NUTRITIONAL EFFICACY OF RAPESEED MEAL AS A SOURCE OF DIETARY PROTEIN FOR BROILER CHICKEN

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INTRODUCTION

The deleterious effects on weight gain, feed efficiency, and general performance often associated with inclusion in animal and poultry diets of rapeseed meal (RSM) produced from the older varieties of rapeseed have been attributed to the erucic acid, glucosinolate and/or fiber content of such meals (Josefsson, 1972; Leslie and Summers, 1975). This has led, through plant breeding endeavours, to the development of new rapeseed varieties low in all three of these constituents. The two most recent varieties of rapeseed licensed for commercial production in Canada are Brassica napus cv. Tower (low erucic acid, low glucosinolate) and B. campestris cv. Candle (low erucic acid,low glucosinolate, low fiber). Thus it became important for us to evaluate the nutritional value of the meal produced from these two new varieties of rapeseed as a partial or complete replacement for soybean meal in chicken broiler diets.

EXPERIMENTAL

Two experiments were conducted. Both experiments began at one day of age and were terminated at 49 days. The starter and finisher control (basal) diets fed in both experiments contained 24% and 16% protein (calculated), respectively (Table 1).

TABLE 1

COMPOSITION (KG/TONNE) OF THE CONTROL (BASAL) DIETS USED

Ingredient	Starter	Finisher
Ground Corn	300	562
Ground Wheat	265	220
Soybean Meal (44%)	335	105
Fishmeal (63%)	50	50
Poultry Grease	20	32
Limestone	9	8
Dicalcium Phosphate	6	8
Iodized Salt	5	5
Vitamin Mineral Premix	10	10
Calculated analyses:		
Metabolizable Energy	2991 Kcal/Kg	3242 Kcal/Kg
Crude Protein	24.0%	16.0%

In experiment 1, duplicate pens each containing 26 male and 26 female Hubbard chicks were fed either the control diet or one of eight different dietary treatments. In this experiment in both the starter and finisher diets, Tower RSM replaced 20, 40 or 60% of the soybean meal and Candle RSM replaced soybean meal at levels of 20, 40, 60, 80 and 100% for a total of eight different dietary treatments. In each case the inclusion of RSM was on a straight replacement basis, that is to say no attempt was made to keep the diets isonitrogenous or isocaloric. Thus in experiment 1 the protein content of the starters ranged from 22% to 24% and finishers

from 15 to 16% and the metabolizable energy content ranged from 2827 to 2991 Kcal/Kg for starters and from 3190 to 3242 Kcal/Kg for finishers.

In experiment 2, duplicate pens each containing 40 male and 40 female Cobb chicks were fed the control diet or one of nine different dietary treatments. In this experiment, Tower RSM replaced soybean meal at levels of 20, 40, 60, 80 and 100% and Candle RSM replaced 20, 40, 60 and 80% of the soybean meal, in both starter and finisher diets. In each case the diets were kept isocaloric and isonitrogenous by varying the amount of poultry grease and fishmeal.

Mortality, male and female live weights, feed conversion and monetary returns over the cost of chick and feed (based on current local producer prices) were calculated. Analysis of variance was conducted on all data and differences between treatment means were determined by the procedure of Williams (1971) except for differences in mean monetary returns which were tested using the Dunnett (1955) procedure.

RESULTS AND DISCUSSION

TABLE 2

PERFORMANCE OF BROILER CHICKEN FED DIETS IN WHICH TOWER OR CANDLE RSM SUPPLIED DIFFERENT PROPORTIONS OF THE DIETARY PROTEIN (EXPERIMENT 1)

	Mortality (%)		27D Live Wts (g)		48D Live Wts (g)			Monet.
Diets	Male	Female	Male	Female	Male	Female	Feed Conv.[1]	Rets[2] (¢)
Control	5.8	0.0	844	781	2107	1825	2.01	54.2
20% Tower	3.9	2.0	853	772	2116	1816	1.99	55.8
40% Tower	3.9	3.9	867	781	2125	1789	2.01	57.4
60% Tower	3.9	3.9	822	776	2093	1802	2.04	53.4
20% Candle	3.9	0.0	795	763	1979	1756	2.01	51.6
40% Candle	2.0	0.0	831	767	2052	1798	2.00	59.1
60% Candle	2.0	0.0	858	790	2043	1802	2.02	60.9
80% Candle	3.9	0.0	844	772	2048	1798	2.06*[3]	61.7
100% Candle	9.6	0.0	808	717**	1952*	1630**	2.14**	39.2**

