# Lupin seed meal (*Lupinus albus* cv. Buttercup) as a source of protein for early weaned piglets

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Two experiments were conducted to evaluate *L. albus* cv. Buttercup as an alternative to heated full-fat soya bean meal for early weaned piglets. In Experiment 1, the performance of piglets, fed diets with 0%, 4%, 8% and 12% lupins and formulated to contain equivalent amounts of digestible energy and lysine, was used to evaluate the effect of increasing levels of commercially produced Buttercup seed in the diet. The results obtained led to Experiment 2, conducted to evaluate certified *L. albus* cv. Buttercup seed (at an 8% inclusion level) as a partial replacement of full-fat soya beans. The apparent nitrogen and energy digestibilities of the diets were also determined. The commercial Buttercup lupins had an alkaloid content in excess of 0,05% and the certified seed only 0,01%. The digestibility of both energy and protein in the diet was not affected by lupin inclusion. Although statistically non-significant ($P>0,05$), the retention of digested nitrogen was decreased by about 5 and 7% with lupin inclusion in the two trials. The high-alkaloid seeds in Experiment 1 depressed feed intake by as much as 21%. The low-alkaloid seeds used in Experiment 2 had no effect on feed intake. Growth rate was retarded by 25% when high-alkaloid seeds were used, but by only 6% when low-alkaloid seed was used. Digestible energy utilization was reduced by 2 and 4% with lupin inclusion.

Twee studies is uitgevoer om *L. albus* cv. Buttercup, as 'n alternatief vir verhitte volvetsojaboonmeel in die dieet van vroeggespeende varkies te evalueer. In die eerste studie is die prestasie van varkies, wat diëte met 0%, 4%, 8% en 12% lupiene en ekwivalente hoeveelhede verteerbare energie (VE) en lisien bevat het, gebruik om die invloed van toenemende peile van kommersieel-geproduseerde Buttercup-saad in die dieet, te ondersoek. Die resultate behaal het tot die tweede studie gelei, wat uitgevoer is om gesertifiseerde *L. albus* cv. Buttercupsaad (teen 'n 8%-insluitingspeil) as gedeeltelike vervanger vir volvetsojabone, te evalueer. Die waarskynlike stikstof en energieverteerbaarheid van die diëte is ook bepaal. Die kommersiële Buttercuplupiene het 'n alkalo'iedinhoud van meer as 0,05% gehad en die gesertifiseerde saad slegs 0,01%. Die verteerbaarheid van beide energie en proteïen in die dieet is nie deur lupieninsluiting beïnvloed nie. Hoewel statisties nie betekenisvol nie ($P>0,05$) is die retensie van verteerde stikstof (N) met omtrent 5 en 7% onderdruk deur lupieninsluiting in die twee studies. Die saad met hoë alkalo'iedinhoud wat in die eerste studie gebruik is, het voerinname met tot 21% verlaag. Daarenteen het saad met lae alkalo'iedinhoud wat in die tweede studie gebruik is geen effek op voerinname gehad nie. Groeitempo is met 25% vertraag toe saad met hoë alkalo'iedinhoud gebruik is, maar slegs met 6% waar die alkalo'iedinhoud laag was. VE-benutting is met 2 - 4% verlaag met lupieninsluiting in die dieet.

Keywords:White lupins, digestibility, N retention, growth, alkaloids, pigs

## Introduction

Lupin-seed has been used extensively in pig diets in Australia since the development of low alkaloid varieties by Gladstones (1972). Research work by Taverner (1975), Pearson & Carr (1976) and Batterham (1979) has shown that the cultivars of *Lupinus angustifolius*, Uniwhite and Unicorp, which contain no toxic or undesirable factors, are excellent sources of protein for pigs.

According to Hill (1977) *L. albus* has higher protein and oil contents and a lower fibre content than *L. angustifolius*, thus suggesting a greater potential as a protein source for pigs. Pearson & Carr (1977), Hove, King & Hill (1978) and Batterham (1979),however,found that the use of *L. albus* varieties is responsible for decreased feed intakes and growth rates when fed to pigs and rats. A higher alkaloid content as well as a high manganese content was held responsible by the research workers mentioned.

