WEATHER-DAMAGED WHEATS FOR PIGS

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Summary

The chemical composition, dry matter digestibility, crude protein digestibility and digestible energy content of weather-damaged wheats were examined for growing pigs. Digestible energy content, on a weight basis, decreased 13% as the density of the wheat decreased from 77 to 50 kg/hl (r=0.89). Digestible crude protein decreased 10% and dry matter digestibility decreased 6% but both were less related to wheat density (r=0.72 and 0.76 respectively). Crude protein and lysine content (g/16gN) were unrelated to wheat density but lysine content was inversely related to crude protein content (r=-0.93). The results indicated weather-damaged wheats were suitable as energy and protein sources for pigs provided allowances were made for the decreases in digestible energy content and crude protein digestibility.

I. INTRODUCTION

Considerable quantities of weather-damaged wheats are produced when excessive rainfall occurs during the latter part of the wheat season. Such wheats are normally either affected by rust or "shot and sprung" and both conditions are associated with reduced grain density (Farlin et al. 1971). These wheats are unsuitable for export and are made available locally for stock feeding at discounted rates.

Any reduction in the digestible energy content of wheats as a result of decreased density may reduce the potential of these wheats for young pigs, but should have little effect on baconers and adult stock. With the latter, energy intake is normally restricted to prevent overfatness and they should be capable of consuming the greater volume associated with the feeding of diets containing lower density wheat. Any reduction in the crude protein and amino acid content of the wheat (on a weight basis) could be detrimental as the cereal base of a diet contributes a considerable portion of these nutrients to the overall diet. In particular, lysine is normally the first limiting amino acid in grower pig diets and so any reduction of lysine in weather-damaged wheats would reduce their value.

To enable accurate diet formulation using weather-damaged wheats it is therefore necessary to have information on their digestible energy, crude protein and amino acid (lysine) content. This information is also necessary for determining the price discount to apply for the degree of weather-damage relative to undamaged wheats and other energy sources. This paper reports investigations that were conducted to supply this information.

II. MATERIALS AND METHODS

Eight samples of wheat ranging in density from 50 to 77 kg/hl (Table 1) were selected from the 1973 wheat harvest. The wheats were from different parts of the N.S.W. grain belt but the variety of each sample was unknown. The degree of sprouting was estimated according to Farlin et al. (1971). The wheats were coarsely crushed through a hammer

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TABLE I

Chemical composition and dry matter digestibility (DMD), crude protein digestibility (CPD) and digestible energy content (DE) of weather-damaged wheats for growing pigs

	Wheats†								SEM	r*
	1	2	3	4	5	6	7	8		
Grain density (kg/hl)	77	72	68	66	60	58	53	50		
Degree of sprouting (%)	0	2	50	55	70	85	11+	96		
Chemical analyses										
Moisture (%)	12.6	12.5	13.2	11.9	13.3	12.5	12.5	14.2		-0.46
Crude protein (%)	13.3	14.3	11.3	13.4	10.5	13.7	11.8	15.5		-0.07
Gross energy (MJ/kg)	20.0	19.9	20.4	19.3	19.9	19.4	19.2	18.8		0.74
Amino acids (g/16gN)										
Threonine	2.7	2.7	2.4	2.4	2.7	3.0	2.7	2.6		-0.21
Valine	4.6	4.2	4.8	4.4	4.7	4.5	4.6	5.1		-0.54
Methionine + cystine	2.6	2.6	2.9	2.9	2.9	2.8	3.2	2.9		-0.74
Isoleucine	3.9	3.8	4.2	3.9	4.4	4.2	3.5	3.9		0.09
Leucine	6.3	7.5	7.8	6.6	6.6	6.4	7.4	8.2		-0.38
Phenylalanine + tyrosine	8.3	8.9	8.3	8.2	8.3	8.4	9.0	9.0		-0.50
Lysine	3.3	2.7	4.0	3.0	4.0	3.1	3.6	2.9		-0.05
Histidine	2.2	2.0	2.6	2.0	2.5	2.4	2.6	3.1		-0.75
Arginine	5.5	5.0	4.8	5.3	4.9	5.1	5.5	5.6		-0.31
Pig data										
DMD (%)	85.0	85.0	84.2	85.4	84.2	84.4	80.1	81.9	0.6	0.76
CPD (%)	81.5	82.5	79.6	82.3	74.0	81.2	73.9	75.8	1.5	0.72
DE (MJ/kg)	14.9	14.6	14.9	14.1	14.3	14.2	13.1	12.9	0.1	0.89

* Correlation coefficient between grain density and horizontal parameter; significance levels, $P < 0.05 = 0.71$, $P < 0.01 = 0.83$.

\+ Rust affected, shrivelled grain.

† Air dry basis.

mill. Diets were formulated to contain 96.5% wheat and were supplemented with 0.4% l-lysine and a mineral-vitamin premix which added the following per kg of diet: - Fe 60mg, Zn 100mg, Mn 30mg, Cu 5mg, I 2mg, Se 0.15mg, Na Cl 2.5g, Ca 7.8g, P 5g, retinol equivalent 865μg, cholecalciferol 10μg, ∝tocopherol equivalent 6mg, thiamin 0.9mg, riboflavin 3mg, nicotinic acid 12mg, pantothenic acid 10mg, pyridoxine 1.5mg, cyanocobalamin 15μg, pteroylmonoglutamic acid 2mg, choline 450mg, ascorbic acid 10mg and biotin 0.1mg.

