EVALUATION OF CANOLA AND LUPINS FOR PIG AND POULTRY FEEDING

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Executive Summary:

This is an interim report on the research being conducted at the University of Natal in which two protein sources, namely, full-fat canola and full-fat lupins, are being evaluated for their suitability in the feeding of poultry and pigs. Apart from extensive chemical and biological analyses of the proteins themselves, experiments have been conducted on broilers, laying hens and pigs to determine (a) whether these protein sources will sustain performance of a standard achieved on proteins conventionally used in South Africa (soya, fishmeal and sunflower), and (b) whether they contain anti-nutritional factors that might cause a loss in production or feed refusal.

13 varieties of Lupin, obtained from the PRT, were analysed for ME and total and available amino acid contents. It was found that the difference between the variety with the lowest and that with the highest protein content was 25 percent (280.8 vs 351.1g/kg), that the range in lysine contents was 4g/kg (1.40 vs 1.80) and the range in AME contents was 3.50MJ/kg (9.24 vs 12.74). It is important therefore that nutritionists are made aware of the range in protein and energy, and take precautions to ensure that they know the nutritional content of the variety which they are using in animal feeding.

Four growth trials with broilers and pigs, and a laying hen trial have thus far been completed, in which canola seed meal has been extensively evaluated. In two of these trials, lupin seed meal has also been included, mainly as a pilot trial for the next series of trials with poultry and pigs, in which lupin will be evaluated. The lupin trials are due to begin before the end of June 1998 and should have been completed by the end of the year.

Two general observations could be made with these trials:

1. Good performance could be sustained on feeds containing canola seed meal, this performance in most cases being equal to that on feeds containing conventional protein sources. This applied in the broiler starter experiment, the laying hen trial and the pig growth trial. In only one trial, the first of the broiler finisher trials, did feeds based on soy/fish and on canola not result in identical performance among the broilers. In this experiment the feed containing canola seed meal produced slightly inferior results (175g less gain in 21d, and a small but significant difference in FCE) compared with the other.
2. In all cases where a choice was offered between basal feeds containing conventional protein sources, lupins and canola, the overwhelming choice was in favour of soya. The protein

source next favoured was canola, with lupin proving to be unpopular to poultry and pigs when given as a choice.

The conclusion from the research thus far is that canola, if milled before use, is an excellent source of energy and amino acids, and that the performance of broilers, laying hens and pigs fed this protein source is virtually the same as on proteins conventionally used in South Africa.

A. **Lupin evaluation**

1. Metabolisable Energy (ME) and Amino Acid analysis of various Lupin varieties

13 varieties of Lupin, obtained from the PRT, were analysed for ME and total and available amino acid contents using the method of McNab and Fisher. This method, for evaluating individual ingredients, consists of force-feeding adult roosters 50g of the test feed, and collecting and weighing all the excreta produced within a 48hr period. The feed and excreta are analysed for gross energy, and for amino acid content, and the digestibilities are then calculated. The results of these analyses are presented in Tables 1 and 2.

Table 1. Protein, Apparent (AME) and True (TME) metabolisable energy (ME) contents of varieties of Lupin obtained from the PRT in November 1997.

Variety	Protein content (g/kg)	AME (MJ/kg)	TME (MJ/kg)
Multolupa	351.1	12.01	12.42
LAL 186-02 (Topless)	291.3	10.93	11.34
SAL 32 (Gail)	292.5	12.22	12.63
Kiev	297.3	11.47	11.88
TIF White (CS3)	344.7	12.58	12.99
Hantie	340.6	11.99	12.40
SAL 11 (Ronell)	348.0	12.58	12.99
Esta	358.9	12.74	13.15
SAL 23	280.8	10.98	11.39
Astra	280.9	12.44	12.85
WPK Helderb	333.8	9.24	9.65
WPK Eureka	316.3	9.48	9.89
Merit	305.8	9.97	10.38

Table 2*Total and Available Amino Acid contents of varieties of Lupin obtained from the PRT in November 1997.*