King (1981) evaluated *L. albus* cv. Hamburg as a protein source for growing pigs. The growth performance of pigs from 22 to 70 kg live mass was unaffected by 10,3% Hamburg replacing soya bean meal and meat and bone meal, but at higher levels both growth rate and feed conversion efficiency were significantly depressed. Feed intake was however not significantly affected by the level of Hamburg. The addition of synthetic lysine to a diet with 31% Hamburg improved feed conversion efficiency, but not to the level of the diet containing no Hamburg. According to King the growth-depressing effect of the lupins appeared unrelated to alkaloid levels (<0,02%) or high manganese levels (>2000 ppm) in the seed. He, therefore, suggested that amino acid availability may be low.

Taverner (1982) consequently investigated amino acid availability in Hamburg lupins using both a growth and a digestibility trial. Each increment of dietary lupins (soya bean meal was replaced by 8,3 ; 16,5 or 25% lupins) decreased both growth rate and feed utilization but had no significant effect on food intake. Lysine digestibilities of the soya bean meal and lupins were calculated to be 89 and 82% respectively, whilst less than half of the dry matter of the lupins was digested in the gut proximal to the ileal cannula but 36% was digested in the hind gut. Consequently Taverner concluded that the reduction in nutritive value of Hamburg lupins relative to soya bean meal can be ascribed to the joint effects of amino acid digestibility and a

lower utilization of energy resulting from the high proportion of energy digested in the hind gut (Just, 1981).

Although low-alkaloid *L. albus* has been known and cultivated in South Africa for more than 30 years, only small quantities have been produced through a lack of interest and demand (Wassermann, 1983). The production of feed proteins in South Africa is, however, not keeping up with the demand. Projections by Cloete (1984) have shown that there will be a deficit of 1,2 million tons of oilcake equivalent at the turn of the century. Hence the need to evaluate lupins as a protein source for pigs.

Two experiments were conducted to evaluate *L. albus* cv. Buttercup as an alternative to heated full-fat soya bean meal for early weaned piglets. In Experiment 1, the performance of piglets fed diets containing different lupin levels, was used to evaluate the effect of increasing levels of commercially produced Buttercup seed in the diet. The results achieved in the first experiment led to Experiment 2, conducted to evaluate certified *L. albus* cv. Buttercup seed as a partial replacement for full-fat soya beans in the diet of early weaned pigs.

## Materials and Methods

One seed sample of each of the four *L. albus* cultivars currently tested by the Cereal Grain Research Institute at Potchefstroom was obtained. The samples were analysed for nitrogen, fat and fibre using standard AOAC techniques and for essential amino acids according to standard techniques (Beckman, 1969). Methionine and cystine were, however, determined as described by Dennison & Gous (1984). The alkaloid content of the lupins was determined by the method described by Ruiz (1977).

### Experiment 1

*Digestion trial:* Ten Landrace-type boars of 58,7 ± 4,2 kg live mass were used. Five pigs per diet were fed Diets 1 or 4 in Table 1 at a rate of 1 800 g of air-dry meal per day. The pigs were subjected to a 14-day trial period consisting of a 7-day preliminary period and a 7-day collection period, during which faeces and urine were collected in metabolism crates. The pigs had free access to water at all times. The procedures followed in collecting and analysing faeces and urine samples are described in detail by Kemm & Ras (1971).

*Growth trial:* Forty-eight Landrace-type piglets (24 gilts and 24 boars) were randomly allotted to four experimental treatments for a period of 35 days when 23 days old and 6,44 ± 0,97 kg in live mass. Four diets, formulated to be equivalent in DE and lysine content, and to comply with the nutrient requirements of the early weaned pig (Viljoen, Kemm & Ras, 1984), were fed to 12 piglets (six of each sex) per diet. The diets (Table 1) contained either 0; 4; 8 or 12% commercially produced Buttercup lupin seed as a replacement for heated full-fat soya bean meal. The piglets were housed in groups of two (same sex) in flat-deck type cages, 1,6 m × 1 m, fitted with a self-feeder and an automatic water nipple. Temperatures in the building were controlled to the extent that minimum temperatures

