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The use of animal byproducts in broiler feeds. Use of animal co-products in broilers diets

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ABSTRACT

This study aimed at evaluating live performance and carcass yield of broilers fed vegetarian diets or containing different animal byproduct meals after 8 days of age. In the experiment, 1080 one-day-old male chicks were distributed in a completely randomized experimental design with 6 treatments with 6 replicates. Diets were based on corn and soybean meal, and included or not animal meals, maintaining constant levels of minerals (calcium, phosphorus, and sodium) and amino acids (methionine, cystine, lysine, and threonine), The following treatments were applied: T1. Control (corn and soybean diet); T2. Inclusion of 5% meat and bone meal (MBM); T3. Inclusion of 5% blood meal (BM); T4. Inclusion of 5% feather meal (FM); T5. Inclusion of 5% poultry offal meal (OM); T6. Combination of meat and bone meal, feather meal, offal meal, and blood meal. Broiler weight gain, feed intake, feed conversion, livability and carcass yield were evaluated. At 35 days of age, it was verified that the combination of the four animal meals compromised weight gain. Broiler performance at 42 days of age was influenced by treatments, and the worst weight gain and true feed conversion were observed in birds fed diets with the combination of the four animal meals. The inclusion of 5% BM negatively affected the weight gain. It is concluded that MBM, FM, and OM inclusion can be individually used with no negative influence on broiler performance or carcass yield. In addition, it reduces feed costs.

INTRODUCTION

The number of slaughtered animals has increased with animal production growth, generating large volumes of animal residues. After being submitted to treatments, these residues may be used as an alternative feedstuff in broiler diets, reducing feed costs.

The most common animal byproducts used in broiler diets are meat and bone meal, blood meal, feather meal, and poultry offal meal. These feedstuffs contain high protein levels and may partially replace soybean meal. In addition of being a protein source, meat and bone meal is also a significant source of totally available calcium (Ca) and phosphorus (P), whereas in plant feedstuffs, phosphorus is only 33% bioavailable to animals due to the presence of phytate.

Broiler performance results when animal byproducts are fed may be very variable as a function of raw material type and quality, processing temperature, use of antioxidants to maintain their quality, contamination by pathogenic microorganisms, high polyamine content, amino acid unbalance, nutrient content and digestibility, and storage conditions (Bellaver, 2001).

Sartorelli (1998) compared diets containing meat and bone meal from five different sources with a diet with dicalcium phosphate, and did not observe significant differences in broiler performance. Bellaver *et al.* (2005) showed that the inclusion of 4% meat and bone meal and 3% poultry offal meal in broiler diets did not influence live performance at 21 days of age as compared to corn-soybean meal based diets. However, at 35 and 42 days, broilers fed animal meals presented lower average weight.

The objective of the present study was to evaluate broiler live performance and carcass traits of broilers fed an all-vegetable diet and diets containing animal meals after 8 days of age.

MATERIAL AND METHODS

The experiment was carried out at the experimental poultry farm of the School of Veterinary Medicine of the Federal University of Uberlândia, MG, Brazil. In the trial, 1,080 one-day-old Avian 48 male broilers, with 43g average weight, were distributed in a completely randomized experimental design into six treatments with six replicates of 30 birds each. Birds were housed in 36 floor pens, with 30 birds in each at a density of 12 birds/m^2. Feed and water were offered *ad libitum*. A continuous lighting program (24h of light) was used. Average house temperature was recorded daily from 10 days up to slaughter. Average minimum and maximum temperatures recorded during the experimental period were 25.34 °C and 25.86 °C, respectively.

