METABOLIZABLE ENERGY OF CORN HYBRIDS FOR BROILER CHICKENS AT DIFFERENT AGES

Energia metabolizável de milhos híbridos para frangos de corte em diferentes idades

Reinaldo Kanji Kato[1], Antonio Gilberto Bertechini[2], Edison José Fassani[3], Jerônimo Avito Gonçalves de Brito[4], Solange de Faria Castro[3]

ABSTRACT

We determined the values of apparent metabolizable (AME), apparent corrected (AMEn), true (TME) and true corrected (TMEn) energy of six corn hybrids for broiler chickens in phases 1-7, 8-14, 15-21, 22-28, 29-35 and 36-42 day-old birds, using the substitution method (40%) of reference diet with the test ingredient. Ross-308 male chicks (1,134) were allotted to metabolism cages and the number of birds per experimental unit was adjusted to suit each bird's density stage in the cage, using six replicates. Simultaneously, birds continue to fast for the determination of metabolic and endogenous losses for each study phase. The birds received water and food ad libitum during the experimental period. The birds were maintained in metabolism cages for seven days, four days for adaptation to the cage and food, and three days for excreta collection. The corn energy values were significantly lower only in the pre-initial phase (1-7 days). Thus, broiler feed formulations of AMEn values for corn of 3563 kcal/kg DM for 1 to 7 days and 3778 kcal/kg DM from 7-day-old birds are recommended.The agronomic characteristics of the corn had no influence on the birds energy levels.

Index terms: Energy content, flint corn, dent corn, semi-dent corn, soft corn.

RESUMO

Foram determinados os valores de energia metabolizável aparente (EMA), aparente corrigida (EMAn), verdadeira (EMV) e verdadeira corrigida (EMVn) de seis milhos híbridos para frangos de corte nas fases de 1 a 7, 8 a 14, 15 a 21, 22 a 28, 29 a 35 e 36 a 42 dias de idade das aves, usando o método de substituição (40%) da ração referência pelo ingrediente em teste. Pintos machos Ross-308 (1.134) foram distribuídos em gaiolas de metabolismo, sendo o número de aves por parcela, ajustado em cada fase para adequação da densidade de aves na gaiola, sendo utilizadas 6 repetições por tratamento. Simultaneamente, foram mantidas aves em jejum para a determinação das perdas endógenas e metabólicas para cada fase do estudo. As aves receberam água e ração à vontade durante todo período experimental. As aves foram mantidas nas gaiolas de metabolismo durante sete dias, sendo quatro dias para adaptação à gaiola e à alimentação e três dias para a coleta de excretas. Os valores energéticos dos milhos foram significativamente inferiores somente na fase pré-inicial (1 a 7 dias) em relação às demais. Assim, recomenda-se usar nas formulações os valores de EMAn do milho de 3563/kg MS de 1 a 7 dias e de 3778 kcal/kg MS a partir 7 dias de idade das aves As características agronômicas dos milhos não influíram nos seus teores de energia.

Termos para indexação: Conteúdo energético, milho duro, milho dentado, milho semi-dentado, milho mole.

(Received in february 18, 2011 and approved in july 6, 2011)

INTRODUCTION

Breeding programs have produced high-field production corn hybrids, with different agronomic characteristics, as well as those of grain composition and texture. Moreover, there are no comparative assessments of these maize varieties in terms of their energy values in poultry feed formulations. Variations in protein content, fat and starch are observed in analysis of these hybrids (DUARTE et al., 2005; CANTARELLI et al., 2007; VIEIRA et al, 2007). As for starch, there are also variations in the amylose and amylopectin levels, which may contribute to the variation of metabolizable energy of the grain. At the same time, the feeding programs for broilers have evolved towards better nutritional adequacy of diets for each development stage of the birds. Modern broilers are extremely precocious and there is a need to know the real capacity of these birds' energy use of corn during the short production cycle, in order to achieve the best performance results. In this context, weekly diet formulations have been applied in order to acquire knowledge of the nutrients and energy availability of these diets. Energy values currently used are obtained from food composition tables (EMBRAPA, 1991, NRC, 1994,

