HOW MUCH COTTONSEED AND CANOLA MEAL CAN BE USED IN COMMERCIAL BROILER DIETS

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Abstract

Previous research using cages indicated that, high levels of selected canola meal (CM) and cottonseed meal (CSM) support satisfactory broiler performance when diets are formulated on a digestible amino acid (DAA) basis. The present study will provide the poultry industry with practical recommendations for CM and CSM for chicken meat production. There were three treatments x 15 replicate pens x 40 birds (20 males and 20 females day old Cobb chicks) in a completely randomised block layout of the 45 pens. Crumbled diets during the starter period were fed from 1 to 21 d old including a control commercial diet, a CM diet (200 g/kg inclusion) and a CSM diet (200 g/kg inclusion). During the finisher period (21-43 d old), inclusions of each CM or CSM was increased to 300 g/kg and were offered as pelleted diets formulated on a DAA basis in both periods. The results in the starter period indicated that feed intake (FI), live-weight gain (LWG) and feed efficiency were not influenced by the level of CSM or CM in the diet. During the finisher period, FI of birds fed on CM was lower ($P<0.05$) but this did not affect LWG or feed efficiency, which were not different ($P>0.05$) from the control diet. It is concluded that for chicken meat production, up to 200 g/kg of either CSM (solvent extracted) or CM (solvent extracted or extruded) can be used during the starter phase, and up to 300 g/kg of either CSM (solvent extracted) or CM (solvent extracted or extruded) can be used during the finisher phase in diets formulated on a DAA basis.

Keywords: canola meal, cottonseed meal, poultry, broiler chicken, digestible amino acids

Introduction

Work carried out using metabolism cages showed that up to 200 or 300 g/kg of selected cottonseed meals (CSM) and canola meals (CM) could be successfully included in broiler diets during the starter period and up to 300 g/kg of selected CM or CSM can be potentially used during the finisher period without affecting broiler production parameters (Perez-Maldonado *et al.*, 2001). However, there is a need to evaluate broiler performance using diets containing practical upper levels of CM or CSM in a semi-commercial environment. This trial was undertaken to provide to the Australian poultry industry practical recommendations for CM and CSM for chicken meat production.

Materials and Methods

Bioassays and Chemical Analyses

Prior to this trial CM and CSM samples were analysed for proximate analysis (AOAC, 1984), Non-starch polysaccharides (Choct and Annison 1992), condensed tannins (Perez-Maldonado and Norton 1996), and total gossypol (AOAC, 1984). Amino acid (AA) analyses in CSM, CM, feed and digesta samples were performed by HPLC. Chromium, concentration (as a marker) in feed, digesta and excreta samples was determined by ICP. Gross energy (GE) was determined using an AC-350 LECO adiabatic bomb calorimeter. Glucosinolates (GSNL) in CM samples was determined by NIRS, (AOF method 4-1.22.) CSM samples were analysed for pesticide residues.

The apparent metabolisable energy (AME of the meals was determine using the classical, total collection of excreta and measurement of food intake (FI) over 4 days (d) made on four replicate cages each of six male broiler chickens (14-21 d old) and accustomed to the diets for 3 d.

Ileal digestible amino acid (AA) determination for CM and CSM was determined in three replicate groups of four (37-42 d old) broilers as described in Ravindran *et al.,* (1999). A mineral-vitamin broiler pre-mix and oil were added to each diet and chromic oxide as a marker.

Ingredients, diet formulations and experimental design

Commercial CSM (Cargill, Australia, Ltd) and CM (Riverland Oilseed Processors Pty Ltd, Australia) were obtained from the 2000-2001 cycle. Diets were prepared as crumbled starter (chicks 1-21 d of age) contained 0, 200 g CSM or 200 g CM/kg and pelleted finisher (chickens 21-43 d of age) contained 0, 300 g CSM/kg or 300 g

CM/kg. Diets were formulated on a digestible AA basis using determined AA coefficients and reported ideal AA ratios (Baker and Han 1994 and Baker *et al.,* 1993). Ferrous sulphate provided a 2:1 iron to gossypol ratio in each CSM diet. Diets were designed to contain similar calcium, phosphorus, AME with a similar digestible crude protein content, to meet the minimum digestible, AA requirements estimated for maximum growth.
The control diet contained (g/kg): sorghum (48), wheat (20), soybean meal (20), meat and bone meal (7), and poultry offal meal (2), plus vitamins and minerals. Food, water, light and comfortable temperature were offered ad libitum to male and female broiler chicks (Cobb) in each pen.
There were three treatments x 15 replicate pens x 40 birds (20 males and 20 females) in a completely randomised block layout of the 45 pens. Analysis of variance (ANOVA) was used to test the effects of treatments using an ANOVA model. A pen of 40 birds was the experimental unit. The treatment means were compared using an ANOVA. The main effects were tested using a protected LSD ($P<0.05$).