Variety	threonine		serine		valine		methionine		isoleucine		leucine	
	total	available	total	available	total	available	total	available	total	available	total	available
Multolupa	1.24	1.16	1.63	1.56	1.54	1.42	0.22	0.21	1.59	1.50	2.64	2.50
LAL 186-02 (Topless)	1.09	0.98	1.49	1.40	1.37	1.21	0.20	0.18	1.40	1.28	2.41	2.25
SAL 32 (Gail)	1.11	1.03	1.45	1.37	1.39	1.25	0.20	0.18	1.41	1.32	2.34	2.19
Kiev	1.06	1.00	1.31	1.23	1.35	1.25	0.20	0.19	1.34	1.28	2.21	2.10
TIF White (CS3)	1.18	1.14	1.63	1.60	1.49	1.42	0.20	0.20	1.56	1.52	2.66	2.59
Hantie	1.26	1.15	1.67	1.58	1.58	1.37	0.22	0.19	1.64	1.48	2.65	2.41
SAL 11 (Ronell)	1.27	1.22	1.72	1.68	1.58	1.48	0.21	0.20	1.68	1.61	2.71	2.60
Esta	1.20	1.12	1.66	1.58	1.50	1.36	0.20	0.18	1.61	1.51	2.59	2.44
SAL 23	1.06	0.94	1.37	1.26	1.35	1.16	0.20	0.18	1.37	1.22	2.24	2.02
Astra	1.09	1.01	1.44	1.36	1.34	1.20	0.20	0.18	1.34	1.23	2.26	2.09
WPK Helderb	1.13	1.02	1.63	1.55	1.42	1.24	0.17	0.14	1.51	1.37	2.38	2.18
WPK Eureka	1.04	0.95	1.57	1.51	1.30	1.14	0.17	0.14	1.39	1.27	2.29	2.12
Merit	0.91	0.84	1.25	1.19	1.21	1.09	0.15	0.12	1.24	1.15	1.97	1.85

Table 2 (continued) *Total and Available Amino Acid contents of varieties of Lupin obtained from the PRT in November 1997.*

Variety	tyrosine		phenylalanine		histidine		lysine		arginine	
	total	availabl e	total	availabl e	total	availabl e	total	availabl e	total	availabl e
Multolupa	1.40	1.36	1.41	1.32	0.85	0.78	1.71	1.46	3.67	3.51
LAL 186-02 (Topless)	1.18	1.14	1.21	1.12	0.75	0.68	1.57	1.30	2.86	2.73
SAL 32 (Gail)	1.25	1.21	1.26	1.17	0.73	0.65	1.57	1.35	2.80	2.70
Kiev	1.10	1.08	1.17	1.11	0.71	0.65	1.51	1.28	2.65	2.45
TIF White (CS3)	1.32	1.31	1.31	1.27	0.81	0.76	1.66	1.43	3.63	3.41
Hantie	1.44	1.37	1.43	1.29	0.82	0.72	1.80	1.45	3.73	3.53
SAL 11 (Ronell)	1.48	1.45	1.46	1.40	0.82	0.77	1.79	1.33	3.93	3.71
Esta	1.39	1.34	1.39	1.31	0.79	0.72	1.69	1.41	3.95	3.78
SAL 23	1.17	1.10	1.20	1.07	0.68	0.59	1.53	1.25	2.86	2.67
Astra	1.14	1.09	1.19	1.09	0.71	0.64	1.51	1.29	2.70	2.57
WPK Helderb	1.17	1.11	1.42	1.30	0.90	0.81	1.66	1.25	3.73	3.50
WPK Eureka	1.04	0.99	1.28	1.18	0.87	0.80	1.56	1.23	3.42	3.23
Merit	0.95	0.91	1.17	1.09	0.76	0.70	1.40	1.18	3.02	2.88

B Canola evaluations

Chemical analyses

As with the lupin evaluations, the canola seed meal that was delivered to the research farm for evaluation was first submitted for chemical and biological analysis. Samples of canola were taken from various parts of the consignment and these were fed to adult roosters to determine the availability of amino acids and energy, as described above. The results of these analyses are presented in Table 3 below.