Diets were formulated and manufactured to supply the broilers' nutritional requirements according to the recommendations of Rostagno *et al.* (2005). Corn, soybean meal and animal meals were chemically analyzed for feed formulation (Table 1). Diets were based in combinations of corn, soybean meal, meat and bone meal (MBM) blood meal (BM), poultry offal meal (OM), feather meal (FM), soybean oil, dicalcium phosphate, limestone, salt, and vitamin and mineral premix supplemented with synthetic amino acids (DL-methionine, L-lysine, and L-threonine), and were supplied according to a four-phase feeding program (pre-starter, starter, grower, and finisher). Animal meals started to be fed when broilers were 8 days old, and their individual inclusion percentages in the starter, grower, and finisher diets were previously established. Tables 2, 3, 4, and 5 show the ingredient and nutritional composition of the experimental diets.

Feed supplied and feed residues, as well as birds, were weighed on days 7, 14, 21, 35, and 42, in order to calculate the performance parameters feed intake (FI), live weight (LW) and feed conversion ratio (FCR). Bird mortality was recorded daily to calculate livability (L). True feed conversion ratio (TFCR) was calculated as the ratio between feed intake and weight gain, adding dead bird weights and subtracting initial chick weight.

Table 1 - Chemical composition of the animal meal, corn, and soybean meal used in the experimental diets.

Nutrientes	MBM (%)	OM (%)	FM (%)	BM (%)	Corn	SBM
Crude protein	42.02	60.02	79.95	84.74	8.05	46.84
Ether extract	14.11	11.79	10.00	0.38	2.18	1.63
Mineral matter	38.02	11.11	3.46	3.44	1.93	6.42
Calcium	13.80	2.48	0.72	0.20	0.03	0.24
Phosphorus	6.81	1.72	0.38	0.21	0.24	0.53
Dry matter	92.06	97.13	92.23	93.50	88.00	89.52
Dig. arginine	3.11	4.03	5.41	2.73	0.36	3.15
Dig. lysine	2.03	3.19	2.13	5.80	0.20	2.53
Dig. methionine	0.53	1.07	0.58	0.83	0.15	0.60
Dig. Met+Cys	0.81	1.90	4.27	1.31	0.32	1.12
Dig. threonine	1.25	2.28	3.68	3.32	0.27	1.57
Dig. tryptophan	0.21	0.53	0.67	1.13	0.05	0.59

Table 2 - Composition of the pre-starter experimental diets (1-7 days).

Ingredients	(%)
Corn grain	59.16
Soybean meal	35.02
Soybean oil	1.35
Dicalcium phosphate	1.98
Limestone	0.85
Salt	0.44
DL-methionine	0.38
L-lysine	0.42
Starter premix[1]	0.20
L-threonine	0.17
R$/kg feed	0.643
Nutritional levels	
ME (Mcal/kg)	2.960
Crude protein (%)	22.11
Calcium (%)	0.95
Available phosphorus (%)	0.47
Sodium (%)	0.22
Dig. methionine (%)	0.67
Dig. Met+Cys (%)	0.96
Dig. lysine (%)	1.36
Dig. threonine (%)	0.88
Dig. arginine (%)	1.36
Dig. tryptophan (%)	0.23

MC-Mix Frango inicial SAA 2kg (®M-Cassab Comércio e Indústria Ltda) - Composition/kg feed - VitA 11,000UI; D3 2,000UI; E 16mg; folic acid 400mcg; calcium pantothenate 10mg; biotin 60mcg; niacin 35mg; pyridoxin 2mg; riboflavin 4.5mg; thiamin 1.2mg; B12 16mcg; K 1.5mg; Se 250mcg; choline 249mg; Cu 9mg; Zn 60mg; I 1mg; Fe 30mg; Mn 60mg; growth promoter 384mg; anticoccidial 375mg; antioxidant 120mg.

On day 42, four birds per experimental unit representative of average body weight were selected for the evaluation of carcass traits. Birds were fasted for eight hours, slaughtered, defeathered, and eviscerated. The following traits were evaluated: carcass yield (CY), breast bone-in (BBI), deboned breast (DBB), and thighs+drum (TD) yields. Carcass yield was calculated relative to live weight before slaughter [%CY= (carcass weight with no feet, neck, and head x 100)/ live weight] and parts yield relative to carcass weight [Parts yield %= (parts weight x 100)/ carcass weight].