[1]Comércio e Indústria Uniquímica Ltda. – Diadema – SP – Brasil
[2]Universidade Federal de Lavras/UFLA – Departamento de Zootecnia/DZO – Cx. P. 3037 – 37200-000 – Lavras – MG – Brasil – bertechini@dzo.ufla.br
[3]Universidade Federal de Lavras/UFLA – Departamento de Zootecnia/DZO – Lavras – MG – Brasil
[4]Universidade Federal do Recôncavo da Bahia/UFRB – Cruz das Almas – BA – Brasil

ROSTAGNO et al., 2005), and were determined using adult birds with different corn from that currently found in the market. Furthermore, research (MORAN JUNIOR, 1985) indicates that the digestive capacity of birds varies with age, increases occurring in nutrient utilization values with advancing age, and depending on the development of accessory organs and the digestive system itself. Several factors can be cited which could affect the energy values of corn hybrids. Besides agronomic aspects, energy values are affected by the level of feed intake and age of the birds (FREITAS et al., 2006). Thus, there is a need for continuous evaluation of ingredients to keep the database as completely up to date as possible, to improve the average metabolizable energy and nutrient estimates that are supplied to the birds' diets (DE BRUN et al. 2000). Our objectives were to assess the energy values of corn hybrid varieties with different agronomic characteristics determined at the various ages of the chickens used in the conventional determination of metabolizable energy.

MATERIALS AND METHODS

Six experiments was carried out to determine the energy values of six corn hybrids for broiler chickens in phases of 1-7, 8-14, 15-21, 22-28, 29-35 and 36-42 days of bird age.

The tests were performed at room temperature with controlled metabolism and ambient relative humidity. The average minimum and maximum temperature and relative humidity recorded during the tests were 29° C, 33° C and 65% 1-14 days and 23º C, 26° C and 68% from 14 days old, respectively. The metabolism cages (50 x 50 x 45cm) were fitted with metal collecting trays, covered with plastic trough type feeders and glass type bottles, individually per plot. A total of 1344 day-old male Ross-308 chicks from commercial hatcheries were used with 336, 288, 240, 192, 144 and 144 birds with average weights of 45 + 1.1 g, 159 + 3.4 g, 437 + 7.6 g, 892 + 15.5 g, 1433 g and 2142 + 49.9 ± 74.5 g for phases 1-7, 8-14, 15-21, 22-28, 29-35 and 36-42 days of age, respectively. The reference diets were based on corn and soybean meal, formulated specifically for each study phase using ingredient composition values according to Rostagno et al. (2005). The birds were raised in a conventional system until they were transferred to the cages according to each assessment stage and after their utilization in the cages, were removed from the test. The diets used for rearing the birds were the same used as a reference. The chemical and calculated composition of the reference diets are presented in Table 1.

The weekly evaluations of the study consisted of six corn hybrids, one reference, and one group of birds to determine endogenous losses. We used six replicates of seven, six, five, four, three and three birds, respectively, for day-old stages 1-7, 8-14, 15-21, 22-28, 29-35 and 36-42. We evaluated six commercial hybrids with distinct characteristics (semi-Flint, Flint, semi-soft and soft). The hybrids were produced under similar conditions as to the planting site, planting date, fertilization level, both for planting as well as covering, and other cultural practices throughout the production phase. After harvesting and mechanical grain threshing, the grain was dried in the shade and classified to remove impurities. The maize grains were ground in a 'hammer type' mill, in a 3-mm sieve and homogenized for use in trials.

The ingredients were evaluated by the substitution method based on natural matter, which replaced 40% of the reference diet with maize in the study (MATTERSON et al., 1965).

