

Lablab purpureus SEED AS A SUPPLEMENT FOR GOATS FED LOW QUALITY ROUGHAGE

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Summary

Young goats were fed low quality roughage *ad libitum* and supplements of insect-damaged *Lablab purpureus* (var. Highworth) seed fed at approximately 3, 6 or 12 g/kg liveweight (LW), or sweet lupin seed (*Lupinus angustifolius* var. Uniharvest) fed at 12 g/kg LW. Roughage intake was not changed by 3 or 6 g/kg LW levels of *Lablab* or by 12 g/kg LW lupin supplement, but was reduced ($p < 0.05$) by 35% by 12 g/kg LW *Lablab* supplement. Organic matter (OM) digestibility was increased by all supplements, and digestible OM intake was increased by the 6 g/kg LW *Lablab* and 12 g/kg LW lupin supplements. LW gain and feed conversion ratio were not changed by 3 or 6 g/kg LW *Lablab* or the 12 g/kg LW lupin, but were reduced ($p < 0.05$) by 12 g/kg LW *Lablab* supplement. It was concluded that young goats could efficiently utilize supplements of *Lablab purpureus* seed fed at levels of up to 6 g/kg LW. However, when 12 g/kg of the *Lablab* seed was fed, poor performance suggested that the goats were adversely affected by anti-nutritional factors which were not neutralized by rumen fermentation.

(Key Words: Goats, *Lablab purpureus* Seed, Lupin Seed, Supplements)

Introduction

Low productivity of goats in many tropical and subtropical regions is associated with low digestibility and low nitrogen (N) contents of available feed resources. One strategy to alleviate the effects of such under-nutrition is by supplementation. In recent years there has been increased interest in the use of grain legumes, especially lupin seed, field peas and faba beans, as supplements (Batterham and Egan, 1986; Dixon and Hosking, 1992). As readily acceptable feedstuffs high in metabolizable energy and protein, and which generally do not cause digestive upsets, grain legumes are ideal as supplements for low quality roughages. Soyabean is widely grown in the tropics, but it is agronomically suitable for only some areas and most production is used for human food or for monogastric diets. How-

ever, there are a large number of other high-yielding tropical grain legumes (eg. *Lablab*, *Canavalia*, *Phaseolus*, *Vigna* spp.), often known but little liked or used as human food, which have potential as animal feedstuffs (National Academy of Sciences, 1979). In common with soyabean most of these grain legumes contain anti-nutritional factors which have adverse effects on monogastric animals, and which means that these grain legumes cannot be used in monogastric diets without previous treatment (Liener, 1980; Puztai, 1989). However, rumen fermentation can modify many anti nutritional factors to forms less toxic to mammalian metabolism, and hence reduce the susceptibility of ruminants to many specific anti-nutritional factors (James et al., 1975). Thus in general ruminants are likely to be less susceptible than monogastrics to the anti-nutritional factors in grain legumes. Much greater tolerance by ruminants than by monogastric of the anti-nutritional factors in *Canavalia ensiformis* seed has been demonstrated (Dixon et al., 1983; Paredes et al., 1987).

Lablab purpureus (also known as hyacinth bean, field bean, Indian bean, and Bonavist bean, and formerly known as *Dolichos lablab*) is a high-yielding species widely distributed in the tropics, but which contains anti-nutritional factors

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(lectins, protease inhibitors, cyanogenetic glucosides and canavanine) which make it unsuitable for monogastrics (Phadke and Sohoni, 1962; Lambourne and Wood, 1985). Addison et al. (1984) reported the use of *Lablab purpureus* seed as a supplement for cattle, but growth responses were less than expected. The present experiment examined the suitability of seed of *Lablab purpureus* as a supplement for young goats.

Materials and Methods

Twenty-five weaner goats (15 males and 10 females, liveweight (LW) mean 22.0 kg; range 16.6 to 27.8 kg) were held in metabolism crates during the 42 day trial. The goats were blocked on the basis of sex and liveweight and allocated to one of five treatments. The five treatment diets offered were: T1, roughage; T2, roughage + 3 g air dry/kg LW *Lablab* seed; T3, roughage + 6 g air dry/kg LW *Lablab* seed; T4, roughage + 12 g air dry/kg LW *Lablab* seed; and T5, roughage + 12 g air dry/kg LW lupin seed. The roughage consisted of a mixture of equal parts of chopped grass hay and barley straw, and approximately 20% in excess of actual intake was offered to achieve *ad libitum* intake. The *Lablab purpureus* (insect-damaged reject seed of var. Highworth) and lupin grain (*Lupinus angustifolius* var. Uniharvest) were fed separately to the roughage at 08:00-09:00 h in amounts based on the initial liveweights. Fifteen g per day of a mineral mixture comprising 33.7% NaCl, 13.5% KCl, 10.1% CaCO₃, 30.2% Ca₂HPO₄, 12.0% MgSO₄ · 7 H₂O and 0.5% trace minerals was also mixed into the offered roughage. The trace mineral mix comprised 0.67 g CoSO₄ · 7H₂O, 1.35 g CuSO₄ · 5H₂O, 33.73 g FeSO₄ · 7H₂O, 5.73 g ZnCO₃ · 2ZnO · 3H₂O, 6.75 MnSO₄ · 4H₂O, 0.34 g KI, 0.7 g Na₂SeO₄ and 0.59 g K₂MoO₄. Water was available at all times.