Table 3 - Composition of the starter experimental diets (7-21 days).

Ingredients (%)	T1	T2	T3	T4	T5	T6
Corn grain	60.51	65.24	61.78	64.72	64.75	66.58
Soybean meal	33.31	27.57	26.84	25.27	26.12	18.21
Soybean oil	2.23	0.55	2.71	1.01	0.55	0.19
Dicalcium phosphate	1.87	0.02	1.87	1.84	1.45	-
Limestone	0.80	0.24	0.82	0.80	0.81	0.16
Salt	0.45	0.40	0.41	0.41	0.40	0.40
DL-methionine	0.27	0.29	0.27	0.24	0.27	0.25
L-lysine	0.25	0.32	0.06	0.41	0.32	0.24
Starter premix1	0.20	0.20	0.20	0.20	0.20	0.20
L-threonine	0.08	0.11	0.0006	0.06	0.10	0.02
Poultry offal meal	-	-	-	-	5.00	3.00
Blood meal	-	-	5.00	-	-	3.00
Feather meal	-	-	-	5.00	-	3.00
Meat and bone meal	-	5.00	-	-	-	4.72
R$/kg feed	0.611	0.547	0.601	0.570	0.556	0.499
Nutritional levels						
ME (Mcal/kg)	3.050	3.050	3.050	3.050	3.050	3.050
CP (%)	21.14	21.14	22.24	21.94	21.14	23.32
Ca (%)	0.90	0.90	0.90	0.90	0.90	0.90
Av. P (%)	0.45	0.45	0.45	0.45	0.45	0.48
Na (%)	0.22	0.23	0.22	0.22	0.22	0.26
Dig. met (%)	0.56	0.57	0.57	0.51	0.56	0.54
Dig. M+C (%)	0.85	0.85	0.85	0.85	0.85	0.85
Dig. lys (%)	1.18	1.18	1.18	1.18	1.18	1.18
Dig. thr (%)	0.78	0.78	0.78	0.78	0.78	0.78
Dig. arg (%)	1.31	1.26	1.24	1.29	1.25	1.27
Dig. trp (%)	0.22	0.20	0.24	0.20	0.20	0.20

ME- metabolizable energy, CP - crude protein, Ca - calcium, av. P - available phosphorus, Na - sodium met - methionine, M+C - methionine +cystine, lys - lysine, thr - threonine, arg- arginine, trp - tryptophan. 1 MC-Mix Frango inicial SAA 2kg (®M-Cassab Comércio e Indústria Ltda) - Composition/kg feed - VitA 11,000UI; D3 2,000UI; E 16mg; folic acid 400mcg; calcium pantothenate 10mg; biotin 60mcg; niacin 35mg; pyridoxin 2mg; riboflavin 4.5mg; thiamin 1.2mg; B12 16mcg; K 1.5mg; Se 250mcg; choline 249mg; Cu 9mg; Zn 60mg; I 1mg; Fe 30mg; Mn 60mg; growth promoter 384mg; anticoccidial 375mg; antioxidant120mg

The obtained data were submitted to analysis of variance and F test (5%), and means were compared by the test of Tukey at 5% using the software program "ESTAT" developed by the Department of Exact Sciences of FCAV/UNESP - Jaboticabal.

RESULTS AND DISCUSSION

Liver performance results obtained on days 14 and 21 are shown in Tables 6 and 7. Feed intake of 14-

Table 4 - Composition of the grower experimental diets (21-35 days).

