A NUTRITIONAL EVALUATION OF TRITICALE

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SUMMARY

Two experiments were conducted with rats and pigs to determine the nutritive value of triticale and to compare it with wheat. Unsupplemented triticales supported the same growth rate of rats as unsupplemented wheat. Additions of lysine and threonine to all grains improved growth rate and feed conversion ratio (FCR) of rats, but there was no further response when soybean meal and fish meal were added.

Growth rates and FCR of pigs were the same on triticale-(630 g/d) and wheat-(620 g/d) based diets with the same protein supplements. Triticale supplemented with sunflower meal and lupinseed meal gave reduced growth rate and FCR, but addition of meat meal (6%) improved performance to 600 g/d and 2.58 respectively.

INTRODUCTION

A recent decision by the Australian Wheat Board to handle all wheat grain, including that used for animal feeding, has resulted in an increase in the price of wheat to the feed mixer. As a consequence triticale is currently priced about $20 per tonne below wheat. It is therefore of importance to establish if triticale is of equal nutritive value to wheat.

The early-selected varieties of triticale frequently had high protein and lysine contents, although varieties released in Australia are generally no higher in protein than many of the wheat varieties grown under similar conditions. However, amino acid profiles of many samples of triticale and measurements of protein efficiency ratio (Knipfel 1962) indicate that the protein may be of higher quality than that of wheat of comparable protein content. The purpose of this paper is to compare triticale with wheat, and to test its nutritive value in the diets of growing pigs and rats when supplemented with free amino acids, plant proteins, meat meal and their combinations.

MATERIALS AND METHODS

Individual weanling rats (six per treatment), housed at constant temperature (22°C), were offered ad lib. for 14 d one of five diets. These contained either one of three triticales of mixed varieties (16.9, 15.4 and 14.7% CP, N x 6.25), or wheat (15.4% CP) supplemented with free-amino acids, or soybean and fish meal, bone meal and a vitamin-mineral pre-mix, calculated to meet the nutrient requirements of the weanling rat.

Thirty Large White x Landrace entire male pigs (19 kg) were placed in individual pens in a temperature-controlled (22°C) piggery. Following a short period of adjustment six pigs (20 kg) were allocated to each of the five diets (Table 1); these were by calculation approximately isocaloric, isonitrogenous, and of similar lysine content. Restricted amounts of each diet were offered once daily, according to the formula

$$\text{feed (g/d)} = 120W(\text{kg})^{0.75}$$

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Pigs were weighed each week and their daily feed allowance adjusted accordingly. The experiment was terminated when each pig weighed 45 kg, and back-fat thickness was then measured using an ultrasonic instrument (Scanoprobe, Ithaca).

Apparent digestibility of feed dry matter, nitrogen and energy of the diet of each pig was determined using chromic oxide (0.1%) in the feed and its concentration measured in corresponding faeces to determine faecal output. Chemical analysis of diets and faeces followed standard analytical procedures (AOAC 1960; Van Soest and Wine 1967). Amino acids were determined on the acid hydrolysates (Spackman, Stein and Moore 1958) using a TSM-1 Technicon Amino Acid Analyser. Analysis of variance was used to determine treatment effects and differences between means were examined using Duncan's Multiple Range test.

TABLE 1 Ingredient (g/d) and chemical composition of experimental diets (air-dry basis) offered to five groups each of six pigs

	Diet				
	1	2	3	4	5
Triticale (12.5%CP)		818	642	747	718
Wheat (12.5%CP)	818				
Soybean meal (46.6%CP)	100	100			
Meat meal (45%CP)	80	80		50	60
Sunflower meal (34.8%CP)			130	200	70
Lupinseed meal (29.3%CP)			200		150
Bone meal			25		
L-Lysine HCl			1.2	0.8	0.4
Vitamin-mineral premix	1.0	1.0	1.0	1.0	1.0
Chromic oxide	1.0	1.0	1.0	1.0	1.0
Determined composition					
Digestible energy (MJ/kg)	13.3^{a*}	13.4^{a*}	12.7^{bc}	12.5^{b}	12.8^{c}
Crude protein (g/kg)	191	183	191	182	178
Crude protein digestibility (g/kg)	787	803	793	767	782
Lysine (g/kg)	7.9	8.1	8.7	8.3	7.5
Threonine (g/kg)	6.8	6.5	6.4	6.6	5.7
Neutral detergent fibre (g/kg)	106	118	161	166	163

*Values with the same superscript are not significantly different (P>0.05).

RESULTS AND DISCUSSION

Growth rates and feed conversion ratios (FCR) of rats, although not statistically different between diets, were generally better on the triticale diets than on the wheat diet without supplementation (Table 2). Differences between the 15.4% CP wheat and the 16.9% CP triticale approached significance (0.1>P>0.05). In all cases there was a growth response (P<0.05) to lysine addition and a further response (P<0.05) to threonine. Addition of methionine to the 14.7% CP triticale did not improve growth rate further. Soybean meal and fish meal when added to each grain in amounts to meet the essential amino acids requirements of the weanling rat gave no improvement in growth or FCR compared to lysine and threonine additions to the same grain. When the data were analysed as a 4 x 4 factorial experiment by excluding the methionine-supplemented diet, there was no effect of grain on performance, there was an effect (P<0.05) of amino acid supplementation and there were no treatment interactions. The results found here

agree with a previous study (Ivan and Farrell 1975) in which improvement in growth rate of rats was observed with additions of lysine and threonine to wheat with a range of protein contents. There is some evidence here that the protein quality of triticale is superior to that of wheat of similar protein content. The lysine and threonine contents (%) of the triticales used were 0.47 and 0.48, 0.51 and 0.49, and 0.60 and 0.42 for the 14.7, 15.4 and 16.9% CP grains respectively. The amino acid content of the wheat (15.4% CP) was 0.43 and 0.47% for lysine and threonine respectively. It has already been shown (Taverner et al. 1978) that disappearance of lysine and threonine at the terminal ileum of pigs is the same for triticale and wheat.