Twenty four Large White male castrate pigs were divided into three groups of eight, based on live weight (means of 26, 29 and 33 kg/group) and randomly allotted to metabolism cages. The cages were designed for pigs from 20-45 kg live weight. The diets were randomly allotted within each group of eight pigs. The pigs were fed once daily, at a feeding rate of 4% of live weight. Water (2/1, w/w) was added to the feed. The' pigs were allowed 11 d to adjust to the diets. The collections of faecal samples were then made as follows. The pigs were weighed and feed allowances adjusted. Three days later a seven-d collection of faeces commenced. At the completion of the collection period the pigs were re-weighed and feeding rates adjusted. Three days later a second seven-d collection of faeces was undertaken with two of the groups of eight pigs. The third group of pigs was discarded as their size had reached the maximum capacity of the cages.

. During the seven-d collection periods the faeces were collected daily and stored at -15°C. At the end of each collection period the faeces were thawed, mixed, sampled and dried at 105°C for 24h.

Gross energy was determined by ballistic bomb calorimetry, dry matter in the wheats by freeze drying and crude proteins (N x 6.25) on fresh samples of wheat and faeces by macro Kjeldahl technique. Total amino acids were determined using reflux hydrolysis under N in six normal HCl and separation of the amino acids by ion-exchange chromatography.

The digestible energy content of the wheats were calculated by subtracting the estimated digestible energy of the lysine and mineral and vitamin supplements (gross energy x 90%) from the digestible energy content of the diets.

III. RESULTS

There was little relationship between wheat density and chemical composition (Table 1). Lysine content (g/16gN) was, however, inversely related to crude protein content (r=-0.93).

Digestible energy content, on a weight basis, decreased 13% as the density of the wheat decreased from 77 to 50 kg/hl(r=0.89). Digestible crude protein decreased 10% and dry matter digestibility decreased 6% but both were less related to wheat density (r=0.72 and 0.76 respectively).

IV. DISCUSSION

Although the digestible energy content of the wheats decreased 13% on a weight basis as grain density decreased from 77 to 50 kg/hl, the digestible energy content /hl decreased from 1147 to 645 MJ. This 44% reduction in energy density in severely weather-damaged wheats would need to be considered in relation to the desired energy intake of the pigs. With pigs up to porker weight it may not be possible to compensate for this degree of reduced energy density and it may be necessary to limit the proportion of these wheats in such diets. For baconers and adult stock, however, it should be possible to increase dietary intake sufficiently to compensate for the lowered energy density. This may even be advantageous as it may result in more even feed intake in group fed animals and more contented stock. The decrease in grain density of weather-damaged wheats, however, indicates the desirability of purchasing wheats on a weight basis and not on a bushel or bag basis.

The parameters used to assess protein content and quality in these present studies indicated little effect of weather damage except in the severely damaged wheats. Although amino acid digestibility was not determined, crude protein digestibility could be used as an indicator of this, particularly for lysine (Nielsen 1968). Thus in severely damaged wheats a correction of 10% for loss in crude protein and amino acid content could be made. This correction for decreased crude protein and amino acid content would automatically be made when correcting for loss of digestible energy content as the magnitudes of these losses were similar.

One limitation of the use of weather-damaged wheats may be greater risk of contamination of toxins from moulds. In the present study no adverse effects from feeding any of the wheats was noticed but longer term production experiments would be needed to confirm this observation. If contamination from moulds was a problem, then additional precautions such as the use of organic acids during storage (Wilson et al. 1975) may be warranted.

Overall the results indicated weather-damaged wheats are suitable as energy and protein sources for pigs. It is necessary to select these wheats on a weight basis and an allowance needs to be made for the decrease in digestible energy as the density of the wheat decreases. In severely-damaged wheats, allowance for the decrease in crude protein digestibility and the possible greater risk of contamination from moulds needs to be considered.

V. ACKNOWLEDGEMENTS

The authors wish to thank Messrs. P.R. Hassab, W.T. Kirsop and G.L. Wright of the N.S.W. Department of Agriculture and Dr. J.M. Holder, "Wonga Projects" Young, for the selection and supply of weather-damaged wheats and Mr. G.H. O'Neill, Biometrician, for the statistical analyses. The amino acid analyses were conducted by Professor C.G. Payne,. University of Sydney. The salary of Mr. C.J. McMillan and funds for this project were supplied by the Australian Pig Industry Research Committee.

VI. REFERENCES

FARLIN, S.D., DAHMEN, J.J., BULL, R.C., PETERSEN, C.F., MURRAY, G.A., and BELL, T.D. (1971). Idaho Agricultural Experiment Station Bulletin 523.

NIELSEN, A.J. (1968). Royal Veterinary and Agricultural College Yearbook, Copenhagen, Denmark, p. 79.

WILSON, W.M., COSTA, P.M., WILSON, L.L., and HATFIELD, E.E. (1975). In "Corn Quality in World Markets", ed. L.D. Hill. (The Interstate Printers: Illinois.)