Ingredients (%)	T1	T2	T3	T4	T5	T6
Corn grain	63.20	66.82	67.70	66.17	67.40	64.85
Soybean meal	29.85	25.00	20.91	22.89	22.67	19.77
Soybean oil	3.24	1.79	2.81	2.26	1.58	2.51
Dicalcium phosphate	1.73	-	1.74	1.69	1.31	0.93
Limestone	0.76	0.13	0.79	0.75	0.77	0.60
Salt	0.43	0.40	0.40	0.40	0.40	0.40
DL-methionine	0.09	0.26	0.26	0.21	0.24	0.04
L-lysine	0.24	0.29	0.13	0.37	0.31	0.15
Grower premix[1]	0.20	0.20	0.20	0.20	0.20	0.20
L-threonine	0.06	0.08	0.01	0.03	0.08	-
Poultry offal meal	-	-	-	-	5.00	3.00
Blood meal	-	-	5.00	-	-	3.00
Feather meal	-	-	-	5.00	-	3.00
Meat and bone meal	-	5.00	-	-	-	1.36
R$/kg feed	0.613	0.553	0.593	0.573	0.559	0.547
Nutritional levels						
ME (Mcal/kg)	3.150	3.150	3.150	3.150	3.150	3.150
CP (%)	19.73	20.00	20.06	20.88	19.73	22.32
Ca (%)	0.84	0.84	0.84	0.84	0.84	0.84
Av. P (%)	0.42	0.44	0.42	0.42	0.42	0.42
Na (%)	0.21	0.23	0.21	0.21	0.21	0.24
Dig. met (%)	0.52	0.53	0.53	0.46	0.52	0.48
Dig. M+C (%)	0.79	0.79	0.79	0.79	0.79	0.79
Dig. lys (%)	1.10	1.10	1.10	1.10	1.10	1.10
Dig. thr (%)	0.71	0.71	0.71	0.71	0.71	0.74
Dig. arg (%)	1.20	1.18	1.07	1.21	1.15	1.23
Dig. trp (%)	0.20	0.18	0.21	0.18	0.18	0.21

ME- metabolizable energy. CP - crude protein. Ca - calcium. av. P - available phosphorus. Na - sodium met - methionine. M+C - methionine+cystine. lys - lysine. thr - threonine. arg- arginine. trp - tryptophan. 1 MC-Mix Frango engorda SAA 2kg (®M-Cassab Comércio e Indústria Ltda) - Composition/kg feed - VitA 9.000UI; D3 1.600UI; E 14mg; folic acid 300mcg; calcium pantothenate 9mg; biotin 50mcg; niacin 30mg; pyridoxin 1.8mg; riboflavin 4mg; thiamin 1mg; B12 12mcg; K 1.5mg; Se 250mcg; choline 219mg; Cu 9mg; Zn 60mg; I 1mg; Fe 30mg; Mn 60mg; growth promoter 385mg; anticoccidial 550mg; antioxidant 120mg.

day-old broilers ranged between 0.650 and 0.737kg, and between 1.298 and 1.452kg when broilers were evaluated on day 21; however, there were no significant differences among treatments (p>0.05). Live weight ranged between 0.503 and 0.528kg on day 14 and between 0.986 and 1.028kg on day 21, and again no differences were detected among treatments (p>0.05). All the other evaluated performance parameters were not influenced by the treatments. Sartorelli (1998), Junqueira et al. (2000), and Faria Filho *et al*. (2002) did not find significant differences in broiler performance when MBM was included in the feeds during the same period. Bellaver *et al*. (2005), comparing the inclusion of 4% meat and bone meal, 3% poultry offal meal, and vegetable diets, did not observe any influence of diets on 21-day-old broiler performance. On the other hand Kamwa (1997) showed that diets containing, in addition to soybean

Table 5 - Composition of the finisher experimental diets (35-42 days).