TABLE 2 Mean weight gains (g/14d) and feed conversion ratios (FCR) of groups of six rats offered diets based on triticales of three protein contents and wheat supplemented with free amino acids or protein concentrates

Supplement	Triticale						Wheat	
	16.9		15.4		14.7		15.4	
	Gain	FCR	Gain	FCR	Gain	FCR	Gain	FCR
0	43.9^{ab*}	4.4^{ab}	40.3^{ab}	4.2^{b}	39.3^{ab}	4.9^{a}	28.8^{a}	4.7^{ab}
Lysine	56.3^{bcd}	3.2^{cd}	54.7^{bc}	3.3^{c}	60.4^{cd}	3.1^{ced}	45.1^{bc}	3.4^{c}
Lysine + threonine	72.5^{def}	2.7^{cdef}	75.8^{def}	2.6^{def}	79.2^{ef}	2.5^{ef}	70.7^{def}	2.3^{f}
Soybean + fish meal	64.4^{de}	2.7^{def}	78.7^{ef}	2.4^{f}	83.8^{f}	2.5^{ef}	78.5^{ef}	2.4^{f}
Lysine + threonine + methionine					78.8^{ef}	2.3^{f}		

*For each parameter values with common superscripts are not significantly different (P>0.05)

In the second experiment the growth rate and FCR of pigs (Table 3) given wheat when supplemented with soybean meal and meat meal (diet 1) were similar to those of pigs given triticale supplemented with either meat meal and soybean meal (diet 2), cr soybean meal, sunflower meal and lupin seed meal (diet 5). However performance of pigs was reduced when triticale was supplemented with either sunflower meal and lupinseed meal diet (diet 3) or meat meal and sunflower meal (diet 4). It is apparent that the variety of triticale (Quickgro) used here was equivalent to that of wheat in nutritive value. This is not always the case. King (pers. comm.) found that when triticale replaced all of the wheat in a wheat-based diet, both growth rate and FCR were significantly reduced compared with diets with triticale replacing up to 67% of the wheat. Some triticales contain 5-alkyl resorcinol (Radcliffe 1979) which may reduce their acceptability by pigs.

Analysis of diets (Table 1) showed them to be essentially isonitrogenous but not isocaloric. Digestible energy contents of diets 1 and 2 were higher (P<0.05) than the remainder. Because pigs on all treatments were on the same feeding scale it was not surprising that differences in performance occurred. Had pigs on diets 3 and 4 been given amounts of feed commensurate with the actual digestible energy contents of the diets, differences in performance between groups may not have been observed. Thus differences between groups did not necessarily reflect differences in protein quality of the diets.

TABLE 3 Growth rates, feed conversion ratios and back-fat thicknesses of groups of six pigs per treatment grown from 20-45 kg

Diet	Wheat	Triticale			
	1	2	3	4	5
Growth rate (g/d)	620^{a*}	630^{a}	490^{b}	520^{b}	600^{a}
Feed conversion ratio	2.45^{a}	2.44^{a}	3.16^{b}	2.94^{c}	2.58^{a}
Back-fat thickness (mm)	9.8^{ab}	9.6^{ab}	11.1^{a}	8.3^{b}	10.7^{a}
Digestible energy (MJ/kg gain)	32.5^{a}	32.6^{a}	40.0^{b}	36.7^{c}	32.9^{a}

* For each parameter values with common superscripts are not significantly different ($P>0.05$)

It would seem to be an important part of pig experimentation to determine the digestible energy content of diets. Clearly, table values for many ingredients serve only as a rough guide and unless digestible energy determinations are made, misinterpretation of the results may follow.

Diet 3 supported the lowest growth rate and poorest FCR although its digestible energy content was the same as diet 5 (Table 1). This would indicate that the protein concentrates, sunflower meal and lupinseed meal used in diet 3 may have a low availability of some amino acids as suggested by Batterham (pers. comm. and Batterham et al. 1978) and that utilization of free lysine is also reduced on a once-daily feeding regime (Batterham and O'Neil 1978). Diet 5 contained sunflower meal and lupinseed meal but also meat meal (6%). Growth rate and FCR were significantly ($P<0.05$) better on diet 5 compared with diet 3.

It can be tentatively concluded that triticale is of equal nutritive value to that of wheat of similar crude protein, and there is a suggestion that protein quality of triticale may be superior to that of wheat. Supplementation of triticale with lupinseed meal and sunflower meal, even with lysine addition, did not support pig growth to the same extent as when 6% meat meal was added.

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