We used the traditional method of total excreta collection, through which the birds were kept in metabolism cages for seven days. Four days were adopted for adaptation to the cages and food, and three days for excreta collection (of 5^{th}-7^{th} day, the 12^{th} -14^{th} day, the 19^{th} -21^{th} day 26^{th} -28^{th} day, the 33^{th} -35^{th} day and 40^{th} - 42^{th} days, respectively for the phases under study). Diets and scraps were weighed and recorded, respectively, at the beginning and end of each phase, to obtain the feed intake during the evaluation period. After the adjustment period, the beginning and end of collection of excreta was determined using ferric oxide (1%) in feed as a fecal marker. Samples were collected twice daily at 8:00 a.m. and 4:30 p.m. in order to prevent fermentation and possible loss of material. The collected excreta was packed into labeled plastic bags and stored in a freezer at -5º C until the final period of each test. At the end of the collections, samples were defrosted, weighed, homogenized and 200 grams aliquots removed for subsequent laboratory analysis. These samples were subjected to pre-drying by ventilation (55º C) for 72 hours. Subsequently, they were weighed to determine dry matter at 55º C and ground in a Willey mill type, with 0.5 mm sieves for determination of dry matter (DM), gross energy (GE) and nitrogen (N).

Simultaneously, six replicates were maintained for each stage with birds that received the reference diet during the adaptation period and were subjected to fasting for 12 hours to promote cleansing of the digestive tract. Subsequently, excreted content was collected for 48 hours to determine metabolic and endogenous losses. The metabolic and endogenous loss values were corrected for three days of collection to determine the true metabolizable (TME) and true corrected energy for the nitrogen balance (N). Roosters are commonly used to determine the TME (SIBBALD et al. 1982), however, in this work, we used the chickens in each phase of determination, with metabolic and endogenous loss measurements each week, thus reducing the energy value determination errors.

Table 1 – Ingredients and diet composition (%) of experiments according to phases.

	Phases					
Ingredient	1 - 7 d	8 – 14 d	15 – 21 d	22 – 28 d	29 – 35 d	36 – 42 d
Corn	59.740	57.687	58.468	59.420	60.408	61.556
Soybean meal, 46%	37.036	35.814	34.518	33.129	31.671	30.124
Limestone	0.998	0.982	0.964	0.948	0.929	0.909
Dicalcium phosphate	1.892	1.831	1.766	1.695	1.624	1.549
Salt	0.457	0.439	0.441	0.410	0.411	0.386
Soybean oil	1.950	2.568	3.179	3.749	4.324	4.860
DL-methionine, 99%	0.248	0.236	0.225	0.212	0.198	0.184
L-lysine, 78%	0.170	0.168	0.164	0.162	0.160	0.157
Anticoccidial[1]	0.050	0.050	0.050	0.050	0.050	0.050
Growth promoter[2]	0.025	0.025	0.025	0.025	0.025	0.025
Vitamin supplement[3]	0.100	0.100	0.100	0.100	0.100	0.100
Mineral supplementl[3]	0.100	0.100	0.100	0.100	0.100	0.100
Total	100.00	100.00	100.00	100.00	100.00	100.00

Calculated composition						
ME (kcal/kg)	2.950	3.000	3.050	3.100	3.150	3.200
Crude Protein(%)	21.914	21.389	20.834	20.249	19.634	18.989
Calcium(%)	0.988	0.963	0.936	0.908	0.879	0.848
Av. Phosphorus(%)	0.466	0.453	0.439	0.424	0.409	0.393
Sodium(%)	0.224	0.216	0.216	0.203	0.203	0.192
Lysine(%)	1.305	1.271	1.234	1.196	1.156	1.114
Methionine(%)	0.508	0.495	0.482	0.468	0.454	0.439
Methionine + Cystine(%)	0.927	0.902	0.877	0.850	0.822	0.792

[1]Salinomicin 15%; [2]Zinc bacitracin 10%; [3]Enrichment per kg of diet: vit. A = 12.000UI; vit. D3 = 2.200UI; vit. E = 30 mg; vit. K3 = 2,5 mg; vit. B1 = 2,2 mg; vit. B2 = 6 mg; vit. B6 = 3,3 mg; vit. B12 = 0,016 mg; Niacin = 53 mg; Pantotênic acid = 13 mg; Biotin = 0,11 mg; Folacin = 1 mg; Se = 0,25 mg; Mn = 75 mg; Zn = 70 mg; Cu = 8,5 mg; Fe = 50 mg; I = 1,5 mg; Co = 0,2 mg.