**Table 1** Percentage composition of diets used in Experiment 1

| | Diet | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Component | | | | |
| Lupin meal[a] | 0 | 4 | 8 | 12 |
| Maize meal | 58,7 | 57,7 | 56,6 | 55,6 |
| Fish meal | 5,0 | 5,0 | 5,0 | 5,0 |
| Wheaten bran | 13,0 | 13,0 | 13,0 | 13,0 |
| Full fat soya meal | 20,0 | 16,2 | 12,2 | 8,2 |
| Sunflower oil | 0 | 1 | 2 | 3 |
| Synthetic lysine | 0,3 | 0,35 | 0,4 | 0,45 |
| Salt | 1,0 | 1,0 | 1,0 | 1,0 |
| Feed lime | 1,2 | 1,2 | 1,2 | 1,2 |
| Monocalcium phosphate | 0,4 | 0,4 | 0,4 | 0,4 |
| Mineral & vitamin mixture[1] | 0,2 | 0,2 | 0,2 | 0,2 |
| Calculated nutrient content | | | | |
| Protein[b], % | 20,1 | 19,8 | 19,5 | 19,2 |
| Lysine[b], % | 1,24 | 1,25 | 1,25 | 1,25 |
| DE[c], MJ/kg DM | 14,5 | - | - | 14,2 |

[a]The lupins used had 80% white seeds and 20% pink seeds with respective alkaloid contents of 0,01 and >0,20%.
[b]The protein and lysine values used are based on analyses of the feed ingredients used and are presented on a DM basis.
[c]Values determined in the digestion trial (Table 4).
[1]A commercial mixture was used.

**Table 2** Percentage composition of diets used in Experiment 2

| | Diet | |
|---|---|---|
| | 1 | 2 |
| Component | | |
| Lupin meal[a] | 0 | 8 |
| Maize meal | 52,4 | 56,9 |
| Fish meal | 3,9 | 4,4 |
| Wheaten bran | 17,3 | 9,5 |
| Full fat soya meal | 23,3 | 17,5 |
| Synthetic lysine | 0,3 | 0,2 |
| Salt | 1,0 | 1,0 |
| Feed lime | 1,2 | 1,7 |
| Monocalcium phosphate | 0,3 | 0,5 |
| Mineral & vitamin mixture[1] | 0,2 | 0,2 |
| Calculated nutrient content | | |
| Protein[b], % | 19,0 | 19,1 |
| Lysine[b], % | 1,18 | 1,19 |
| DE[c], MJ/kg DM | 15,5 | 15,5 |

[a]The lupins had an alkaloid content of 0,01%.
[b]The protein and lysine values used are based on analyses of the feed ingredients used and are presented on a DM basis.
[c]Values determined in the digestion trial (Table 6).
[1]A commercial mixture was used.

never dropped below 20°C, whereas maximum temperatures seldom rose above 30°C. Pigs were fed *ad libitum* at all stages. Feed intake and live mass were recorded every 7 days. Feed and water were not withdrawn before mass determinations were done. The growth, feed intake and feed conversion data of the piglets were subjected to a one-way analysis of variance to test for treatment differences.

Experiment 2

*Digestion trail:* Twelve Landrace-type boars 61,8 ± 3,1 kg in live mass were used. Six pigs per diet were fed the diets in Table 2 at a rate of 1 000 g of air-dry meal per day. The rest of the experimental procedures followed were similar to those described for the first trial

*Growth trial:* Certified alkaloid-free *L. albus* cv. Buttercup lupin seeds were used to formulate the experimental diets. The diets, presented in Table 2, were formulated to be equivalent in DE and lysine content, to contain the essential amino acids in an 'ideal protein' pattern (Cole, 1978) and to comply with the nutrient requiremmnts of the early weaned pig (Viljoen, *et al.*, 1984). Thirty-two Landrace type boars, with a mean initial mass of 5,9 ± 0,27 kg and 21 days old, were used. The experiment lasted 35 days. Four groups of four pigs each, were randomly allotted to each diet (16 pigs/diet) . The eight groups were kept in cages, 1,5 m × 1 m in size, fitted with self feeders, drinking nipples and perforated metal floors, in a building with a minimum temperature of 23°C. The animais had *ad lib.* access to their specific diet for the duration of the trial period.