Intake of roughage and of supplement were measured daily, and subsamples taken for dry matter (DM) determination and subsequent chemical analysis. The goats were weighed weekly and liveweight change calculated by regression. Faeces were collected from day 31 to day 38, a separator fitted to each metabolism crate allowing collection of faeces with at most minor urine contamination.

Following the growth trial blood samples were

taken from two goats selected at random from each diet, and were analysed for a range of constituents chosen as indicators of metabolic abnormalities. Also three goats selected at random from the control treatment (T1) and three from the treatment fed 12 g *Lablab*/kg LW (T4) were killed with an overdose of sodium pentobarbitone and a post-mortem examination performed. The liver, pancreas, rumen-reticulum, omasum, abomasum, small intestine and large intestine were removed and weighed. Samples of these tissues were taken promptly and placed in 10% phosphate buffered formalin. After fixation samples were processed in a routine manner and paraffin embedded, and haematoxylin and eosin stained sections were examined histologically. The gut contents were emptied and DM contents of tissue and digesta determined. Specimens of the lungs, intestinal tract and reticulo-rumen were examined histologically.

Samples of feed and faeces were dried at 100°C for 24 h to determine DM content, and were ignited at 550°C for 6 h to determine organic matter (OM) content. Contents of neutral detergent fibre, acid detergent fibre and lignin were determined by the procedures of Goering and van Soest (1970). Contents of total nitrogen (N) were determined by a Kjeldahl procedure, and ether extract by Soxhlet extraction (AOAC, 1975).

Data were subjected to analysis of variance in which the effects of treatment and blocks were examined. Duncan's multiple range test was used to compare differences between means.

Results

The composition of the feeds offered is shown in table 1. Lupin and *Lablab* seed were similar in crude protein content (30.8% and 27.9% respectively). Lupin grain was lower in neutral detergent fibre (26.4% and 32.7% respectively) but higher in acid detergent fibre (22.7% and 15.6% respectively) and ether extract (6.3% and 1.6% respectively).

The goats consumed all of the offered supplements. The intake of roughage during the first week of the trial was similar for all treatments, and with the exception of treatment 4 (12 g *Lablab*/kg LW) increased during the remainder of the trial (figure 1). However, with treatment

TABLE 1. CHEMICAL COMPOSITION OF FEEDS (EXCEPT FOR DM CONTENT ON A DM BASIS). VALUES ARE THE MEANS OF 6 SAMPLES OBTAINED AT WEEKLY INTERVALS DURING THE EXPERIMENT

Composition	Pasture hay	Barley straw	<i>Lablab</i> seed	Lupin seed
Dry matter (%)	89.6	89.2	87.7	90.3
Organic matter (%)	94.1	92.7	95.6	97.0
Crude protein (%)	8.4	5.5	27.9	30.8
Neutral detergent fiber (%)	69.6	70.5	32.7	26.4
Acid detergent fibre (%)	35.4	40.1	15.6	22.7
Lignin (%)	3.2	3.2	3.0	2.5
Ether extract (%)	ND	ND	1.6	6.3

ND = not determined.

4 roughage intake tended to remain constant until week 4, and tended to decline in weeks 5 and 6. On average over the 42 days of the trial goats fed the highest level of *Lablab* (12 g/kg LW) consumed 35% less roughage ($p < 0.05$) than the control goats fed roughage alone, and 24% less roughage than the goats fed the same amount of lupin (table 2). Total DM intakes by goats fed 3 or 12 g/kg LW of *Lablab* were similar to the control diet, whereas total intake of goats fed 6 g/kg LW of *Lablab* or 12 g/kg LW of lupin was greater ($p < 0.05$) than the control.

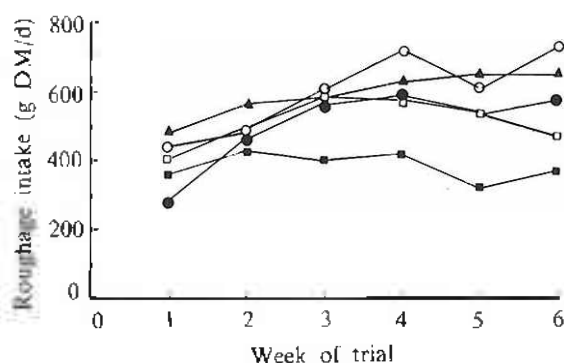


Figure 1. Intake of roughage dry matter during the trial by goats fed treatment 1 (○), treatment 2 (●), treatment 3 (▲), treatment 4 (■), treatment 5 (□).