Laboratory tests were performed (Table 2) for ingredients, diets and excreta following the methodology described in AOAC (1990). The gross energy (GE) ingredients in feed and excreta were determined using bomb calorimetry (Parr model 1261) and are expressed in kcal/kg., The values of apparent metabolizable energy (AME), corrected apparent nitrogen balance (AMEn), TME and TMEn were determined. The energy values of the ingredients, presented in kcal/kg DM, were determined according to Matterson et al. (1965) and adjusted for nitrogen. The Tukey test at 5% was applied among the hybrids. The analysis of variance was performed using the program SAS (SAS, 2001).

RESULTS AND DISCUSSION

The values of corn hybrid compositions (Table 2) ranged up to 12.6% crude protein content (8.6 to 9.6%) and 3.1% gross energy (3789-3906 kcal / kg). There were also no differences in other components tested, with slight variation in chemical composition. Among the factors that influence the levels of grain crude protein, nitrogen fertilizer stands out (DUARTE et al., 2005). However, this factor could be disregarded in this work, since these hybrids were specifically produced in the same soil type and received similar fertilization and cultural practices. The variations observed in the amounts of crude protein and gross energy are consistent with those found in the chemical analysis carried out by Laboratory of Animal Research in the Animal Science Department of the Federal University of Lavras, in a large number of analyzed maize samples.

Table 2 – Chemical and physical composition and gross energy of corn (based on natural matter).

Corn	1	2	3	4	5	6
Composition[1 2]	Flint	Semi flint	Semi flint	Flint	Semi soft	Soft
DM (%)	86.04	86.31	86.23	87.21	86.25	86.98
CP (%)	9.40	9.28	8.64	8.68	9.64	8.56
GE(kcal/kg)	3.808	3.803	3.847	3.931	3.789	3.906
EE (%)	3.47	3.05	3.62	3.48	3.72	4.25
CF (%)	1.65	1.73	1.87	2.03	1.97	1.54
NDF (%)	13.20	12.21	14.71	14.26	13.91	12.43
ADF (%)	4.43	4.52	4.41	4.53	3.52	3.52
MM (%)	1.56	1.57	1.16	1.12	1.09	1.39
Ca (%)	0.021	0.028	0.029	0.018	0.018	0.019
P (%)	0.26	0.20	0.20	0.31	0.19	0.23
Mg (%)	0065	0.078	0.069	0.065	0.062	0.069
Zn (ppm)	15.00	21.16	14.04	17.40	17.19	13.77
Fe (ppm)	46.11	59.31	49.68	50.02	50.77	43.72
DGM (μm)	710.34	874.54	804.74	788.18	730.32	715.28

[1]Analyses done in the Animal Laboratory Research of the Animal Science Department of the Federal University of Lavras, Minas Gerais. [2]DM – dry matter; CP – crude protein; GE – gross energy; EE – ether extract; CF – crude fiber; NDF – neutral detergent fiber; ADF – acid detergent fiber; MM – mineral matter; GMD – geometric mean diameter.