Table 3. *Chemical analysis of samples of canola seed meal*.

Nutrient	Unmilled canola		Milled canola
	Total		
Protein	22.6		
AME (MJ/kg)	14.0		19.4
TME (MJ/kg)	14.4		19.8
		Digestibility	Digestibility
Fat	36.3	55.2	93.4
Threonine	0.98	81.8	90.5
Valine	1.24	82.1	88.6
Methionine	0.40	93.6	96.8
Isoleucine	0.96	83.0	90.8
Leucine	1.71	84.3	92.9
Tyrosine	0.60	85.6	93.4
Phenylalanine	0.99	84.6	92.8
Histidine	0.69	86.6	92.8
Lysine	1.60	82.7	88.5
Arginine	1.40	87.7	95.0

The most important finding with the above analysis is that where the canola is not milled, poultry cannot access all the nutrients in the seed. The digestibilites of amino acids and particularly of fat are significantly lower when the seed has not been broken. This would be of great importance to feed compounders who might think that because of the small size of the seed it is not necessary to mill the seed.

Poultry and pig trials

A series of broiler trials, both in the starter and the finisher periods, a laying hen trial, and a pig growth trial have been conducted to evaluate both the acceptability of Canola Seed Meal to the birds and pigs, and the ability of Canola Seed Meal to act as a substitute for Soybean oilcake meal.

1. Broiler trials to evaluate Canola seed meal

a. Starter period (BR 98/1):

Three basal feeds, based on soya, lupin and canola seed (Table 4) were blended in different proportions in order to produce a response surface that could be analysed as a mixture experiment. The basal feeds were all isonitrogenous and balanced as far as possible for amino acid composition as well as for major and minor minerals, i.e. the chemical analyses of the three protein sources were used to produce three basal feeds identical in the limiting amino acid content. The response measured is therefore a reflection of the accuracy of the analyses on the ingredients themselves, as well as of the presence of anti-nutritional factors. The lupin meal used in this trial was analysed chemically and biologically prior to the basal feed being formulated. The protein content was measured to be 322.3g/kg while the AME and TME values were 10.66 and 11.07 MJ/kg respectively.

The feeds were offered from age 7d to 21d. There were 13 mixture treatments and five treatments involving the two basal feeds used in the finisher experiment (Table 5).

Table 4. *Composition of the three basal feeds used in the experiment*

Ingredient	***Basal A***	***Basal B***	***Basal C***
Yellow maize	50	49.7	18.4
Sunflower oilcake meal		1.1	20
Fishmeal	5	10	10
Canola seed meal			30
Lupin meal		30	
Soybean oilcake meal	30		
Limestone	1.37	1.05	1.07
Monocalcium phosphate	1.34	0.91	0.96
Salt		0.22	0.17
L-lysine HCl	0.32	0.40	0.47
DL methionine	0.10	0.12	
Oil	5	3	2.82
Vitamin and mineral premix	0.25	0.25	0.25
Sunflower husks	6.61	3.25	15.86

Table 5. *Design of experiment, with pen allocations*

Trt	***Proportion of each basal feed***		
1	1.00	0.00	0.00
2	0.00	1.00	0.00
3	0.00	0.00	1.00
4	0.67	0.33	0.00
5	0.67	0.00	0.33
6	0.00	0.67	0.33
7	0.33	0.67	0.00
8	0.33	0.00	0.67
9	0.00	0.33	0.67
10	0.33	0.33	0.33
11	0.66	0.17	0.17
12	0.17	0.66	0.17
13	0.17	0.17	0.66
14	1.00	vs	1.00
15	1.00 vs 1.00		
16		1.00 vs 1.00	
17	1.00*	0.00*	
18	0.00*	1.00*	
19	0.67*	0.33*	
20	0.33*	0.67*	

* These feeds are the basal feeds A and B that were used in the Finisher Experiment.