## Results

In Table 3 the nutrient content of *L. albus* seed samples obtained from the Cereal Grain Research Institute are compared to the range of literature values collected by Hill (1977). The data presented in Table 3 show the protein (30,3 - 36,1%) and oil (8,9 - 10,2%) content of the samples analysed to be at the lower end or below the range of values presented by Hill (1977). Fibre content was, however, appreciably higher (12,4 - 17,1%) than the values quoted by Hill (1977). The amino acids, lysine, threonine ,isoleucine and valine levels were all at or below the lowest values given by Hill. It is, however, significant to note that for both methionine and cystine, values appreciably higher than the maximum figures given by Hill (1977) were found. The Buttercup, Kiev and Ultra samples had an alkaloid content of 0,01% or less which is below the level of 0,02% which Pearson & Carr (1977) found low enough to induce normal growth performance in the pig. The Hamburg sample,however, had an alkaloid content of 0,13% which seems much too high for use in pig diets.

Experiment 1

The energy and N metabolism data for the control and 12% lupin-containing diets fed in Experiment 1 are summarized in Table 4. Although the pigs were fed an amount of only 1 800 g of air-dry feed per day, given in two equal portions,pigs fed diet 4 containing 12% lupins consumed 7,9% less meal per day than those on the control diet. This in turn resulted in gross energy (GE) and N intakes that were respectively 10 and 11,8% lower than those consumed by control pigs. Dry matter (DM) and energy

**Table 3** Nutrient content of lupin seed samples (on a DM basis) of cultivars supplied by the Research Institute for Grain Crops

| | Lupin cultivar | | | | |
|---|---|---|---|---|---|
| Component | *L.albus* cv. Buttercup | *L.albus* cv. Hamburg | *L.albus* cv. Kiev | *L.albus* cv. Ultra | *L.albus* cv. (Hill, 1977) |
| Protein, % | 30,3 | 30,7 | 35,0 | 36,1 | 34,3-44,9 |
| Oil, % | 8,9 | 10,2 | 9,1 | 9,6 | 9,9-14,5 |
| Fibre, % | 16,5 | 15,9 | 17,1 | 12,4 | 3,3-10,0 |
| Ash, % | 3,7 | 3,5 | 3,4 | 3,0 | 2,9- 4,7 |
| Essential amino acids, g/16 g N | | | | | |
| Lysine | 4,6 | 4,5 | 4,2 | 3,9 | 5,0- 5,8 |
| Methionine | 0,9 | 0,8 | 0,7 | 0,8 | 0,3- 0,5 |
| Cystine | 2,1 | 2,1 | 1,8 | 1,8 | 1,0- 1,6 |
| Threonine | 3,8 | 3,5 | 3,4 | 3,2 | 3,7- 4,7 |
| Leucine | 7,3 | 7,0 | 7,0 | 6,1 | 7,0- 9,1 |
| Isoleucine | 3,9 | 3,6 | 3,7 | 2,8 | 4,0- 5,7 |
| Valine | 3,7 | 3,3 | 3,7 | 2,9 | 3,9- 5,0 |
| Phenylalanine | 3,8 | 3,3 | 3,6 | 3,2 | 3,5- 4,5 |
| Tyrosine | 4,2 | 4,1 | 4,1 | 3,9 | - |
| Histidine | 2,1 | 2,1 | 1,9 | 1,9 | - |
| Arginine | 9,8 | 10,0 | 10,3 | 9,9 | 9,4-13,0 |
| Alkaloid content, % | <0,01 | 0,13 | 0,01 | 0,01 | - |

**Table 4** Energy and nitrogen metabolism data (mean ± *SD*) for 10 boars (five per diet) fed either a control diet or a diet with 12% commercial lupin seed meal (Experiment 1)

| Measurement | Diet 1 | Diet 4 |
|---|---|---|
| DM intake, g/day | 1670 ± 1,42 (100) | 1538 ± 126,0 (92,1) |
| DE intake, MJ/day | 31,1 ± 0,03 (100) | 28,0 ± 2,0 (90,0) |
| DM digestibility, % | 80,0 ± 0,83 (100) | 79,8 ± 1,5 (99,3) |
| Energy digestibility, % | 77,9 ± 1,81 (100) | 77,9 ± 2,3 (100) |
| Dietary DE content, MJ/kg DM | 14,5 ± 0,34 (100) | 14,2 ± 0,42 (97,9) |
| N intake, g/day | 52,6 ± 0,05 (100) | 46,4 ± 3,8 (88,2) |
| N digestibility, % | 82,2 ± 1,29 (100) | 80,0 ± 2,3 (97,3) |
| N retention, g/day | 31,2[a] ± 0,49 (100) | 24,9 ± 4,6 (79,8) |
| N retention, % of intake | 59,3 ± 0,93 (100) | 53,3 ± 6,8 (89,9) |
| N retention, % of digested | 72,1 ± 1,7 (100) | 66,7 ± 8,8 (92,5) |