From 1 to 21 days

The energy values of corn hybrids (Table 3) assessed during this evaluation did not show significant variations ($P > 0.05$), considering they were grown, harvested and stored under similar conditions. According to Collins et al. (2001), the degree of similarity of hybrids is greatly influenced by the environment in which they are produced. In an experiment evaluating two maize hybrids with different characteristics (flint x soft), with broilers during 1-7 days of age, these authors found similar results in performance of broilers using hybrids in nutrient composition, but with differences in physical characteristics of the grain. Comparing the energy measurements, it appears that the corrected values for N balance were lower by 1.6% and 2.2% for AME and TME, respectively. When birds are kept under conditions of "ad libitum" consumption, nitrogen retention is greater than zero, and consequently the metabolizable energy corrected for the nitrogen balance is lower than the AME and TME. However, they are lower than those observed by Albino et al. (1992), who found 6.9% and 6.4%. The TMEn based on dry matter (DM) was on average 1.6% higher than the AME, demonstrating the influence of the metabolic fecal energy, and endogenous urinary energy losses on the energy values of the ingredients. Leclercq et al. (1999) observed TMEn value of 5% to 10% higher than the AME value, the difference being influenced by the level of food consumption of birds.

As for age assessment, lower ($P < 0.05$) energy values were observed for the first week in relation to the rest. From the second week of age, the energy values determined were similar to those shown in national (EMBRAPA, 1991; ALBINO et al. 1994; ROSTAGNO et al., 2000; ROSTAGNO et al., 2005) and international literature (NRC, 1994; FEEDSTUFFS, 2001). Comparing the average value of 3563 kcal / kg AMEn, expressed on the basis of dry matter (DM), with a value of 3881 kcal / kg referenced in Brazilian tables (ROSTAGNO et al. 2005), there is a difference of 318 kcal/kg which represents a value less than 8.19%. This difference can be explained by the difference between ages of birds used in the energy value determination tests. The energy values of the ingredients described in the tables, both domestic and international, were determined with roosters and/or broilers in the growth phase (21 to 35 days old), in which the bird's digestive capacity is already more developed. In contrast, the digestive tract of birds in the pre-initial phase is in early development, with less ability to digest, which affects the utilization of the energy content of the ingredient. This fact was also observed by Nir et al. (1993) in which a value of 3244 kcal of AME / kg for the first week-old birds was obtained, and this value was 6% lower than indicated in the NRC (1994).

Table 3 – Values of apparent metabolizable (AME), corrected (AMEn), true (TME), and corrected (TMEn) energy of corns expressed as DM from 1-21 days of age.

Corn	AME[1] (kcal/kg)	AMEn[1] (kcal/kg)	TME[1] (kcal/kg)	TMEn[1] (kcal/kg)
		1 -7 d		
1 (Flint)	3.651 ± 44	3.573 ± 43	3.775 ± 38	3.683 ± 39
2 (Semi-flint)	3.609 ± 43	3.560 ± 38	3.743 ± 42	3.680 ± 38
3 (Semi-flint)	3.637 ± 49	3.579± 36	3.765 ± 51	3.693 ± 38
4 (Flint)	3.585 ± 38	3.567 ± 32	3.713 ± 38	3.681 ± 29
5 (Semi-soft)	3.641 ± 41	3.556 ± 28	3.767 ± 40	3.668 ± 26
6 (Soft)	3.609 ± 47	3.543 ± 36	3.730 ± 43	3.650 ± 33
Average	3.622 ± 42	3.563 ± 33	3.749 ± 40	3.676 ± 32
		8 - 14 d		
1 (Flint)	3.809 ± 37	3.752 ± 32	3.876 ± 36	3.784 ± 31
2 (Semi-flint)	3.854 ± 28	3.760 ± 29	3.919 ± 27	3.791 ± 29
3 (Semi-flint)	3.802 ± 38	3.722 ± 36	3.866 ± 37	3.753 ± 36
4 (Flint)	3.864 ± 49	3.806 ± 32	3.921 ± 50	3.834 ±33
5 (Semi-soft)	3.912 ± 26	3.798 ± 39	3.966 ± 48	3.824 ± 39
6 (Soft)	3.871 ± 34	3.805 ± 36	3.935± 35	3.837 ± 36
Average	3.852 ± 36	3.774 ± 33	3.914± 36	3.804 ± 33
		15 - 21 d		
1 (Flint)	3.811 ± 32	3.758 ± 24	3.861 ± 29	3.784 ± 22
2 (Semi-flint)	3.834 ± 37	3.803 ± 30	3.903 ± 37	3.838 ± 30
3 (Semi-flint)	3.845 ± 33	3.809 ± 23	3.882 ± 34	3.832 ± 23
4 (Flint)	3.843 ± 27	3.793 ± 24	3.873 ± 26	3.819 ± 24
5 (Semi-soft)	3.854 ± 33	3.789 ± 23	3.902 ± 37	3.814 ± 25
6 (Soft)	3.848 ± 38	3.813 ± 31	3.917± 38	3.849 ± 31
Average	3.839 ± 31	3.794 ± 25	3.890± 32	3.823 ± 25