Results and Discussion

The mixture design used in this trial is designed to determine what combination of the three sources of protein produced the best results, in terms of growth rate, food intake and food conversion efficiency (g gain/kg food). The three basal feeds were composed in such a way that, if the chemical analyses were correct, and if there were no anti-nutritional factors in any of the three basal protein sources, the results should have been the same on all combinations of the three basals. The results of the trial are presented in Table 6 below.

The results of the mixture analysis are shown in Table 7. These regression coefficients indicate that the response to the three basal feeds was almost identical, but with a slight advantage to the use of the second basal feed, namely, that containing lupin. Weight gains were somewhat higher on mixtures containing this basal feed, and FCE was significantly improved when the lupin basal was included in the mixture.

Table 6. *Gain in weight, food intake and food conversion efficiency (FCE) in broiler chickens from 7 – 21d of age.*

Treatment	Weight gain (g/bird d)	Food in (g/bird d)	FCE (g gain/kg food)
1	29.53	53.38	555.8
2	33.97	53.51	637.5
3	30.90	54.64	570.2
4	36.08	56.74	635.9
5	34.18	56.22	609.1
6	34.83	56.30	618.3
7	34.78	53.96	643.4
8	35.20	57.23	614.9
9	32.60	56.47	578.3
10	34.83	54.65	631.1
11	37.45	58.67	639.0
12	37.00	57.33	645.3
13	33.88	56.68	598.3
14	36.20	60.58	597.1
15	35.73	54.64	653.2
16	38.35	60.91	632.1
17	41.00	61.09	671.2
18	37.50	58.57	639.4
19	36.88	57.42	636.6
20	38.35	57.86	662.4

Table 7. *Regression coefficients relating performance to the content of each of three basal feeds*.

Basal feed	Weight gain	Food intake	FCE
B1	30.311	55.91	560.61
B2	33.917	55.03	636.38
B3	30.549	56.54	563.65
B1 x B2	16.871	N.S.	208.86
B1 x B3	19.695	N.S.	236.59
B2 x B3	N.S	N.S.	N.S.
R^2	43.0	6.7	51.9
s	2.288	4.25	28.7

The conclusion from this trial is that the chemical analyses of the canola, lupins and soya were sufficiently accurate to enable the formulation of three feeds that produced very similar broiler performance in the starter period. There were no apparent anti-nutritional factors that interfered with the performance of the broilers in this trial. The basal feed containing lupins

performed better than the other two basal feeds, indicating that there are no problems with the use of this protein source in broiler feeding.

b. Finisher period (BR 98/2)

Six feeds were produced from two basal feeds (Table 8) and these were offered to broilers in the three-week period from 15d to 35d of age. The sexes were kept separate, and there were two replications of each feed x sex treatment (Table 9).

Table 8. *Composition of the two basal feeds to be used in the broiler finisher trial.*

Ingredient	***Basal A***	***Basal B***
Yellow maize meal	588	224
Wheat bran	-	200
Sunflower oilcake meal	156	156
Soybean oilcake meal	106	72
Fishmeal (local)	60	-
Canola seed	-	300
L-Lysine HCl	6.85	7.37
DL Methionine	0.19	-
Limestone	13.4	17.7
Monocalcium phosphate	12.1	16.4
Salt	2.8	4.2
Vitamin and mineral premix	2.5	2.5
Oil	52.4	-

Table 9. *Design of experiment, with pen allocations*

Treatment number	***Feed description***
1	Basal A
2	Basal B
3	0.75 Basal A : 0.25 Basal B
4	0.50 Basal A : 0.50 Basal B
5	0.25 Basal A : 0.75 Basal B
6	Basal A vs Basal B - choice

Results and Discussion

This experiment was designed to determine whether a finisher feed based on canola seed meal as the predominant protein source (300g/kg) would perform as well as a feed based on soya, sunflower and fishmeal. Various blends of the two basal feeds was made, to determine whether there might be an optimum combination of these two feeds where performance is maximised. The performance of the broilers in the finisher period (15 to 35d of age) is shown in Table 10.