DM and OM digestibilities were increased by consecutive levels of *Lablab* supplement, and were similar for the *Lablab* and lupins when fed at similar levels (T4 and T5; table 2). Neutral detergent fibre and acid detergent fibre digestibilities were similar for all diets. Digestible OM

intakes were similar for the control diet (T1, 328 g/d) and for the 3 g *Lablab*/kg LW treatment (T2, 331 g/d), and were increased ($p < 0.05$) by the 6 g *Lablab*/kg LW (T3, 422 g/d) and the 12 g lupin/kg LW (T5, 486 g/d) treatments. The 12 g *Lablab*/kg LW treatment (T4, 405 g/d) was not different to the other treatments. LW gain and feed conversion ratio were not changed by the lower levels of *Lablab* supplement or the lupin supplement, but LW gain was reduced ($p < 0.05$) and feed conversion ratio was increased ($p < 0.05$) by 12 g *Lablab*/kg LW (T4).

The concentrations in serum (mean \pm standard error, $n = 10$) of sodium (141.9 ± 0.69 m mol/L), potassium (6.48 ± 0.21 m mol/L), chloride (110.0 ± 0.71 m mol/L), calcium (2.35 ± 0.037 m mol/L), phosphate (2.21 ± 0.061 m mol/L), urea (5.48 ± 0.408 m mol/L), creatinine (0.079 ± 0.0031 m mol/L), total bilirubin (0.9 ± 0.233 m mol/L), alkaline phosphatase (235 ± 35.6 U/L), gamma glutamyl transferase (30.1 ± 3.17 U/L), aspartate amino transferase (83 ± 5.61 U/L), creatine phosphokinase (347.5 ± 164.0 U/L), total protein (65.0 ± 0.87 g/L) and albumin (35.9 ± 0.65 g/L), were all within the range expected for healthy animals. Weights of liver, pancreas and tissue and digesta of the gastrointestinal tract were not affected by the *Lablab* supplements. Histologically there appeared to be no consistent differences between the two groups of goats, and in no goat was there evidence of villus atrophy or brush border alterations such as that observed in rats fed *Phaseolus vulgaris* seed and attributed to the lectins present in such seed (Puztai, 1989).

TABLE 2. INTAKE, DIGESTIBILITY, LIVEWEIGHT GAIN AND FEED CONVERSION RATIO (FCR) OF THE GOATS (N = 5)

Measurement	Supplement					s.e.m	Significance
	Nil	Lablab		Lupins			
	T1	T2	T3	T4	T5		
Intake (g/d)							
Roughage DM	600 ^b	517 ^b	595 ^b	390 ^a	513 ^b	28.2	**
Supplement DM	0	55	117	248	261	—	
Total DM	600 ^a	571 ^a	713 ^{bc}	638 ^{ab}	774 ^c	29.1	**
Digestible OM	328 ^a	331 ^a	422 ^b	405 ^{ab}	486 ^b	26.8	*
Digestibility (%)							
DM	56.1 ^a	60.0 ^{ab}	59.7 ^{ab}	63.9 ^b	63.6 ^b	1.9	*
OM	58.5 ^a	61.9 ^{ab}	63.2 ^{ab}	67.4 ^b	66.3 ^b	1.7	**
NDF	58.4	60.4	59.8	55.9	58.2	1.7	ns
ADF	52.5	54.2	55.1	51.1	56.9	2.1	ns
N	37.8 ^a	54.9 ^b	57.6 ^b	73.2 ^c	69.0 ^c	2.0	**
LW gain (g/d)	64 ^{ab}	66 ^{ab}	76 ^b	32 ^a	77 ^b	11.2	*
FCR (g/g)	9.4 ^a	8.7 ^a	9.4 ^a	20.0 ^b	10.0 ^a	3.15	*

** (p < 0.01), * (p < 0.05), ns = not significant. Means within rows followed by unlike superscripts differ significantly. FCR was calculated at the ratio between unit weight of total DM intake and the unit LW gain. Digestible OM intake was calculated from the mean OM intake during the 6 week trial and the OM digestibility measured in week 5.

Discussion

Supplementation with 6 g/kg LW of *Lablab purpureus* seed or 12 g/kg LW of lupin increased intake of total DM and digestible OM by the goats, but supplementation with *Lablab* seed at 12 g/kg LW decreased intake of roughage, LW gain and efficiency of conversion of feed to LW gain. The levels of lectin and trypsin inhibitor activity in the batch of *Lablab* used in this experiment were likely to be of physiological importance to monogastrics; lectins and trypsin inhibitors concentrations in the *Lablab* were 2.3 and 1.9 times the respective levels in lupin grain, and 0.17 and 0.56 of the respective levels in *Phaseolus vulgaris* var. Actolac (Domingo, 1990). These anti-nutritional factors were apparently not important in these young goats when a moderate level 6 g/kg LW of *Lablab purpureus* seed was fed, but had an adverse effect on growth when a higher level of 12 g/kg LW was fed. The reduced growth was partly associated with reduced intake of roughage and digestible organic matter, but was also partly apparently associated with a reduced efficiency of utilization of diges-

tible organic matter and hence presumably metabolizable energy for tissue deposition and live-weight gain.

In conclusion this experiment suggests that low dietary levels of *Lablab purpureus* seed can be used effectively as a supplement for goats fed low quality roughage. High levels of *Lablab purpureus* did not cause any clinical abnormalities, but did reduce intake, growth and efficiency of utilization of ingested metabolizable energy.

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