Sweet lupins as a feedstuff for broilers

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An experiment was conducted to determine the feeding value of sweet white lupins (*Lupinus albus* variety Buttercup) for broilers up to 8 weeks of age. Two isocaloric and isonitrogenous starter (0 – 4 weeks) and finisher (4 – 8 weeks) diets were formulated with one containing no lupins and the other 400 g lupins/kg. Two hundred male and 200 female day-old broiler chickens of the Hubbard strain were used. Each pen consisted of 10 male or 10 female chickens. There were four replicates of each treatment giving 40 birds per treatment. The results showed that inclusion of up to 400 g/kg sweet lupins (containing less than 0,1 g/kg alkaloids) in the diet had no deleterious effects ($P \leq 0{,}05$) on growth, feed efficiency or carcass characteristics when fed to broilers up to 8 weeks of age.

'n Proef is uitgevoer om die voedingswaarde van soet, wit lupiene (*Lupinus albus* variëteit Buttercup) vir braaikuikens tot op 8-weke-ouderdom te bepaal. Twee aanvangs- (0 – 4 weke) en afrondingsdiëte (4 – 8 weke) met gelyke kalorie- en stikstofwaardes is saamgestel. Die een dieet het geen en die ander 400 g/kg lupiene bevat. Tweehonderd dag-oud haantjies en 200 dag-oud hennetjies van die Hubbard-lyn is gebruik. Elke groep het bestaan uit 10 haantjies of 10 hennetjies. Daar was vier herhalings van elke behandeling wat neerkom op 40 kuikens per behandeling. Die resultate het getoon dat die insluiting van soveel as 400 g/kg soet lupiene (wat minder as 0,1 g/kg alkaloïede bevat het) in die dieet, geen nadelige effekte ($P \leq 0{,}05$) op groei, voerdoeltreffendheid en karkaseienskappe van braaikuikens tot op 'n ouderdom van 8 weke gehad het nie.

Keywords: Sweet lupins (*Lupinus albus*), broilers, body mass, feed efficiency, carcass evaluation

Introduction

The use of sweet lupins as stock feed could ease South Africa's reliance on imports of oilcake (soybean, sunflower, groundnut) and fishmeal which costs the country in excess of R150 million annually (Cloete, 1981). Lupins possess good agronomic characteristics which make them more appealing to cultivate than soybeans, and they have no anti-nutritive factors, such as trypsin-inhibitor which would decrease cost-effectiveness and make them less practical for the farmer to utilize for poultry. Sweet lupins contain less than 0,02 % of various alkaloids, compared with much higher levels in the bitter lupins (Gladstones, 1970). However, problems can arise if there is contamination with bitter seeds, where even relatively low alkaloid contents can suppress feed intake and growth of monogastric animals (Hill, 1977).

Erikson & Elliot (1984) replaced up to 300 g maize/ kg with lupin seed (*L. albus*) in chicken feeds. Daily live mass gain and food conversion efficiency did not differ from the controls. Castaing & Seroux (1984) added 15% lupins to a maize-based ration and obtained improved live mass gain. The addition of 30% lupins to a maize-based ration and 15% lupins to rations based on wheat also produced greater live mass gains than the controls but the carcasses produced were very fatty. However, this may have been due to high levels of animal fats in the ration which are probably not required for energy because of the high lipid content of *L.albus* seed. Yule & McBride (1976) observed that broilers fed diets containing up to 24% ground lupin seed (*Lupinus angustifolius*) grew as rapidly as those fed wheat-based diets when these were balanced for amino acids and energy.

The objective of this study was to determine the feeding value of a modern sweet white lupin (*Lupinus albus* variety Buttercup) in broiler feeds.

Materials and Methods

White lupins (*L. albus* variety Buttercup) were used in this experiment. The lupin seeds were ground in a hammermill with a 3,2-mm screen and blended in a horizontal mixer to ensure uniformity. The lupins were screened for alkaloids by the method of Ruiz (1976). The concentration of alkaloids was found to be less than 0,1 g/kg.

The ground blended samples of lupins and soybeans were analysed for crude protein, ether extract and crude fibre by standard methods (AOAC, 1980). For amino acid analysis the method of De Lange, Smit, Le Roux Cilliers & Ireland (1979) was used. True metabolizable energy values (TME) for the lupin meal and soybean oilcake meal were determined by the method of McNab & Fisher (1984). Results of chemical analysis of lupin meal and soybean oilcake meals used in this trial are given in Table 1.