Because the trial was designed to test the effect of an increasing amount of canola in the feed, the results should be analysed by regression of the performance variables on the amount of canola in the feed. The regression equation would take the following form:

Performance (e.g. growth rate) = a + b * proportion of canola in feed (between 0 and 1)

Table 10. *Performance of broilers in the period 15 to 35d of age on blends of two basal feeds, and on a choice of the two feeds.*

Treatment	Weight gain g/bird	Food in g/bird	FCE g gain/kg food
basal A (soy)	1180.0	2501.5	471.2
basal B (canola)	1007.5	2458.6	409.4
0.75 A :0.25 B	1122.5	2476.1	453.2
0.5 A : 0.5 B	1125.0	2490.4	451.6
0.25 A : 0.75 B	1032.5	2416.4	426.7
A vs B	1116.3	2285.9	487.8

The results of the regression analyses on these treatments, shown in the following table (Table 11), indicate that the performance on the canola feed was inferior to that on the soy/fish basal. Weight gain over the period was 174g (8.3g/d) lower on the canola basal, and this regression was highly significantly linear, i.e. there was no improvement in performance with a combination of the two basal feeds. Food intake was insignificantly lower on the canola basal, but the combination of the lower gain and the lower food intake caused a reduction in the FCE, of 60 g gain/kg food when the soy/fish basal was substituted fully by the canola basal. This indicates that the chemical analysis of the feed ingredients was not accurate, that the presence of fishmeal in the one basal improved performance or that there was some anti-nutritional factor in the canola that caused poorer performance that caused poorer performance. It is interesting to note that the birds, when given the choice between the two basal feeds (Treatment 6) chose a blend consisting of 87.7 percent soy/fish basal and the remainder, canola. It would appear that, when given the choice, broilers preferred not to use the canola basal, although the performance was not dissimilar on the two feeds. As is so often the case with choice feeding treatments, the FCE on Treatment 6 was superior to any of the other treatments in the trial.

Table 11. *Results of regression analysis of performance variables on the proportion of canola in the feed offered.*

Variable	Constant term	Regression coefficient	R^2	S
Weight gain	1180.5	-174.0	39.5	80.33
Food intake	2497.7	-58.17	5.9	86.53
FCE	472	-60.0	53.4	20.90

The conclusion from this trial is that the two protein sources did not result in identical performance among the broilers, with the feed containing canola seed meal producing slightly inferior results than the other. On the basis of these results it may not be prudent to use as much as 300g canola/kg feed, but it is unlikely that any nutritionist would do so.

c. Finisher period (BR 98/3) starting 17 March 1998:

Three basal feeds were produced (Table 12) and these were offered to broilers in the three-week period from 15d to 35d of age according to the treatment descriptions in Table 13. The sexes were mixed, and there were three replications of each of eight treatments.

Table 12. *Composition of the three basal feeds used in the broiler finisher trial.*

Ingredient	***Basal A***	***Basal B***	***Basal C***
Yellow maize meal	57.46	45.55	43.5
Maize germ meal		13.49	
Sunflower oilcake meal	9.7		6.9
Soybean oilcake meal	20	8.14	10.6
Fishmeal (local)	4.47	5	5
Canola seed		25	
Lupin seed			25
L-Lysine HCl	0.08		
DL Methionine			0.02
Limestone	1.42	1.26	1.34
Monocalcium phosphate	1.35	1.14	1.29
Salt	0.27	0.17	0.19
Vitamin and mineral premix	0.25	0.25	0.25
Oil	5		6
Coccidiostat	+	+	+

Table 13. *Design of experiment, with pen allocations*

Treatment number	***Feed description***	***Replications***		
		1	***2***	***3***
1	Basal A	7	16	24
2	Basal B	2	9	17
3	Basal C	4	10	20
4	Basal A vs Basal B	6	13	19
5	Basal A vs Basal C	1	12	18
6	Basal B vs Basal C	5	14	22
7	Basal A vs Basal B vs Basal C	8	11	21
8	0.50 Basal B + 0.50 Basal C	3	15	23