Ingredients (%)	T1	T2	T3	T4	T5	T6
Corn grain	59.36	61.20	66.88	65.13	62.07	64.80
Soybean meal	32.33	29.34	20.72	22.91	26.47	18.65
Soybean oil	5.07	4.04	4.13	3.61	3.69	2.95
Dicalcium phosphate	1.56	-	1.58	1.52	1.13	-
Limestone	0.75	0.23	0.79	0.75	0.75	0.32
Salt	0.40	0.33	0.36	0.36	0.34	0.26
DL-methionine	0.08	0.08	0.12	0.06	0.06	0.04
L-lysine	0.11	0.11	0.09	0.31	0.14	0.09
Starter premix[1]	0.30	0.30	0.30	0.30	0.30	0.30
L-threonine	-	-	-	-	-	-
Poultry offal meal	-	-	-	-	5.00	3.00
Blood meal	-	-	5.00	-	-	3.00
Feather meal	-	-	-	5.00	-	3.00
Meat and bone meal	-	4.33	-	-	-	3.56
R$/kg feed	0.578	0.528	0.572	0.547	0.530	0.496
Nutritional levels						
ME (Mcal/kg)	3.200	3.200	3.200	3.200	3.200	3.200
CP (%)	20.28	20.92	19.76	20.63	20.71	22.59
Ca (%)	0.80	0.80	0.80	0.80	0.80	0.80
Av. P (%)	0.39	0.40	0.39	0.39	0.39	0.40
Na (%)	0.20	0.20	0.20	0.20	0.20	0.20
Dig. met (%)	0.48	0.48	0.50	0.43	0.47	0.45
Dig. M+C (%)	0.75	0.75	0.75	0.75	0.75	0.75
Dig. lys (%)	1.05	1.05	1.05	1.05	1.05	1.05
Dig. thr (%)	0.68	0.68	0.69	0.68	0.68	0.74
Dig. arg (%)	1.26	1.28	1.05	1.20	1.24	1.24
Dig. trp (%)	0.21	0.20	0.21	0.18	0.20	0.20

ME- metabolizable energy, CP - crude protein, Ca - calcium, av. P - available phosphorus, Na - sodium met - methionine, M+C - methionine+cystine, lys - lysine, thr - threonine, arg- arginine, trp - tryptophan. 1 MC-Mix Frango abate 3kg (®M-Cassab Comércio e Indústria Ltda) - Composition/kg feed - VitA 2,700UI; D3 450UI; E 4.5mg; calcium pantothenate 3.6mg; biotin 13.5mcg; niacin 4.5mg; pyridoxin 360mcg; riboflavin 900mcg; thiamin 270mcg; B12 2.7mcg; K3 450mcg; Se 180mcg; choline 130mg; methionine 906mg; Cu 9mg; Zn 60mg; I 1mg; Fe 30mg; Mn 60mg; antioxidant 120mg.

meal, meat and bone meal, poultry offal meal, or a combination of meat and bone meal, feather meal, and poultry offal meal, broilers presented better body weight and feed conversion ratio at 21 days of age as compared to the diet containing only soybean meal.

Table 8 shows the performance results obtained on day 35. The parameters feed intake, feed conversion ratio, true feed conversion ratio, and livability were not affected (p>0.05) by the treatments. However, the live weight of birds fed the combination of animal meals (T6) was significantly lower (p<0.05). Sartorelli (1998) and Junqueira *et al.* (2000) did not find significant performance differences when feeding broilers with MBM in the same period, whereas Faria Filho *et al.* (2002) found that the inclusion of 6% MBM resulted in lower feed intake and lower weight gain in that period, and argued that performance was impaired because the diets were formulate on total amino acid basis and not on digestible amino acids. Bellaver *et al.* (2005) comparing the inclusion of 4% meat and bone meal, 3% poultry offal meal, and vegetarian diets, obtained lower average broiler weight on day 35 when animal meals were fed, as compared to the vegetarian diet.

The worse performance observed in the present study when the combination of the four different animal meals (MBM, BM, OM and FM) were fed may be related to the high crude protein levels of the starter and grower diets (23.32% and 22.32%, respectively) and amino acid levels, particularly of threonine and

Table 6 - Performance of 14-day-old broilers fed diets containing animal meals or not.