Four hundred broiler chickens (Hubbard) were used, 10 chickens were housed per pen and each dietary treatment was applied to four pens of male and four pens of female chickens. Treatments were randomly allocated to the different pens. The birds were reared in electrically heated battery brooders for the first 4 weeks and for the second 4 weeks in unheated finishing batteries.

Two isocaloric and isonitrogenous starter and finisher diets were formulated with one containing no lupin and the other 400 g of the lupins under test per kg. The diets were then appropriately blended to produce five

Table 1 Chemical composition of the lupin and soybean oilcake meal used in this study (g/kg)

Component	Lupin	Soybean
Protein	320,0	460,0
ME (MJ/kg)	10,9	9,4
Fibre	110,0	60,0
Oil	90,0	20,0
Arginine	26,0	34,0
Cystine	7,0	6,6
Glycine	12,4	21,2
Histidine	6,5	11,0
Isoleucine	13,0	25,0
Leucine	23,9	34,0
Lysine	15,0	26,0
Methionine	6,0	6,5
Phenylalanine	13,6	23,7
Threonine	12,2	18,2
Tryptophan	3,0	7,0
Tyrosine	19,2	7,0
Valine	12,8	24,0

Table 2 Basal starter and finisher diets used in this study (g/kg)

	Starter diet		Finisher diet	
Ingredients	No lupin	400 g/kg lupin	No lupin	400 g/kg lupin
Yellow maize meal	580,0	470,0	645,0	535,0
Sweet lupin meal	—	400,0	—	400,0
Soybean oilcake meal	300,0	—	300,0	—
Fish meal	102,0	103,0	32,9	42,5
Monocalcium phosphate	8,4	23,4	8,5	5,5
Limestone powder	7,4	—	11,4	14,3
Synthetic lysine	—	1,6	—	0,7
Synthetic methionine	0,2	—	0,2	—
Vitamin and mineral premix	2,0	2,0	2,0	2,0
Calculated analysis				
Protein	240	240	200	200
ME (MJ/kg)	12,2	12,2	12,2	12,2
Lysine	14,3	13,6	11,0	10,0
Arginine	16,5	16,2	14,6	14,6
Methionine	5,0	5,1	4,0	4,1
Tryptophan	3,4	2,4	2,0	2,0
Isoleucine	12,5	9,9	10,8	8,4
Leucine	21,1	19,4	18,3	17,0
Valine	13,1	10,6	11,1	8,8

experimental diets containing 0, 100, 200, 300, and 400 g lupins/kg diet. The compositions of the two basal starter and finisher rations are shown in Table 2.

The experiment was terminated when the chickens were 8 weeks of age. Three males and three females from each treatment were killed and dressing percentage, moisture and fat determined on the oven-ready carcass (giblets excluded).

Data in all trials were subjected to regression analysis as outlined by Rayner (1967).

Results and Discussion

The average masses and feed efficiencies of the male and female broilers on the five experimental diets are shown in Table 3.

At four weeks of age there were no significant differences in body mass or feed efficiencies, nor were there regression trends evident in male and female broiler chickens fed starter diets containing 0, 100, 200, 300, and 400 g lupins/kg, respectively. Lacassagne (1983) found depressed 28-day body mass when lupins were incorporated at a level of 400 g/kg and replaced all the soybean in the ration but reported that this was due to a folic acid deficiency, as lupin seeds are poorer in folic acid than soybeans. When synthetic folic acid was added

Table 3 Mean 4-week mass and feed conversion efficiency (FCE) of male and female broiler chickens (± *SD*)

Lupin concentration in feed (g/kg)	Males Mass (g)	Males FCE	Females Mass (g)	Females FCE
0	795 ± 18	0,61 ± 0,02	779 ± 46	0,60 ± 0,01
100	799 ± 27	0,61 ± 0,01	780 ± 33	0,60 ± 0,02
200	799 ± 26	0,60 ± 0,01	781 ± 36	0,60 ± 0,01
300	795 ± 21	0,61 ± 0,02	785 ± 35	0,59 ± 0,02
400	794 ± 14	0,60 ± 0,01	778 ± 38	0,60 ± 0,01
Linear effect (± *SE*)	0,058 ± 0,312	0,000 ± 0,000	0,023 ± 0,545	0,000 ± 0,000
Quadratic effect (± *SE*)	0,011 ± 0,027	0,000 ± 0,000	0,009 ± 0,047	0,000 ± 0,000