Results and Discussion

The objective in this trial was to determine the effect of using soya, canola or lupin as the major source of dietary protein in the feed of growing broilers in the finisher phase. This was achieved by offering the three basal feeds on their own, or as choices. Three two-way choices and a three-way choice were offered, as well as a blend of the lupin and canola basals in which equal amounts of the two feeds were mixed together prior to feeding the broilers. In addition to evaluating canola seed meal as a protein source, this trial served also as a pilot trial for the use of lupins in broiler feed. The protein content of the canola basal was measured to be lower than

that of the other two basals (191.8 vs 226.5 and 238.3 g/kg respectively), while the AME content was higher (14.09 vs 13.89 and 13.58 MJ/kg respectively).

Although this trial was planned to end when the broilers reached 35d of age, a heat wave killed a large proportion of the birds when they were only 30 d old, so the results here reflect a shorter period than was originally planned. Nevertheless, the growth rates during the 14d period were sufficient to ascertain the relative effects of these three protein sources. The daily growth rate, food intake and FCE of the birds on the six treatments are given in Table 14.

Table 14. *Treatment means for growth rate, food intake and FCE*.

Treatment	Growth rate, g/bird d	Food intake, g/bird d	FCE, g gain/kg food
Basal A	69.6	148.5	469.6
Basal B	67.0	146.9	456.2
Basal C	69.4	150.6	461.1
A vs B	69.3	132.3	526.3
A vs C	73.2	124.1	591.0
B vs C	68.4	120.3	568.3
A vs B vs C	69.4	126.9	547.5
0.5 B : 0.5 C	66.2	127.7	518.0
SEM	82.63	766.9	772.3

The proportions of feeds A (soya), B (lupin) and C (canola) consumed by the birds, when given the choice, are given in Table 15. It is apparent from these results that broilers preferred the soya basal feed to the other two feeds when these were offered as a choice. Their second preference was for canola, which was preferred to the lupin basal, even though the canola basal contained less protein than did the other two feeds. Interestingly, the FCE on the choice feeding treatments was significantly better than on the basal feeds when fed alone. This is generally the case with choice feeding treatments.

Table 15. *Proportions of basal feeds chosen by broilers when given a choice of feeds.*

Treatment	Basal A chosen	Basal B chosen	Basal C chosen
A (soya) vs B (canola)	0.66	0.34	
A (soya) vs C (lupins)	0.81		0.19
B vs C		0.82	0.18
A vs B vs C	0.54	0.37	0.09

These results indicate that the basal feeds supported growth to the same extent, with no significant differences between these three treatments. The slightly lower growth rate on the canola basal feed can be explained by the lower protein content of this feed. As with the other trials in this series, it is apparent that whereas canola and lupin support the same growth rate as do the conventional protein sources used in South Africa, when broilers are given a choice

between feeds based on different protein sources, they prefer soya/fish-based feeds. The reason for this has not been investigated in this series of trial as yet.

2. Laying trial (Started January 1998)

600 laying hens were used in the trial. They were divided into groups of 30 birds per replication (three cages top row, and three cages bottom row), with four replications of five different dietary treatments. Two basal feeds were mixed by Meadow Feeds (Table 16) which differed in the amount of Canola Seed meal. These basal feeds were blended (Table 17) to produce five dietary treatments differing in Canola content. The feeds were allocated to pens according to the schedule in Table 17.

Measurements:

- Body weight was recorded at the start, after 4w and at the end of the trial. All birds in one cage per replication were weighed together at each weighing.
- Egg production was recorded daily.
- Egg weight was recorded on three days each week throughout the trial.
- Broken, shell-less and other abnormal eggs were recorded separately each day.
- Food intake was measured weekly. 50 kg bags were allocated to each pen at the start, and food remaining each week was measured and recorded.
- Mortalities were recorded daily.
- A taste panel test was conducted on the eggs from three of the treatments, namely, treatments 1, 3 and 5 to determine whether any taint was noticeable in the eggs produced by hens on the canola treatment. These results are not yet available.