Treatment	Feed intake (kg)	Live weight (kg)	True FCR	FCR	Livability (%)
1	0.683[a]	0.507[a]	1.446[a]	1.063[a]	96.66[a]
2	0.705[a]	0.513[a]	1.501[a]	1.089[a]	100.00a
3	0.674[a]	0.503[a]	1.458[a]	1.083[a]	97.77[a]
4	0.663[a]	0.504[a]	1.425[a]	1.061[a]	97.77[a]
5	0.650[a]	0.512[a]	1.380[a]	1.041[a]	98.33[a]
6	0.737[a]	0.528[a]	1.500[a]	1.092[a]	97.77[a]
CV	8.96	3.54	6.99	4.69	2.88

T1-control feed; T2-Inclusion of 5% de MBM; T3-Inclusion of 5% BM; T4-Inclusion of 5% FM; T5-Inclusion of 5% OM; T6- Combination of MBM, BM, FM, and OM. Means followed by different letters in the same column are significantly different by the testo f Tukey (p<0.05).

Table 7- Performance of 21-day-old broilers fed diets containing animal meals or not.

Treatment	Feed intake (kg)	Live weight (kg)	True FCR	FCR	Livability (%)
1	1.341[a]	1.003[a]	1.014[a]	1.338[a]	95.55[a]
2	1.386[a]	1.028[a]	1.398[a]	1.348[a]	98.89[a]
3	1.319[a]	0.986[a]	1.396[a]	1.340[a]	97.22[a]
4	1.374[a]	0.996[a]	1.423[a]	1.378[a]	96.66[a]
5	1.298[a]	0.999[a]	1.336[a]	1.297[a]	96.66[a]
6	1.452[a]	1.014[a]	1.449[a]	1.431[a]	95.00a
CV	8.97	4.24	8.26	8.33	3.51

T1-control feed; T2-Inclusion of 5% de MBM; T3-Inclusion of 5% BM; T4-Inclusion of 5% FM; T5-Inclusion of 5% OM; T6- Combination of MBM, BM, FM, and OM. Means followed by different letters in the same column are significantly different by the testo f Tukey (p<0.05).

arginine in the grower diet, as compared to the other treatments. According to Leclercq (1996), excessive protein is catabolized and excreted as uric acid by birds. Based on the principle that the estimated metabolic cost to incorporate one amino acid into the protein chain is 4 mol of ATP, and that the estimated cost to excrete an amino acid ranges between 6 and 18 mol of ATP, it is concluded that the excretion of excessive amino acids has a high metabolic or calorie cost. This may have impaired the performance of the birds fed the diet with excessive protein and amino acids, and the energy that should be used for muscle accretion was diverted to nitrogen excretion.

Feed intake, live weight, feed conversion ratio, and livability results of 42-day-old broilers are shown in Table 9. The combination of the four animal meals again resulted in the lowest live weight ($p<0.05$) followed by the treatment with BM inclusion, and the birds fed the diets soybean meal, MBM, FM, and OM diets presented better live weight.

The worst true feed conversion ratio ($p<0.05$) was observed in birds fed the diet that included the four animal meals are compared to the other treatments.

The other studied performance parameters were not influenced ($p>0.05$) by the treatments. These results agree with the findings of Sartorelli (1998) and Junqueira *et al.* (2000), who did not find significant performance differences when MBM was added in the feeds fed to birds of the same age. In contrast, Faria Filho *et al.* (2002) included 6% MBM in broiler diets and observed lower feed intake and weight gain in the same period.

When the levels of the individual animal meals are considered, the results of the present study differ from those of Donkoh *et al.* (1999), who concluded that the inclusion of 5 and 7.5% BM promoted better weight and feed conversion ratio as compared to the treatments with zero or 2.5% BM. Guichard (2008) also verified that the use of 1% feather meal in broiler diets resulted in better weight gain than the diet based on corn and soybean meal.

The poor performance obtained with the combined

Table 8 - Performance of 35-day-old broilers fed diets containing animal meals or not.