[1] Grams of feed consumed per gram of gain

[2] Mean returns per bird housed from meat marketed over the cost of feed and chicks, based on current local producer prices

[3] Significance denoted by: *($P<0.05$); **($P<0.01$)

Mortality was low (Table 2) for all treatments with the exception of males fed the diet in which all the soybean protein was replaced by Candle RSM. Of interest, however, was the complete absence of mortality in females fed diets containing Candle RSM.

Live weights of both males and females at 27 and 49 days were not affected ($P<0.05$) by feeding either level of Tower RSM. On the other hand, a quadratic effect was observed at 27 days ($P<0.01$) and 49 days ($P<0.05$) on the body weights of both males and females fed Candle RSM. This effect resulted from the fact that the weight response of both sexes fed the intermediate levels (40, 60, 80%) of Candle RSM was superior to that of those fed diets in which Candle RSM replaced either 20 or 100% of the soybean protein. Replacing all of the soybean meal with Candle RSM resulted in lower live weights of females at 27 days ($P<0.01$) and lower male

($P<0.05$) and female ($P<0.01$) weights at 49 days.

When Candle or Tower RSM replaced up to 60% of the soybean meal in the diet feed conversion (g feed consumed/g gain) was not affected (Table 2). On the other hand when Candle RSM replaced 80% or all of the soybean meal in the diet a significant ($P<0.05$, 80% replacement; $P<0.01$, 100% replacement) lower feed conversion resulted. The affects on live weights and feed conversion observed in this experiment when RSM replaced all of the soybean meal without compensating for energy and protein were not totally unexpected considering the possible amino acid imbalance of RSM (Leslie and Summers, 1975; March, 1977).

Replacing up to 60% of the soybean meal in the diets with Tower RSM or up to 80% with Candle RSM had no effect on monetary returns. The lower ($P<0.01$) monetary returns observed when all of the soybean meal was replaced by Candle RSM was a consequence of the somewhat higher male mortality, lower live weights and feed consumption which resulted when this diet was fed.

TABLE 3

PERFORMANCE OF BROILER CHICKEN FED ISONITROGENOUS, ISOCALORIC DIETS IN WHICH TOWER OR CANDLE RSM SUPPLIED DIFFERENT PROPORTIONS OF THE DIETARY PROTEIN (EXPERIMENT 2)

Diet	Mortality (%)		28D Live Wts (g)		49D Live Wts (g)		Feed Conv.[1]	Monet. Rets.[2] (¢)
	Male	Female	Male	Female	Male	Female		
Control	7.5	0.0	979	836	2159	1765	2.04	49.4
20% Tower	6.3	3.8	964	812	2189	1762	2.06	49.0
40% Tower	5.0	0.0	989	831	2103	1765	2.03	50.9
60% Tower	3.8	5.0	927	835	2139	1770	2.03	49.6
80% Tower	6.3	0.0	981	850	2147	1755	2.03	49.8
100% Tower	5.0	3.8	947	824	2094	1717	1.99**	48.7
20% Candle	7.5	1.3	955	821	2130	1740	2.04	48.4
40% Candle	5.0	2.5	967	845	2153	1763	2.02	50.6
60% Candle	2.5	7.5	998	817	2179	1717	1.99**	50.6
80% Candle	7.5	1.3	957	832	2126	1720	2.00*	48.9

[1] Grams of feed consumed per gram of gain

[2] Mean returns per bird housed from meat marketed over the cost of feed and chicks, based on current local producer prices

[3] Significance denoted by: *($P<0.05$); **($P<0.01$)

Total replacement of dietary soybean meal with Tower RSM or up to 80% replacement of soybean meal with Candle RSM in isonitrogenous, isocaloric diets had no significant effect on mortality or on live weights of both sexes at 28 or 49 days or monetary returns (Table 3).