Table 16. *Composition of the two basal feeds used in the experiment.*

Ingredient	***Basal A***	***Basal B***
Yellow maize	61.0	21.4
Wheat bran	3.4	21.0
Sunflower oilcake meal	15.0	15.0
Soybean oilcake meal	7.2	11.9
Canola seed meal	-	20.0
L Lysine-HCl	0.22	-
DL methionine	0.14	-
Limestone	9.01	8.97
Monocalcium phosphate	1.11	1.02
Salt	0.47	0.47
Oil	2.00	-
Vitamin and mineral premix	0.25	0.25

Table 17. *Treatment design and allocation to pens.*

Treat	Basal A	Basal B	Replication			
			1	2	3	4
1	100	0	1	9	14	19
2	75	25	3	10	15	18
3	50	50	2	6	13	17
4	25	75	4	7	12	16
5	0	100	5	8	11	20

Results and Discussion

The objective in this trial was to determine whether the performance of laying hens would be impaired when increasing amounts of canola seed meal were introduced into their feed. The design was such that a regression of production variables on the proportion of canola in the feed would ascertain whether canola seed meal had a deleterious effect on performance. Treatment means for rate of lay, egg weight, egg output (g/bird d), body weight gain and food intake are given in Table 18, and the regression analyses are given in Table 19.

Table 18. *Treatment means for rate of lay, egg weight, egg output (g/bird d), body weight gain and food intake*

Treatment	Egg weight g	Rate of lay %	Egg output g/bird d	Food intake g/bird d	Body weight gain, g/bird d
0.00 canola	58.4	91.4	53.4	127.1	3.02
0.25 canola	58.0	93.5	54.2	135.7	1.80
0.50 canola	58.4	92.5	54.0	128.3	1.14
0.75 canola	56.4	94.4	53.2	134.6	0.29
1.00 canola	57.3	92.1	52.7	134.6	-1.19
Significance	NS	NS	NS	**	***

The regression analyses indicate that neither egg weight nor rate of laying was influenced by the proportion of canola seed meal in the feed. This was reflected also in the lack of response in egg output. This indicates that canola seed meal may safely be used in feeds for laying hens. However, it must be noted that the amount of feed consumed by the laying hens increased (not significantly) as the amount of canola was increased in the feed, but that in spite of this, the effect of increasing the body weight gain in the hens. This latter variable was highly significantly influenced by the amount of canola in the feed, being directly related to this.

Table 19. *Results of regression analysis of performance variables on the proportion of canola in the feed offered.*

	Constant term	SE (a)	Regression coefficient	SE (b)	R^2
Egg weight	58.47	0.77	-1.573	1.005	7.1
Rate of lay	92.33	1.18	0.899	1.927	0.0
Egg output	53.96	0.63	-0.94	1.025	0.0
Food intake	129.32	1.75	5.549	2.849	12.8
Weight gain	3.00	0.26	-3.98	0.433	81.5

3. Pig trial (started January 1998)

Objective:

To determine whether pigs will accept feeds containing high contents of canola seed meal, unprocessed, and whether they will perform as well as pigs fed a feed based on soya/fish.

Materials and Methods

48 weaners were obtained from Oaklea Stud, they were placed in individual pens and fed a high density starter feed until each pig weighed 20kg, at which time the weight of the pig was recorded and it was then placed on one of six feed treatments. The experiment continued until each pig reached the finishing weight of 90kg.

Feed treatments:

Two basal feeds were formulated (Table 20), one containing 30 percent Canola seed meal, the other, 40 percent soybean oilcake meal. The remaining ingredients were kept essentially the same in both basal feeds to minimise the effects of other ingredients on growth rate and FCE.

