Paper 15

PEAS IN ANIMAL FEED COMPOUNDING

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INTRODUCTION

To obtain an understanding of the role of peas in the New Zealand stockfeed industry, it is necessary to understand the role and location of the industry.

The New Zealand stockfeed industry primarily services the pig, layer and broiler industries. Although peas are also used to feed cattle, sheep and horses, this use is usually limited to drought periods and will be ignored in this paper.

New Zealand is self sufficient in eggs, and pig and poultry meat. Only very limited quantities are exported (mainly to the Pacific Islands). The number of laying hens in New Zealand is controlled by an entitlement system (at time of writing) and has stabilised following ten years of reducing numbers, as per bird efficiency increased. Although breeding and growing efficiencies have improved within the national pig herd, there has been a shift to meal feeding and the quantity of pea-based stockfood used has probably plateaued. Broiler production has increased quite dramatically over the past ten years and a continued annual growth in sales of 5-10% can be expected if overseas trends in fast foods are mirrored in New Zealand.

Table 1. Estimates of pig and poultry feed production in New Zealand.

Location	Pig (tonne/yr)	Layer (1) (tonne/yr)	Layer (2) (tonne/yr)
Upper North Island (3)	90,000	80,000	40,000
Lower North Island	50,000	50,000	50,000
South Island	60,000	50,000	35,000
Total	200,000	180,000	125,000

(1) Includes 12,000 tonnes of broiler breeder feed
(2) Includes turkey and duck feed (South Island based)
(3) Auckland, Waikato, Bay of Plenty.

Current estimates of pig and poultry feed production (Table 1) have been regionalised to demonstrate the location of intensive animal production in New Zealand.

PEA USAGE

Peas have been used in pig and poultry diets in New Zealand for many years. They are a favoured protein source due to various factors:

- There is a pea industry in New Zealand based on canning, freezing, processing and the export of peas, giving a constant source of raw material.
- The variation in physical and nutritional characteristics of commonly grown varieties of *Pisum sativum* is small.
- Peas do not need to be processed (e.g. heat treated).
- The agronomy of peas is well known and researched.
- Peas are an integral part of mixed cropping systems in Canterbury and elsewhere.
- Pea prices have been relatively competitive with other protein sources.

These factors have allowed the stockfeed industry to vary its requirements from time to time, without affecting the stability of the pea industry.

Use of peas in stockfood production has been concentrated in Canterbury but in recent years the development of cropping systems in the Manawatu has seen an increase in pea usage in that area. High internal transport costs preclude the use of large quantities of peas in Auckland and the Waikato.

An accurate estimate of the quantity of peas used in various New Zealand animal diets is difficult to obtain, however, best estimates of inclusion levels of peas in diets on a national basis can be made and extrapolated into tonnages (Table 2).

Table 2. Inclusion of peas in diets of different animals in various areas.

Location	Pig %	Pig tonnes	Layer %	Layer tonnes	Broiler %	Broiler tonnes	Total tonnes
Upper North Island	0	0	0	0	2	800	800
Lower North Island	3	1500	2	1000	8	4000	6500
South Island	3	1800	2	1000	10	3500	6300
TOTAL		3300		2000		8300	13600

The use of peas in pig and poultry diets is a function of their nutritive value and their price relative to alternative ingredients, such as cereal grains (maize, wheat, barley) and other protein sources (notably meat and bone meal).

NUTRIENT AND ENERGY COMPOSITION OF PEAS

A detailed analysis of three varieties of *Pisum sativum* (Rover, Huka and Partridge) has been conducted in New Zealand by Harris and Douglas (undated). Their results are consistent with those found in the international literature and values for selected nutrients are presented (Table 3).

Table 3. Nutrient content of New Zealand peas.

Gross composition	Mean result
Moisture	12.2%
Crude protein	21.6%
Total lipid	0.9%
Ash	3.0%
Starch	42.7%
Energy	
Digestible energy (pigs)	12.8 MJ/kg
True metabolisable energy (poultry)	8.2 MJ/kg
Amino acids	
Lysine	1.54%
Methionine	0.18%
Cystine (½)	0.30%
Threonine	0.30%
Isoleucine	0.84%
Tryptophan	0.20%
Minerals	
Calcium	0.13%
Phosphorus	0.37%
Sodium	0.01%

The value of digestible energy (pigs) was calculated using the regression equation of Morgan, *et al.*, (1975), whilst true metabolisable energy was determined at the Massey University Poultry Research Centre using the method of Sibbald (1976).

The most expensive components in New Zealand stockfeed diets are energy and protein. The much lower concentration of minerals and vitamins, together with their availability from cheap synthetic sources virtually eliminates their consideration when determining the absolute, or relative, nutritional value of peas.

Energy

Energy is by far the most concentrated animal requirement in peas. Gross energy, as derived from complete combustion of samples in a bomb calorimeter, is of little use to the animal nutritionist since not all of the gross energy is digested or metabolised. Instead, species specific biological assay methods are used for determining digestible and metabolisable energy in feedstuffs and comparisons are made on a common standard (Table 4).

Peas have a higher fibre and ash level than the cereal grains and consequently have a lower energy availability to the monogastric animal. In New Zealand, peas often compete against meat and bone meals for inclusion in poultry and pig diets. Compared to these ingredients peas are a less concentrated source of metabolisable energy, but more concentrated source of digestible energy for pigs.

Table 4. Energy values for various feedstuffs (MJ/kg ingredient).