Table 4 Mean 8-week body mass and feed conversion efficiency (FCE) of male and female broilers fed the five experimental diets (± *SD*)

Lupin concentration in feed (g/kg)	Males Mass (g)	Males FCE	Females Mass (g)	Females FCE
0	2010±92	0,45±0,01	1870±53	0,45±0,01
100	2016±89	0,46±0,01	1880±72	0,45±0,01
200	2030±57	0,46±0,02	1875±33	0,45±0,01
300	2061±83	0,46±0,01	1915±75	0,45±0,01
400	2083±106	0,46±0,01	1925±55	0,45±0,01
Linear effect (± *SE*)	1,98±1,70	0,001±0,000	0,09±0,06	0,00±0,00
Quadratic effect (± *SE*)	0,03±0,15	0,000±0,000	0,01±0,01	0,00±0,00

Table 5 Mean dressed yield, moisture content and fat content of male and female broilers at 8 weeks of age (± *SD*)

Lupin concentration in feed	Dressing percentage		Moisture (g/kg)		Fat (g/kg)	
(g/kg)	Males	Females	Males	Females	Males	Females
0	70,25 ± 1,0	70,75 ± 1,3	627,0 ± 12,0	627,0 ± 6,0	170,0 ± 20,0	180,0 ± 26,5
100	70,25 ± 1,7	70,25 ± 1,7	630,0 ± 10,0	637,0 ± 21,0	160,0 ± 10,0	166,7 ± 25,3
200	69,75 ± 1,7	69,25 ± 1,3	630,0 ± 10,0	633,0 ± 6,0	157,0 ± 12,0	180,0 ± 30,0
300	69,00 ± 2,0	70,25 ± 1,5	643,0 ± 6,0	643,0 ± 21,0	153,0 ± 6,0	166,7 ± 30,6
400	69,25 ± 1,5	70,25 ± 3,3	640,0 ± 10,0	637,0 ± 6,0	157,0 ± 6,0	173,3 ± 6,0
Linear effect (± *SE*)	0,003 ± 0,024	0,010 ± 0,029	0,000 ± 0,001	0,027 ± 0,024	0,033 ± 0,020	0,013 ± 0,039
Quadratic effect (± *SE*)	0,001 ± 0,002	0,002 ± 0,001	0,000 ± 0,001	0,001 ± 0,002	0,002 ± 0,002	0,001 ± 0,003

to the 400 g/kg lupin diets this was sufficient to overcome the depressing effects of the lupins incorporated in the diet. However, Lacassagne (1983) used a vitamin premix that supplied only 0,2 mg of folic acid per kg of diet compared with the 0,5 mg folic acid per kg diet used in this present study, where no deficiencies were noted.

The average 8-week male and female masses and their feed efficiencies are shown in Table 4.

As with the 4-week body masses and feed efficiencies, no significant differences were observed between treatments at 8 weeks of age. Lupins can therefore replace all the soybean in the ration without any deleterious effects on growth or efficiency of food utilization. Yule & McBride (1976) found that broilers offered diets containing up to 240 g ground lupin seed/kg grew as rapidly as those on a diet containing no lupin seed meal. Ground lupin seed meal may therefore be included at high concentrations in broiler diets balanced for amino acids and energy according to these researchers. Similar conclusions were drawn by Smetana (1973).

The results of the carcass yield and the moisture and fat levels in the eviscerated carcass are shown in Table 5.

There were no treatment differences with regard to dressed yield, moisture content or fat content in male and female broilers at 8 weeks of age. Yule & McBride (1976) also found no significant differences in carcass characteristics of broilers fed four different levels of lupins in the diet. Linear and quadratic trends in responses to increasing concentrations of lupins in the feed were in all cases nonsignificant, i.e. body mass, feed conversion efficiency and the carcass characteristics measured, all remained virtually constant over the range of lupin concentrations tested. The substitution of lupins for soybean was therefore, in this experiment, almost total.

Summary

The inclusion of up to 400 g sweet lupin per kg diet had no deleterious effects on growth, feed efficiency or carcass composition in broilers during the period day-old to 8 weeks of age. Lupins can therefore successfully be used to replace soybean oilcake meal in a broiler feed.

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