When comparing the TMEn values, similar behavior can be observed and there is a difference of 8.90% (359 kcal / kg) compared to that achieved by Rostagno et al. (2005). Comparing the average values of AME determined in the first, second and third week-old birds, within that indicated in Brazilian tables (ROSTAGNO et al., 2005), there is narrowing of differences (318, 107 and 87 kcal / kg DM , respectively). This fact indicates that with advancing age and the development of their digestive tract, there is better feed utilization by the birds.

From 22 to 42 days

Energy values (AME, AMEn EMV and AMC) of corn determined from 22 to 42 days (Table 4) were similar (P> 0.05). We observed an average of 3774 kcal of AME / kg DM for these three determinations, and this value was 2.3% higher than that found by Albino et al. (1994), however, 2.8% less than that indicated by Rostagno et al. (2005). The average values of TMEn (kcal / kg DM) showed little variation, but on average only 0.98% higher than those of AME, showing little influence of fecal metabolic energy and endogenous urine energy losses on the energy values of ingredients in this evaluation period.

The energy values (AME, AMEn, TME and TMEn) at this stage are similar to those found in the literature (EMBRAPA, 1991 NRC, 1994; ROSTAGNO et al., 2005). It can be inferred that the gastro digestive tract of the birds used in this is developed and, consequently, the ability to use the nutrients has already been established.

Table 4 – Values of apparent metabolizable (AME), corrected (AMEn), true (TME), and corrected (TMEn) energy of corns expressed as DM from 22 to 42 days of age.