Feedstuff	Gross energy	Digestible energy (pigs)	Metabolisible energy (poultry)
Maize	16.8	14.4	12.8
Wheat	16.3	14.5	11.9
Barley	16.3	13.2	9.5
Peas	16.8	12.8	8.2
Meat and bonemeal	16.5	12.5	10.0

Source: Harris and Douglas

Protein

The most concentrated nutrient in peas is protein. Protein is comprised of amino acids. Animals have a minimum requirement for each amino acid for maintenance and growth. Dietary excesses and imbalances can adversely affect animal performance. Animal nutritionists are therefore interested in both absolute and relative levels of amino acids. Amino acids which are in lowest concentrations in animal diets are referred to as "limiting" amino acids.

The limiting amino acids in poultry diets are methionine, isoleucine and lysine. The limiting amino acids in pig diets are lysine, threonine, tryptophan and methionine. A comparison of the concentration of these amino acids in some selected ingredients is presented (Table 5).

Table 5. Amino acid concentration of selected ingredients (% by weight of meal).

Amino acid	Peas	Barley	Meatmeal	Soybean meal
Crude protein	21.6	9.7	50.0	47.0
Lysine	1.54	0.35	2.70	3.10
Methionine	0.18	0.15	0.70	0.70
Tryptophan	0.22	0.14	0.29	0.62
Threonine	0.80	0.31	1.68	2.00
Isoleucine	0.84	0.34	1.34	2.50

Peas are a relatively rich source of lysine (7.13 percent of protein) compared to other ingredients but are relatively low in methionine (0.83 percent of protein) compared to barley (1.54 percent of protein) and meatmeal (1.40 percent of protein).

The relative balance of amino acids in peas compared to the Agricultural Research Council (1975, 1981) requirements of animal diets is presented (Table 6). All amino acids have been expressed relative to lysine at 100.

Peas are low in methionine relative to the amino acid balance required in pig and poultry diets. Use of peas in these diets therefore necessitates supplementation with synthetic methionine.

Table 6. Amino acid balance in peas, relative to requirements of animals as outlined by the Agricultural Research Council (1975, 1981).

Amino acid	Peas	Broilers	Layers	Pigs
Lysine	100	100	100	100
Methionine	12	44	47	35
Tryptophan	13	19	23	14
Threonine	52	67	48	60
Isoleucine	55	78	73	54

Little information exists on the digestibility of pea protein. Taverner and Curic (1983) have determined that the nitrogen digestibility of peas in pig diets is 85 percent whilst Moughan (1984) obtained a nitrogen digestibility of 70 percent. Bajaj and co-workers (1971) used rats to compare the protein quality of 28 field pea cultivars and found their ability to support growth and nitrogen retention varied greatly. There was no correlation between protein quality and protein content of the different cultivars.

Antinutritional factors

It is not necessary to heat treat field peas even though they do contain an antitrypsin activity and a hemagg lutinizing activity (Tannous and Ullah, 1969). As a plant protein source peas therefore have a practical advantage over those ingredients with antinutritional factors, such as rapeseed (glucosinolate), cottonseed (gossypol), linseed (antipyridoxine) and soybean (anti-trypsin). There is evidence that peas contain saponins, oxalic acid and cyanogens, (Chubb, 1982) but these have not been shown to adversely affect animal performance. It is important to ensure that antinutritional factors are not encouraged in any breeding programme.

Calcium

New Zealand nutritionists rate peas as a medium protein, low to medium energy ingredient. The one advantage that peas have over their major competitor (meat and bone meal) is that they are low in calcium. High calcium levels in monogastric diets reduce the energy level due to complexing of dietary fats. The use of high calcium meat and bone meals must therefore be constrained if optimum animal performance is to be achieved. This constraint automatically results in a premium being placed on low calcium, plant protein sources such as peas. The highest protein diets, using the highest levels of meal and bone meals are broiler diets. These diets therefore use the largest quantities of peas. The level of peas used is largely a function of the upper calcium constraint that the nutritionist imposes on the diet, as well as their relative price in relation to energy and protein concentration.

THE FUTURE

Peas have played a significant role in monogastric feeding in New Zealand. The quantity of peas used in diets is largely a function of their cost as a source of energy and protein, relative to cereals and meat and bone meals. In any breeding programme, every effort should be made to reduce the cost of pea energy and pea protein. Increased yield of energy and/or protein per hectare should be the main criteria in such breeding programmes. Whether emphasis should be placed on energy yield or protein yield will depend on the relative costs of these nutrients at any point in time. Present relativities would favour emphasis on increasing energy yields per hectare, by either increasing weight yield or by increasing metabolisable energy concentration while maintaining weight yield. Close co-operation between agronomists and nutritionists is needed to ensure optimum breeding programmes are developed.

The future use of peas in the New Zealand pig and poultry industries is intimately related to the future development of these industris. Both industries are going through difficult times. Pig farmers see decreasing pigmeat schedules as grain and feed prices increase. The layer industry has undergoing an Industries Development Commission enquiry. Despite these difficulties, both industries remain viable within the current economic and political framework, and in the foreseeable future will supply New Zealand's requirements for pig and poultry products. The longer term outlook is clouded by the development of closer economic relations with Australia. There is no doubt that in ten years time New Zealanders will still be eating chicken, pork and eggs. The question is whether they will be fed in New Zealand on diets containing peas, or in Australia on sunflower, soybean and lupin diets.

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