Lathyrus cicera as quality feed for laying hens

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Introduction

Research at CLIMA has indicated that *Lathyrus cicera* and *L. sativus* (grasspea) have potential as grain legumes on 100 000 to 300 000 ha of neutral to alkaline soils in low-to-medium rainfall areas of southern Australia. They do not have serious disease problems and are envisaged as low maintenance/low cost crops for the purposes of green manure, managing herbicide resistant weeds, forage, hay and grain principally for animal feed. Particularly *L. sativus* is a human food in large parts of the Indian sub-continent and Ethiopia.

Both of these *Lathyrus* species have been used extensively in the past for animal feed. The neurotoxin 3-(-*N*-oxalyl)-L-2,3-diamino propionic acid (ODAP) is found in *L. cicera* and *L. sativus* grain and if consumed in large amounts can produce a paralysis of the hind legs known as "lathyrism". ODAP was identified in the 1960's and since that time plant breeding has produced lines with low toxin levels [(2)]. Due to the presence of ODAP *Lathyrus* species have almost disappeared from many regions where they were once cultivated extensively, such as Europe. The newer lines with low toxin levels have not been widely evaluated for animal feed and the present study is the only one to our knowledge that has evaluated low toxin lines in poultry.

Since one of the goals of establishing *Lathyrus* cultivation in Australia was to develop animal feed markets it was decided to investigate the use of *L. cicera* cultivar 'Chalus' in trials with laying hens. Chalus was released by CLIMA in 1998 and was shown in extensive studies to have low levels of ODAP (Table 1), about 70% lower than what is found in fields in India for example. Chalus has shown good adaptation across southern Australia and is the first in a series of cultivars that are to be released by CLIMA.

One part of the study was to establish Chalus as safe for both the laying hens and for any consumers of eggs or bird tissue. Since little was known about the fate of ODAP in hens, one aim was to investigate whether after feeding with Chalus that ODAP could be found in eggs or body tissue of hens. The second aim was to demonstrate that Chalus was a good quality feed capable of replacing, for example, field peas (*Pisum sativum*) in laying hen diets without penalty in egg production.

Material and Methods

Intense short term feeding study

There were 6 dietary treatments of wheat-based diets with Chalus included at 0, 5, 10, 15, 25 and 30% Chalus (Chalus composition see Table 1). Each diet was fed to 16 replicates of 8 birds each for a period of 8 weeks. Bird weights were recorded at the beginning and end of the experiment. Bird behaviour was observed daily for neurotoxic symptoms. The experimental diets were commenced when the birds were 26 weeks old. Feed consumption was monitored weekly.

In the seventh week excreta from each cage was collected for moisture determination. In the final week egg weight of all eggs laid in a 3 day period was recorded. Shell characteristics and yolk colour of approximately 600 eggs (100 eggs per treatment) were measured. The proportion of dirty eggs was visually assessed. On the final day four samples (pooled) of eggs, breast meat, whole brain and liver per treatment were sampled for analysis of ODAP.

Long term feeding trial

A long term feeding study was conducted on some birds retained after the 8 week feeding study described above. Each of the six dietary treatments was given to three birds for a further period of 24 weeks. Eggs were analysed for ODAP after a further 12 weeks; eggs and tissues were analysed for ODAP at the end of the study as done previously.

Table 1. Chemical composition of *Lathyrus cicera* cv Chalus.

Component	Amount	Component	Amount
	%		*g/16g N*
Moisture	10.6	**Essential amino acids**	
Fat	0.7	Cystine	1.23
Protein	27.6	Methionine	0.82
Ash	3.1	Threonine	3.68
NDF (enzyme modified)	24.5	Valine	4.57
ADF	10.7	Isoleucine	4.01
Starch	42	Leucine	7.36
Lignin	0.2	Phenylalanine	4.46
NFE (nitrogen free extractives)	61.8	Lysine	7.13
In vitro digestibility (IVD)	80	Histidine	2.45
		Arginine	8.81
Minerals			
P	0.33	**Antinutritionals**	
K	0.91		*%*
Na	0.07	ODAP	0.09
Ca	0.25	Tannins (total)	1.08
Mg	0.13	Tannin, catechin	0.51
S	0.17	Oligosaccharides	4.12
	mg/kg	Phytic acid	0.91
Fe	156		*g/kg*
Mn	11	Trypsin inhibitor activity	2.07
Zn	20	Chymotrypsin inhibitor activity	3.46
Cu	9		