[a] Statistically significant at $P \leq 0,05$

digestibilities were not influenced by the substitution of lupin seed for full-fat soya bean meal in the diet. The DE content of the lupin-containing diet was non-significantly lower (2,1%) than that of the control diet. Nitrogen digestibility was also slightly but non-significantly lower (2,7%) for pigs fed diet 4. Nitrogen retention (g/day) was significantly ($P \leq 0,05$) lower (20,2%) in the lupin-fed pigs, a figure which would most probably have been appreciably lower had N intakes been equal. If expressed as a percentage of intake or as a percentage of digested N, the respective differences were consequently reduced to 10,1 and 7,5% and statistically insignificant, most probably due to the fairly large variation between pigs fed diet 4 (see SD's in Table 4).

The performance data of the piglets summarized in Table 5 show that growth, feed intake and feed utilization worsened progressively with each aditional amount of lupins included in the diet. The reduction in growth rate is primarily a direct result of an increase in dietary lupin content and the progressively worsening feed utilization of pigs fed the lupin-containing diets. Daily gain was significantly ($P \leq 0,05$) reduced by the inclusion of 4% lupins and highly significantly ($P \leq 0,01$) by higher levels. Feed intake was significantly ($P \leq 0,05$) reduced by 8 and 12% lupin inclusion, but not (8,3%) when the level was 4% ($P > 0,05$).

## Experiment 2

The energy and N metabolism data for the two diets (Table 2) fed during the metabolism trial in Experiment 2, are presented in Table 6. Contrary to the findings in the first experiment (Table 4) DM intake and hence GE and N intakes were not affected by the inclusion of lupins in the diet. DM, energy and N digestibilities were slightly but non-significantly higher in the 8% lupin-containing diet.

**Table 5** Performance (mean ± *SD*) for 48 piglets (12 per diet) fed diets containing 0, 4, 8 or 12% commercial lupin seed meal (Experiment 1)

| Measurement | Diet 1 | Diet 2 | Diet 3 | Diet 4 |
|---|---|---|---|---|
| Initial mass, kg | 6,5 ± 0,9 (100) | 6,8 ± 0,8 (104,6) | 6,4 ± 0,9 (98,5) | 6,0 ± 1,2 (92,3) |
| Final mass, kg | 17,9 ± 2,4 (100) | 17,2 ± 2,8 (96,1) | 15,2 ± 2,8 (84,9) | 14,6 ± 1,8 (81,6) |
| ADG, g | 325 (100) | 296 (91,1) | 252 (77,5) | 245 (75,4) |
| Feed intake, kg/piglet | 21,6 (100) | 19,8 (91,7) | 17,2 (79,6) | 17,0 (78,7) |
| Feed utilization, kg/kg | 1,90 (100) | 1,93 (101,6) | 1,98 (104,2) | 1,99 (104,7) |
| DE utilization, MJ/kg | 25,6 (100) | - - | - - | 26 (101,6) |

LSD between ADG means $P \leq 0,01$ = 47,9 g
$P \leq 0,05$ = 21,5 g
LSD between feed intake means $P \leq 0,05$ = 3,5 kg

**Table 6** Energy and nitrogen metabolism data (mean ± *SD*) for 12 boars (six per diet) fed diets oontaining 0 or 8% certified lupin seed meal (Experiment 2)

| Measurement | Diet 1 | Diet 2 |
|---|---|---|
| DM intake, g/day | 1491 ± 3,6 (100) | 1482 ± 0,4 (99,4) |
| GE intake, MJ/day | 28,4 ± 0,07 (100) | 27,8 ± 0,01 (97,9) |
| DM digestibility, % | 82,5 ± 1,3 (100) | 84,0 ± 0,84 (101,8) |
| Energy digestibility, % | 81,3 ± 1,4 (100) | 82,6 ± 0,96 (101,6) |
| Dietary DE content, MJ/kg DM | 15,5 ± 0,26 (100) | 15,5 ± 0,18 (100) |
| N intake, g/day | 45,5 ± 0,11 (100) | 45,3 ± 0,01 (99,6) |
| N digestibility, % | 84,5 ± 2,9 (100) | 84,7 ± 1,3 (100,2) |
| N retention, g/day | 21,6 ± 3,0 (100) | 20,4 ± 3,8 (94,4) |
| N retention, % of intake | 47,4 ± 6,6 (100) | 45,1 ± 8,4 (95,1) |
| N retention, % of digested | 56,2 ± 9,0 (100) | 53,2 ± 10,2 (94,7) |