Treatment	Feed intake (kg)	Live weight (kg)	True FCR	FCR	Livability (%)
1	3.655[a]	2.392[a]	1.505[a]	1.527[a]	92.22[a]
2	3.696[a]	2.376[a]	1.461[a]	1.555[a]	89.46[a]
3	3.723[a]	2.335[a]	1.528[a]	1.596[a]	89.44[a]
4	3.702[a]	2.361[a]	1.488[a]	1.569[a]	88.88[a]
5	3.644[a]	2.404[a]	1.479[a]	1.517[a]	93.33[a]
6	3.356[a]	2.146b	1.538[a]	1.565[a]	95.00a
CV	6.05	3.23	6.05	6.56	6.79

T1-control feed; T2-Inclusion of 5% de MBM; T3-Inclusion of 5% BM; T4-Inclusion of 5% FM; T5-Inclusion of 5% OM; T6- Combination of MBM, BM, FM, and OM. Means followed by different letters in the same column are significantly different by the testo f Tukey ($p<0.05$).

Table 9 - Performance of 42-day-old broilers fed diets containing animal meals or not.

Treatment	Feed intake (kg)	Live weight (kg)	True FCR	FCR	Livability (%)
1	5.397[a]	2.994[a]	1.756b	1.806[a]	88.88[a]
2	5.999[a]	2.945[a]	1.841ab	2.035[a]	81.73[a]
3	5.677[a]	2.745bc	1.886ab	2.070[a]	82.77[a]
4	5.372[a]	2.868ab	1.785b	1.873[a]	87.22[a]
5	5.589[a]	3.004a	1.778b	1.860[a]	88.33[a]
6	5.620[a]	2.664c	2.045a	2.111[a]	88.88[a]
CV	9.11	3.60	7.29	9.55	8.63

T1-control feed; T2-Inclusion of 5% de MBM; T3-Inclusion of 5% BM; T4-Inclusion of 5% FM; T5-Inclusion of 5% OM; T6- Combination of MBM, BM, FM, and OM. Means followed by different letters in the same column are significantly different by the testo f Tukey ($p<0.05$).

Table 10 - Carcass yield of 42-day-old broilers fed diets containing animals meals or not.

Treatments	Carcass yield (%)	Breast bone-in	Deboned breast	Thigh+drum
1	64.99[a]	36.44[a]	29.31[a]	28.95[a]
2	65.17[a]	35.88[a]	28.96[a]	29.38[a]
3	63.81[a]	36.43[a]	29.47[a]	28.02[a]
4	65.56[a]	36.75[a]	30.03[a]	29.40[a]
5	66.71[a]	37.67[a]	31.00a	27.90[a]
6	64.21[a]	37.07[a]	29.64[a]	28.29[a]
CV	3.63	6.95	9.50	4.05

T1-control feed; T2-Inclusion of 5% de MBM; T3-Inclusion of 5% BM; T4-Inclusion of 5% FM; T5-Inclusion of 5% OM; T6- Combination of MBM, BM, FM, and OM.Means followed by different letters in the same column are significantly different by the testo f Tukey ($p<0.05$).

inclusion of the four animal meals (T6) and blood meal (T3) may be related to a possible amino acid unbalance, as well as to the high protein levels of the T6 feeds during the experimental period, of 23.32%, 22.32%, and 22.59% in the starter, grower, and finisher diets, respectively.

Carcass yield and breast bone-in, deboned breast, and thigh+drum yields are presented in Table 10. The studied parameters were not influenced (p>0.05) by the use of animal meals. These findings are consistent with those of Junqueira *et al.* (2000) and Faria Filho *et al.* (2002), who did not obtain significant carcass yield differences when MBM was included in the diets. The data obtained in the present study show that the dietary inclusion of animal meals did not compromise carcass yield; however, it reduced feed cost in an average of 9% (Tables 3, 4, and 5).

CONCLUSIONS

The obtained results allowed us to conclude that the individual inclusion of 5% meat and bone meal, feather meal, or poultry offal meal in broiler diets did not compromise live performance or carcass yield, and allowed feed cost reduction.

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