Corn	AME (kcal/kg)	AMEn[1] (kcal/kg)	TME[1] (kcal/kg)	TMEn[1] (kcal/kg)
		22 - 28 d		
1 (Flint)	3.874 $\pm$ 34	3.795 $\pm$ 30	3.943 $\pm$ 30	3.840 $\pm$ 27
2 (Semi-Flint)	3.888 $\pm$ 21	3.807 $\pm$ 19	3.920 $\pm$ 20	3.849 $\pm$ 20
3 (Semi-Flint)	3.890 $\pm$ 40	3.804 $\pm$ 34	3.937 $\pm$ 40	3.842 $\pm$ 34
4 (Flint)	3.908 $\pm$ 35	3.799 $\pm$ 31	3.960 $\pm$ 32	3.829 $\pm$ 31
5 (Semi-soft)	3883 $\pm$ 35	3.759 $\pm$ 27	3.899 $\pm$ 35	3.791 $\pm$ 27
6 (Soft)	3.909 $\pm$ 29	3.807 $\pm$ 32	3.936 $\pm$ 31	3.844 $\pm$ 33
Average	3.896 $\pm$ 31	3.795 $\pm$ 27	3.933 $\pm$ 29	3.833 $\pm$ 28
		29 - 35 d		
1 (Flint)	3.914 $\pm$ 28	3.771 $\pm$ 25	3.954 $\pm$ 34	3.795 $\pm$ 25
2 (Semi-Flint)	3.915 $\pm$ 23	3.814 $\pm$ 14	3.959 $\pm$ 24	3.840 $\pm$ 15
3 (Semi-Flint)	3.886 $\pm$ 37	3.760 $\pm$ 38	3.899 $\pm$ 36	3.768 $\pm$ 38
4 (Flint)	3.885 $\pm$ 39	3.773 $\pm$ 25	3.904 $\pm$ 37	3.785 $\pm$ 24
5 (Semi-soft)	3.888 $\pm$ 27	3.768 $\pm$ 28	3.904 $\pm$ 27	3.777 $\pm$ 28
6 (Soft)	3.864 $\pm$ 36	3.757 $\pm$ 33	3.885$\pm$ 38	3.770 $\pm$ 35
Average	3.892 $\pm$ 30	3.774 $\pm$ 27	3.917 $\pm$ 32	3.789 $\pm$ 28
		36 - 42 d		
1 (Flint)	3.846 $\pm$ 25	3.771 $\pm$ 22	3.956 $\pm$ 23	3.834 $\pm$ 21
2 (Semi-Flint)	3.889 $\pm$ 29	3.813 $\pm$ 26	3.998 $\pm$ 28	3.850 $\pm$ 25
3 (Semi-Flint)	3.864 $\pm$ 20	3.770 $\pm$ 21	3.953 $\pm$ 24	3.832 $\pm$ 24
4 (Flint)	3.834 $\pm$ 33	3.724 $\pm$ 27	3.902 $\pm$ 34	3.773 $\pm$ 27
5 (Semi-soft)	3.775 $\pm$ 36	3.690 $\pm$ 32	3.886 $\pm$ 36	3.764 $\pm$ 32
6 (Soft)	3.827 $\pm$ 29	3.755 $\pm$ 29	3.882 $\pm$ 30	3.818 $\pm$ 29
Average	3.839 $\pm$ 32	3.754 $\pm$ 28	3.929$\pm$ 32	3.812 $\pm$ 28

Effect of Age

The weekly average values of energy measurements determined (Table 5) for the corn used in this study indicate significant differences ($P < 0.05$) regarding the age of the birds. There was a lower energy use of corn in the first week, and from the second week, the energy values were similar and an average of these determinations may be used. These results reaffirm the recommendations of Freitas et al. (2006) regarding the need to use the AMEn with chicks in the formulation of starter diets of broilers for better nutritional adaptation.

Table 5 – Mean values of AME, AMEn, TME and TMEn of corn hybrids expressed as dry matter determined with broilers at different ages.

Kcal/kg	Ages					
	1 – 7 d	8 – 14 d	15 – 21 d	22 – 28 d	29 – 35 d	36 – 42 d
AME	3.622 $\pm$ 42a	3.852 $\pm$ 36b	3839 $\pm$31 b	3.896 $\pm$ 30b	3.892 $\pm$ 30b	3.839 $\pm$ 32b
AMEn	3.563 $\pm$ 33a	3.774 $\pm$ 33b	3.794 $\pm$ 31b	3.795 $\pm$ 27b	3.774 $\pm$ 26b	3.754 $\pm$ 28b
TME	3.749 $\pm$ 40a	3.914$\pm$ 36b	3.890$\pm$ 38b	3.933 $\pm$ 29b	3.917 $\pm$ 32b	3.929 $\pm$ 32b
TMEn	3.676 $\pm$ 32a	3.804 $\pm$ 33b	3.823 $\pm$ 31b	3.833 $\pm$ 28b	3.789 $\pm$ 28b	3.812 $\pm$ 28b

[1]Means followed of different letters on the line are statically different ($P<0.05$).

CONCLUSIONS

The agronomic characteristics of corn hybrids do not influence their levels of metabolizable energy for broiler chickens.

The recommended AMEn values of corn to use in broiler feed formulation are 3563 kcal/kg DM for 1 to 7 days, and 3778 kcal/kg DM from 7-day-old birds.

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