupin grain (Lupinus angustifolius)

Chemical composition	Percentage of dry matter*
Crude protein	28-34
Crude fibre	13-17
Crude fat (oil)	5-7
Ash (total minerals)	2.5-4.0
Nitrogen-free extract	34-38
Mineral composition	
Calcium	0.19-0.26
Phosphorus	0.27-0.40
Magnesium	0.13-0.31
Potassium	0.85-1.15
Sodium	0.05-0.06
Sulphur	0.25

Trace mineral composition	Parts per million of dry matter*
Aluminium	15
Boron	16
Cobalt	<1
Copper	1-7
Iron	55-75
Manganese	10-300
Molybdenum	0.1-6
Zinc	34-43

Energy	Megajoules per kg of dry matter*
Metabolizable Energy Ruminants	13-13.5

Digestibililty of Dry Matter* (whole lupins)	Percentage
Sheep	84-88
Cattle	75-82

*Dry Matter Percentage is usually 87-92%

LUPIN GRAIN - EFFECT ON ROUGHAGE INTAKE

A series of experiments were conducted that examined the influence of lupin grain and various other supplements on the intake of poor quality, dry roughage by both young sheep, wethers and young cattle (Kenney, 1981; Smith, 1984; Smith and Warren, 1986).

Results from that work (Table 2) show that lupin grain stimulated both young sheep and young cattle to consume more poor quality roughage. Hence the performance of the stock was boosted by both the supplement and the extra roughage consumed. However, lupin grain was not as effective in that role as cottonseed meal supplements.

The wethers were an exception to this pattern, where the trend was that the lupin supplement substituted for roughage intake. This could have been due to the lower protein requirements of those older sheep or that the low digestibility. of the roughage restricted total DM intake.

TABLE 2 Influence of supplements on roughage intake by lambs and steers

Experiment	Pens or Grazing	Roughage Crude Protein (%)	Roughage Digestible Dry Matter (%)	Supplement (g/hd/day)	Roughage Intake - % Greater Than Control	Liveweight Change+ (g/day)
1a Lambs	Pens	7	43	Control -	-	-76[a]
				Lupins 85	42	1[b]
				CSM* 75	67	61[c]
1b Lambs	Pens	4	42	Control -	-	-96[a]
				Lupins 150	46	-25[b]
				CSM* 150	49	-15[b]
1c Wethers	Outdoor Pens, fed cut, dry pasture	9	47	Control -	-	-160
				Lupins 180	-7	-80
				Lupins 360	-4	0
				Lupins 540	-7	40
				Lupins 650	-45	65
2 Steers	Pens	5	58	Control -		-964[a]
				Lupins 850	79	126[b]
3 Steers	Grazing	5	49	Control -	-	-214[a]
				Lupins 900	11‡	119[b]
				CSM* 900	41‡	321[c]

* Cottonseed meal supplement
‡ From calculations
\+ Within experiments, values with different superscripts are significantly different ($P<0.05$)

LUPIN GRAIN - EFFECTS ON EWE REPRODUCTION, LAMBING PERFORMANCE, LAMB SURVIVAL AND GROWTH

Reproduction

The effect of lupin grain consumed by ewes during mating has clearly been responsible for reproduction responses when ewes were joined while grazing on lupin stubble, compared to grazing dry pasture. This practice produced 24% more lambs per year over 4 years of experimentation (Kenney and Roberts, 1987). The response was due to more twins being born rather than more ewes giving birth. The same research found that ewes fed 400 g/day lupin grain during mating on dry pasture performed at an intermediate level between the lupin stubble and the dry pasture-only treatments (Table 3).

TABLE 3 Production of ewes grazing stubble or pasture with and without a lupin grain supplement

Measurement	Treatment*			SED
	Pasture	Pasture & Lupins	Stubble	
Liveweight change (g/day)	-194 a	41 b	83 b	29
Ewes lambing/ ewe mated	0.80 a	0.80 a	0.85 a	0.03
Lambs born/ ewe mated	0.97 a	1.07 ab	1.25 b	0.06
Fecundity	1.21	1.34	1.47	0.07
Wool production‡	1.00 a	1.62 b	1.58 b	0.03

* Values followed by the same letter are not signficantly different ($P < 0.05$)

‡ Expressed as a ratio of wool produced by ewes grazing pasture

Lambing ewes

Lupin grain has been shown to be a more effective supplement than oats or wheat when fed to lambing ewes fed poor quality hay as the balance of their diet (Kenney and Roberts, 1984).

In the results below (Table 4), lupin grain was clearly more effective than wheat, but no better than oats. However, oats tends to be a variable commodity in terms of both energy and protein contents, and the results when oats is fed, can vary accordingly.