**Table 7** Performance data (mean ± *SD*) for 32 piglets (16 per diet) fed diets containing 0 or 8% certified lupin seed meal (Experiment 2)

| Measurement | Diet 1 | Diet 2 |
|---|---|---|
| Initial mass, kg | 5,9 ± 1,10 (100) | 5,9 ± 1,23 (100) |
| Final mass, kg | 15,5 ± 2,0 (100) | 15,0 ± 3,7 (96,8) |
| ADG, g | 275 ± 34,6 (100) | 259 ± 81,1 (94,2) |
| Feed intake, kg/piglet | 16,2 ± 1,6 (100) | 15,9 ± 1,4 (98,1) |
| Feed utilization, kg/kg | 1,68 ± 0,05 (100) | 1,76 ± 0,22 (104,8) |
| DE utilization, MJ/kg | 24,3 (100) | 25,3 (104,1) |

The two diets had a similar DE content (15,5 MJ/kg DM).

Although there was a tendency for N retention to be lower (5,6%) when lupins were included in the diet, the difference found when feeding the two diets was statistically non-significant ($P>0,05$).

Contrary to the results obtained in Experiment 1 the inclusion of certified Buttercup lupins at a rate of 8% (Table 7) retarded growth rate by only 5,8% (statistically non-significant, $P>0,05$) in contrast to the 22,5% slower growth rate of the piglets fed 8% commercial Buttercup lupins in Experiment 1. The fact that feed intake was not affected by the inclusion of lupins in the diet is probably the main reason for the differences in growth rate between piglets in the two experiments. Although the efficiency with which feed and DE was utilized dropped by about 5% when the diet contained lupins, as was the case in Experiment 1 the difference was however also statistically non-significant ($P>0,05$).

## Discussion of Results

The finding that the apparent digestibility of energy and protein was not affected by the inclusion of both the high and low alkaloid-containing lupins supports the work of other researchers Pearson & Carr,1976 ; Petersen & Shulz,1979 ; Just, Jorgensen, Fernandez, Bech-Andersen & Hansen,1983;Aguilera, Molina & Prieto, 1985 who reported both *L. angustifolius* and *L. albus* cultivars to have a high energy and protein digestibility.

The depression in feed intake and growth rate found in the first experiment when commercial Buttercup lupins containing 20% high-alkaloid seeds were fed, confirms the suggestion that a high alkaloid content reduces feed intake and retards growth rate (Pearson & Carr,1977 ; Hove, *et al.*,1978 ; Batterham , 1979). This is in marked contrast to the second experiment where the use of certified alkaloid-free seed resulted in feed intakes equal to that of the control animals. Although the growth rate of the piglets fed 8% certified seeds was 5% lower than that of control piglets, the difference proved to be statistically non-significant ($P>0,05$). It must however be noted that, although again non-significant, N retention and feed utilization were also about 5% lower when lupins were included in the diet. Taverner (1982) concluded that the reduction in nutritive value of *L. albus* lupins relative to soya bean meal can be ascribed to the joint effects of amino acid absorption and a lower utilization of energy resulting from the high proportion of energy digested in the hind gut (Just, 1981). An unpublished report by Siebrits, Davie & Barnes (1986) also showed that although full-fat soya bean meal and Buttercup lupins have similar protein digestibilities, the latter has a lower relative nutritive value.

It can be concluded that *L. albus* cv. Buttercup can be used to good effect in a balanced diet for young growing pigs provided the lupins are free of alkaloids. Therefore, it is most essential that alkaloid-free seed be supplied to growers on a regular basis. The rapid screening test developed by Ruiz (1977) can be used effectively to monitor the alkaloid content of the lupins used.

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