Results and Discussion

Table 1. Chemical composition (g/kg DM) of experimental cottonseed meal and canola meal

Analysis	Cottonseed meal	Canola meal
Dry matter	902	903
Gross energy MJ/kg	19.9	19.9
Crude protein	476	399
Phosphorus	13.5	10.2
Calcium	2.3	7.4
Sulphur	4.3	6
Fat	29	29
Free gossypol	0.07	37.9
Free condensed tannin	43.5	57.9
Bound tannins	24.6	34.2
Total condensed tannin	68.1	92.1
Glucosinolates (μml/g)	ND	4.4
Sinapine	ND	15.2
Cyclopropanoid fatty acids (μn/g)	102.2	ND
Neutral Determined Fibre	172	288
Alanine	16.5	14.9
Arginine	53.5	23.3
Leucine	24.9	24.8
Lysine	17.5	19
Methionine	4.3	5
Phenylalanine	23.4	14.5
Proline	22.4	27
Serine	19.4	15.7
Aspartic acid	40.8	25.3
Cystine	6.7	9.1
Glutamic acid	93	67.9
Glycine	17.8	17.5
Histidine	10.8	8.4
Isoleucine	14.1	13.8
Threonine	14	15
Tryptophan	5.7	5
Tyrosine	11.2	8.9
Valine	18.2	17.1
AME (MJ/kg DM) in broilers	11.7	9.5

ND= not determined

The chemical analysis (Table 1) showed that CSM from Cargill, Australia Ltd contained less CP, fat and a different AA profile when compared with CSM from Cargill, Narrabri, evaluated during previous experiment. CM from Numurkah also differed chemically from a similar CM source evaluated during the previous year. Chemical composition of the meals indicated that the variation depended on seasonal, environmental and plant

processing conditions. Hence, it is best to determine the composition of ingredients before formulating poultry diets.

The apparent ileal digestibility values (Table 2) for CSM from Cargill, Australia Ltd and CM from Numurkah indicated that the overall AA coefficients of Cargill CSM are higher when compared with previously evaluated CSM, but the digestibility of lysine and threonine still gave relatively low values of 0.56 and 0.65 respectively, when compared with CM. Hence, synthetic AA should be added to diets when using upper levels of CSM. CM on the other hand, gave similar digestible AA coefficients to previously evaluated Numurkah CM. Contrary to CSM digestible AA values, CM had satisfactory digestible coefficient values for most AA.

Table 2. Apparent ileal digestibility coefficients of amino acids in cottonseed meal and canola meal for broilers

Amino acids	Cottonseed meal	Canola meal
Alanine	0.71	0.73
Arginine	0.87	0.81
Leucine	0.72	0.76
Lysine	0.56	0.73
Methionine	0.74	0.86
Phenylalanine	0.81	0.76
Proline	0.73	0.71
Serine	0.72	0.67
Aspartic acid	0.74	0.63
Cystine	0.76	0.74
Glutamic acid	0.84	0.81
Glycine	0.71	0.74
Histidine	0.78	0.80
Isoleucine	0.71	0.72
Threonine	0.65	0.66
Tryptophan	0.75	0.74
Tyrosine	0.76	0.74
Valine	0.72	0.69

Broiler performance

The responses of 200 g/kg level of CSM or CM compared with the control diet, on growth, FI and FCR on starter diets formulated on a digestible AA basis are presented in Table 3. The responses of 300 g/kg level of CSM or CM compared with the control diet, on production parameters on finisher diets, formulated on a digestible AA basis, are presented in Table 4.

Table 3. Feed intake (FI), live-weight gain (LWG), feed conversion ratio (FCR) means for broiler chickens (1-21 d) fed 200 g/kg level of cottonseed meal (CSM) or canola meal (CM)

Dietary treatments	FI (g/bird)	LWG (g/bird)	FCR (G FI / g LWG)
Control	1150	825	1.407
CSM Cargill (200 g/kg)	1134	813	1.408
CM Numurkah (200 g/kg)	1130	829	1.372
LSD (P=0.05)	28	19	0.038
Coefficient of variation %	3	6	4

Means for each CSM within a column with different superscript are significantly different (P<0.05).

The results in the starter period (Table 3) indicated that FI, LWG and FCR were not influenced by the level of CSM or CM in the diet. During the finisher period (Table 4), FI of chicks fed on CM was lower (P<0.05) but this did not affect LWG or FCR, which was not different (P>0.05) from the control diet. This semi-commercial broiler experiment indicated that bird production was not affected when fed diets with upper levels of either CSM or CM and confirming our earlier results obtained with metabolism cages. In this semi-commercial trial each dietary treatment was replicated in 15 pens using 40 birds each (20 males and 20 females) and diets were formulated on a digestible AA basis. Hence it is concluded that up to 200 g/kg of either CSM (solvent extracted) or CM (solvent extracted or extruded) can be used during the starter phase, and up to 300 g/kg of either CSM (solvent extracted) or CM (solvent extracted or extruded) can be used during the finisher phase in diets

formulated on a digestible AA basis. There were no detrimental effects on chickens during the course of this semi-commercial trial. Mortality and culled birds were not related to leg problems, even though it is well known that CM may influence bird mortality. Litter and environment in the shed were not quantitatively evaluated but the Research staff at the Centre did not observe any negative effect on the litter when using these levels of these meals.

Table 4. Mean feed intake (FI), live-weight gain (LWG) and feed conversion ratio (FCR) for broiler chickens (21-43 d) fed 300 g/kg level of cottonseed meal (CSM) or canola meal (CM)

Dietary treatments	FI (g/bird)	LWG (g/bird)	FCR (g FI / g LWG)
Control	3383 [a]	1570	2.169 [ab]
CSM Cargill (300 g/kg)	3451 [a]	1579	2.206 [a]
CM Numurkah (300 g/kg)	3263 [b]	1538	2.134 [b]
LSD (P=0.05)	119	68	0.041
Coefficient of variation	5	6	2

Means for each CSM within a column with different superscript are significantly different (P<0.05).

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