In experiment 2 there was no evidence of a quadratic effect for any of the traits measured with the exception of mortality of females fed diets containing Candle RSM ($P<0.05$). Feed conversion was linear ($P<0.05$) for diets containing either Tower or Candle RSM. With but two exceptions (20% Tower, 20% Candle) feed conversion was improved by the replacing soybean meal with Tower or Candle RSM. The improvement in feed conversion was significant when Tower RSM replaced all of the soybean meal ($P<0.01$) and when Candle RSM replaced 60% ($P<0.01$) and 80% ($P<0.05$) of the soybean meal.

The mortality observed in broiler chicken fed these RSMs is comparable to the mortality observed in laying hens fed diets containing 5 or 10% Tower (940) RSM (Clandinin et al. 1977). In the current study the higher mortality experienced with each dietary treatment in experiment 2 compared to that of experiment 1 was primarily due to an increased incidence of Acute Death Syndrome (ADS) in experiment 2. Interestingly, ADS has been associated with rapid growth (Cassidy et al. 1975). It will be noted that birds fed the isocaloric, isonitrogenous diets (experiment 2, Table 3) grew at a much faster rate than birds on diets where RSM replaced soybean meal on a straight replacement basis (experiment 1, Table 2).

The deleterious effects on live weights and feed conversion experienced in experiment 1 when RSM replaced all of the soybean meal in the diet, were removed when all of the soybean meal was replaced by RSM in experiment 2. In the latter experiment the diets were kept isocaloric and isonitrogenous by adjusting upward the level of fishmeal and poultry grease added as the amount of RSM replacing soybean meal in the diet increased. It has been demonstrated that, when fortified with arginine and methionine, RSM can be fed at a level of 40% to supply the entire protein requirement of the chick (Leslie et al. 1976). In the study reported here, it would appear that when a high percentage (80%) or all (100%) of the soybean meal in the diet is replaced by RSM, the inclusion of additional fishmeal (experiment 2) served to maintain a good amino acid balance in such diets, and supported growth similar to that experienced when the control diet was fed. In other words, fishmeal additions probably served the same purpose of maintaining dietary amino acid balance as achieved by adding amino acids in the crystalline form (Olomu et al. 1975; Leslie et al. 1975), a practice considered by some in the feed industry to be both cumbersome and impractical. Interestingly, the data in Table 3 would indicate that additional fishmeal can be included in diets containing high levels of RSM without adversely affecting monetary returns, thus making this method of maintaining amino acid balance in such diets even more practical.

To summarize, the results of this study would suggest that RSM can replace up to 80% of the soybean meal in broiler diets on a straight replacement basis, and can replace all of the soybean meal in such diets provided energy and protein differences are compensated, without adversely effecting weight gains, feed efficiency, mortality or monetary returns. The results also suggest that fishmeal is a good complementary source of dietary protein for use in diets containing high levels of RSM. Good amino acid balance can be maintained by increasing the level of fishmeal in such diets thus negating the need to add crystalline amino acids.

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REFERENCES

Cassidy, D.M., M.A. Gibson and F.G. Proudfoot, 1975. Poult. Sci. 54: 1882-1886.

Clandinin, D.R., A.R. Robblee, Y.K. Goh, K. Darlington and G. R. Milne, 1977. Proc.Symp. Rapeseed Oil, Meal and By-Prod. Utiliz. Vancouver, B.C. pp. 177-190.

Dunnett, C.W., 1955. J. Am. Stat. Assoc. 50: 1096-1121.

Josefsson, E., 1972. In: Rapeseed Ed. I.Å. Appelqvist and R. Ohlson, Elsevier Pub. Co., Amsterdam, pp. 354-377.

Leslie, A.J. and J.D. Summers, 1975. Poult. Sci. 54: 532-538.

Leslie, A.J., J.D. Summers, R. Grandhi and S. Leeson, 1976. Poult. Sci. 55: 631-637.

March, B.E., 1977. Proc. Symp. Rapeseed Oil, Meal and By-Prod. Utiliz. Vancouver B.C. pp. 191-194.

Olomu, J.M., A.R. Robblee, D.R. Clandinin and R.T. Hardin, 1975. Can. J. Anim. Sci. 55: 461-469.

Williams, D.A., 1971. Biometrics 27: 103-117.