Results and Discussion

No ODAP was detected in egg white at any time. Egg yolk (Table 2), breast meat and liver showed trace levels of ODAP, but this was not consistent. After the 32 weeks of feeding the brain tissue showed the most consistent traces of ODAP (Table 3) but levels were 20 times less than that shown in previous studies of rats when lathyrism symptoms were evident [(1)]. The trace levels detected in hens and egg yolk were 300 times less than the ODAP levels in the Chalus grain they were fed. Any consumption of these low levels of ODAP in the hens and the eggs would be too low to affect humans or animals. Studies of human consumption of ODAP have shown that regular consumption of grain at levels 3000 times the levels found in this study are sufficient to cause lathyrism symptoms, only if the grain is consumed exclusively and under circumstances of malnourishment. Hence the possibility that consuming eggs or hen tissue as shown here is extremely unlikely to pose any problem. The hens showed no signs of neurotoxicity and deaths in the experiment were minimal and not related to feed type.

Egg production and quality was as good as the field pea based diet and in some cases showed small improvements and was always at a level expected for the age and breed of the hens. Feed intake was marginally greater for Chalus than field pea. Feed conversion was also marginally better for Chalus than field pea (Fig. 1). Soiling of eggs was shown to be slightly better in Chalus. Egg shell thickness and proportion were unaffected by inclusion of Chalus in the diet, as was the egg weight. However the yolk colour was significantly improved by the inclusion of Chalus.

Table 2. Effect of Chalus content of diet on concentration of ODAP (ppm) in egg yolk sample over an extended feeding period of 32 weeks in the second long term feeding experiment.

	Time on diets (weeks)			
Chalus (%)	**0**	**8**	**20**	**32**
0	0.0	0.0	0.0	0.0
5	0.0	0.1	0.1	0.0
10	0.0	0.5	0.0	0.0
15	0.0	0.8	0.7	0.0
25	0.0	0.0	0.2	0.1
30	0.0	0.0	0.2	0.0

Table 3. Effect of Chalus content of diet on concentration of ODAP in brain sample after an extended feeding period of 32 weeks in the second long term feeding experiment.

Chalus (%)	ODAP (ppm)
0	0.0
5	0.5
10	0.8
15	0.4
25	0.7
30	0.7

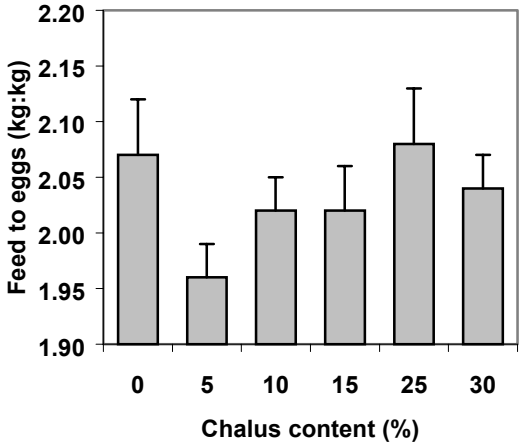

Fig. 1. Effect of Chalus content of diet on conversion rate of feed to eggs at 34 weeks of age (means ± standard errors).

Conclusions

In comparison to field pea Chalus was as good a feed ingredient, with no shown detrimental effects. One significant advantage of Chalus is however the likely grain price. Due to the low maintenance nature of the crop it is expected that grain price is likely to be around $AUS140 per tonne. This compares very favourably with field peas at $AUS220 per tonne and even lupins (*Lupinus angustifolius*) at $AUS190 per tonne. Chalus certainly seems to be a better quality ingredient for layers than lupins are currently. Composition-wise Chalus is almost identical to field peas but has about 2% higher protein levels at about 26%.

The very pleasing results with laying hens bode well for the continued adoption of *Lathyrus* species in low-to-medium rainfall farming systems of southern Australia, especially as the initial problem of establishing cultivation has been the lack of existing markets. Other cultivars are planned with greater adaptation and better agronomic characteristics, the adoption of these cultivars will lead to a stable supply of grain for the egg industry and thus ensuring access to a low cost, high quality feed ingredient.

Wide dissemination of the results of the layer feeding trial will go a long way to establishing Lathyrus species as a choice for farmers wishing to grow a grain legume in their crop rotation system. Previous pleasing feeding results with pigs [3,4] and sheep [5] in Australia will encourage increased local production of grain which will become available for the egg industry.

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