Table 20. *Composition of the basal feeds used in the two periods of the experiment*

Ingredient	Period 1 (20 - 50 kg)		Period 2 (50 - 90 kg)	
	canola (A)	no canola (B)	canola (A)	no canola (B)
maize	200	613	205	522
wheat bran	70		200	
maize germ meal	200		92	
sunflower oilcake meal	129	84		
molasses			70	70
canola seed meal	300		300	
soybean oilcake meal		200		200
vit/min premix	2.5	2.5	2.5	2.5
lysine HCl		1.2		
limestone	15.9	17.5	15.7	162
monocalcium phosphate	13.2	17.3	11.5	18
salt	3.4	30	3.3	3.7
oil		35		68
sunflower husks	66.3	26.2	100	100

These two feeds were blended to produce five different feeds (Table 21). The sixth feed treatment was a choice between each of the two basal feeds. Each of these feed treatments was replicated among eight pigs housed individually.

Table 21. *Blending proportions and treatment allocations*

Treatment	Basal A	Basal B	Replication							
			1	2	3	4	5	6	7	8
1	100	0	5	8	14	23	30	35	37	43
2	0	100	6	10	18	19	25	36	41	48
3	75	25	4	9	16	22	22	31	39	47
4	50	50	2	11	17	24	24	32	42	45
5	25	75	1	12	15	20	20	33	40	44
6	A	vs B	3	7	13	21	21	34	38	46

Measurements:

Pigs were weighed weekly, together with the food consumed. Food was placed in two bins in front of each pig and these bins were weighed separately so that the food consumed from each bin could be calculated.

The results were subjected to an analysis of variance as a completely random design using Minitab (1998) as well as regression analysis to determine differences in incremental increases of canola seed meal concentrations in the diet. Linear regression analysis was also used to determine weekly differences in the proportion of canola meal consumed when pigs were given a choice between diets with or without canola.

Results and discussion

The effects of including canola in the diets fed to growing pigs on daily food intake, growth rate and food conversion efficiency (FCE) are shown in Table 22. There were no significant differences between treatments across all variables.

Analyzing the data using linear regression analyses also showed that the inclusion of canola seed meal had no detrimental effect on food intake or average daily gains (Table 23). There was an indication that the efficiency of food utilization may be adversely affected if canola seed meal is included at 300g/kg feed. However, the very low R^2 values from the regression analysis suggests that this finding is probably coincidental rather than a significant effect.

To determine whether pigs have a preference or a negative reaction to the inclusion of canola seed meal the pigs were given a choice between Basal A and B diets. The results of the choice are expressed as the amount of Basal A consumed as a proportion of total food intake. Table 23 shows that when pigs were given a choice between two feeds, one with and one without canola seed meal, the feed containing canola would constitute no more than 19 percent of their total intake.

The results of this experiment suggest that pigs grown from 20 to 80 kg live weight will not be adversely affected by the inclusion of up to 300 g/kg canola seed meal in the complete ration. However, if given a choice between a feed with or without canola meal they would prefer to eat the diet containing no canola seed.

Table 22. *Daily food intake (FI), average daily weight gain (ADG), food conversion efficiency (FCE) of pigs grown from 20 to 80 kg live weight.*

Treatment	FI (kg/day)	ADG (kg/day)	FCE (g gain/kg food)
1	1.794	0.747	415
2	1.805	0.769	428
3	1.907	0.844	443
4	1.943	0.859	444
5	1.796	0.785	438
6	1.851	0.795	430
s.e.m :	0.073	0.032	9.02
Significance:	NS	NS	NS

Table 23. *Regression analyses of increasing canola concentrations in the diet on food intake (FI), average daily weight gain (ADG) and feed efficiency (FCE) and the amount of feed, with canola as main protein source, consumed (PropCanola), as a proportion of total feed intake (TFI), over an 11 week period*.

Variable	Constant term	s.e.	Signific.	Regression coefficient	s.e.	Signific.	R^2
FI	1.88	0.057	***	-0.054	0.095	NS	1.0
ADG	0.834	0.026	***	-0.064	0.044	NS	5.4
FCE	0.446	0.007	***	-0.024	0.012	*	10.0
PropCanola	0.190	0.050	**	0.0084	0.0074	NS	12.4