TABLE 4 Production of ewes and lambs fed grain supplements with poor quality hay

Observation	Supplement (300 g/day)*			
	Nil	Lupins	Oats	Wheat
Birth weight (kg)	3.7a	4.0b	3.8a	3.9ab
Lamb growth (g/day) from birth to 6 weeks	155a	196b	183b	175b
Lamb survival (%)	81	93	92	82
Milk production (ml/hr)	39a	62d	58c	49b
Fleece weight (kg)	2.8a	3.0b	3.0b	2.9ab
Tender fleeces (%)	40a	10b	10b	30a
Barren ewes next lambing (%)	29	9	25	23

* Values followed by the same letter are not significantly different ($P < 0.05$)

Drought-fed ewes

Under drought-feeding conditions, the production of ewes fed oats or wheat as almost a total diet has been improved by replacing some of the cereal grain with lupin grain (Kenney, 1985; Kenney'and Smith, 1985). Maximum responses were achieved at an inclusion rate of about 30% lupin grain. Although responses for both wheat and oat diets were similar, the overall level of production of ewes fed the oat diet was higher than for the wheat diet (Table 5).

TABLE 5 Production of lambing ewes fed oats or wheat with or without lupins, during drought

Observation	Cereal grain		Lupins	
	Wheat	Oats	Yes	No
Lambs weaned per ewe lambing	0.63**	0.79	0.77*	0.65
Birth weight (kg)	4.11	4.14	4.23**	4.01
Lamb growth (g/day):				
0-17 days	179**	209	204*	184
17-38 days	93	123	123	92
Milk production (ml/hr)	34	40	46**	28

* $P < 0.05$ between pairs
** $P < 0.01$ between pairs

Early-weaned lambs

Early-weaned lambs grow best on all-lupin diets, but the majority of that response can be obtained from including a proportion of lupin grain in cereal-based diets (Kenney, 1986). In contrast with adult animals, lambs grow better when fed with wheat than with oats and there is less effect of including lupins with wheat than with oats. However, when the lambs are poor, provision of lupins in either wheat or oat diets may be essential to reduce deaths. The most important effect of lupins is to increase intake rate and thus weight gains with a reduction in feed conversion ratios.

TABLE 6 Effect of relative proportions of cereal and lupin grain fed to early-weaned lambs on the apparent DM digestibility intake and conversion of feed to carcase gain.'

	Percentage of grain fed*						
	Lupins	Oats		Barley		Wheat	
	100	50	100	50	100	50	100
Feed DM:							
Digestibility (%)	83	80	73	81	75	84	84
Intake (g/day)	710	610	390	760	550	700	700
Conversion ratio:							
DM intake: carcase gain	6.9	8.0	11.1	8.0	12.1	7.8	8.4

* Balance of grain fed was lupins

DISCUSSION

The results presented in this paper demonstrate that lupin grain can significantly improve the production Of both sheep and cattle in a wide range of feeding situati0ns. This conclusion is supported by authors such as Rowe (1986) who claims that lupin grain is the most appropriate supplement for sheep grazing dry forage.

One of the best opportunities for feeding lupin grain is before and during mating. This has been frequently shown to boost the fecundity of ewes in particular. Teleni et al, (1985) reported that feeding ewes a lupin supplement for 10 days before ovulation significantly increased ovualtion rate. That study showed that ovulation rate in ewes could be similarly increased by intravenous infusions of glucose, acetate, a mixture of glucose plus acetate and a supplement of 750 g/day of lupin grain. The work suggested that glucose was the principal nutrient supplied by the lupins to which ovulation rate responded. Rowe (1986) concluded that short-term effects of nutrition on ovulation rate are mediated through pathways associated with the synthesis and/or utilization of glucose, but it was unclear what the pathways

were and whether other factors were involved. Hence, current opinion is that the effect of lupins on ovulation rate is due to its ability to provide energy (glucose) rather than amino acids for specific protein requirements.

On the other hand, a wide range of pen and field experiments have shown significant advantages of feeding lupins, compared to cereal grains of comparable ME contents, to young sheep or cattle consuming poor quality dry forage. Such responses include liveweight gain, milk production, wool growth and feed conversion efficiency. The results suggest that the higher protein content of lupin grain is mainly responsible for the responses in those situations. There does not seem to be any conclusive evidence regarding the mechanism of the response in these situations. It could be due to a more efficient metabolism of the protein fraction of the lupin grain. Hume (1974) found that the protein in lupin meal is relatively soluble (quickly degraded) in the rumen. Hence it seems unlikely that responses to lupin-feeding are due to a bypass protein effect (protein being digested post-ruminally) unless a reasonable proportion of lupin grain particles get beyond the rumen when the grain is fed whole or only coarsely rolled (which are the common forms) rather than ground to a meal.

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