



Ciência Rural

ISSN: 0103-8478

cienciarural@mail.ufsm.br

Universidade Federal de Santa Maria
Brasil

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Ciência Rural, vol. 46, núm. 10, octubre, 2016, pp. 1846-1851
Universidade Federal de Santa Maria
Santa Maria, Brasil

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Performance of broiler chickens at pre starter and starter phases using diets with different metabolizable energy values of ingredients, at different ages

Desempenho de pintos de corte nas fases pré-inicial e inicial, utilizando dietas com diferentes valores de energia metabolizável dos ingredientes, em diferentes idades

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ABSTRACT

The experiment was carried out to evaluate the performance of broilers in 1-7 and 8-21 days of age, using metabolizable energy values of corn, soybean meal and soybean oil previously determined for each phase in another metabolism trial. Two trials were conducted, divided into phases according to ages: pre-starter (1-7 days) and starter (8-21 days). At each trial were used 924 broiler chicken randomly distributed into 42 experimental units in a completely randomized design with six treatments and seven replications. Treatments consisted of five diets using the values of apparent metabolizable energy corrected for nitrogen balance of corn, soybean meal and soybean oil determined in different metabolism trials, and one diet with the metabolizable energy values of these same ingredients, published on the literature. At the end of each stage, the animals and feed leftover were weighted to determine feed intake, weight gain and feed conversion ratio. Diets with higher soybean oil inclusion, showed superior performance at different stages. At pre-starter only feed conversion ratio was significant ($P < 0.05$). In the initial phase, there was a significant difference ($P < 0.05$) for feed conversion ratio, daily and average weight gain.

Key words: energetic coefficients, feed conversion ratio, feed intake, weight gain.

RESUMO

O experimento foi realizado para avaliar o desempenho de frangos de corte nas idades de 1-7 e 8-21 dias de idade, utilizando valores de energia metabolizável do milho, farelo de soja e óleo de soja determinados anteriormente em outro ensaio de metabolismo. Dois estudos foram realizados, divididos em fases de acordo com as idades: pré-inicial (1-7 dias) e inicial (8-21 dias). Em cada estudo, foram utilizados 924 pintos de corte distribuídos aleatoriamente em 42 unidades experimentais, em um delineamento inteiramente casualizado consistindo de cinco dietas utilizando os valores de energia metabolizável aparente corrigida para o balanço

de nitrogênio do milho, farelo de soja, e óleo de soja, determinados nos ensaios de metabolismo, e uma dieta com os valores de energia metabolizável dos mesmos alimentos publicados na literatura. No final de cada fase, os animais e as sobras de ração foram pesadas para determinar o consumo de alimento, ganho de peso e conversão alimentar. As dietas com maiores inclusões de óleo de soja mostraram desempenho superior nas diferentes idades. Na fase pré-inicial, apenas a conversão alimentar foi significativa. Na fase inicial, houve diferença significativa para a conversão alimentar e ganho de peso médio e diário.

Palavras-chave: coeficientes energéticos, consumo de ração, conversão alimentar, ganho de peso.

INTRODUCTION

As consequence of faster growing, broiler chickens were slaughter in earlier phases, which required less feed to reach the final weight and allowed production costs reduction. Genetic programs for growing has led to increased feed intake, and consequently to greater fat deposition due to *ad libitum* access to food, as seen in the broilers production. In addition, modern strains of fast-growing broilers have great potential to develop abnormalities, leading to death, leg and carcass deformities, also reproductive abnormalities, increasing the number of non-conformity hatching eggs and must be; therefore adequate nutrition to new poultry requirements (VIANA et al., 2000).

Broiler performance is intimately related to dietary energy levels, because energy content is

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limiting factor for ingestion, being used in different metabolic processes involving maintenance to maximum productive potential expression. Thus, the accuracy on metabolizable energy (ME) determination is important to reach optimal performance of poultry, since it may reflect in weight gain and feed conversion ratio improvement (DALE & FULLER, 1982).

Dietary energy contents substantially interfere in broilers performance. According to BASTOS et al. (1998), ALBUQUERQUE et al. (2000), LUCHESI (2000), ROSA et al. (2000), SILVA et al. (2000), MOREIRA et al. (2004) and WATANABE et al. (2001) high energy diets promotes better weight gain and feed conversion ratio, but also increased the abdominal fat.

Thus, the aim of this study was to evaluate the performance (feed intake, feed conversion ratio and weight gain) of broiler chicks at two different stages (1 to 7 and 8 to 21 days old), fed with diets with metabolizable energy values determined with five different ages broilers.

MATERIALS AND METHODS

To evaluate the broilers' performance, were realized two different trials. The diet of each trial was formulated to meet the nutritional requirements of animals divided into phases according to ages: pre-starter (1-7 days) and starter (8-21 days) In both phases, were used 924 broiler chicks. Poultry were randomly distributed into 42 experimental units (EU), according to average weight.

In both trials male broilers chicks were provided by Cobb 500 strain, from broiler breeders with 40 to 50 weeks of age. The poultry were acquired in commercial hatcheries and vaccinated against Marek, Gumboro, Bouda Avian, and Infectious Bronchitis disease.

The chicks used to perform the pre-starter trial (1 to 7 days) were not used in the next phase. The animals used in period 8-21 days of age were reared in concrete floors covered with wood shavings litter, receiving starter diet and water *ad libitum*. At 8th day of age were transferred to boxes (EU) for carry on the trial. Broilers received food and water *ad libitum* and when necessary the heat system was used, a 250 watts infrared lamps in each EU. Lighting program used was of 24 hours (natural and artificial). Pinnus wood shaving was used as litter.

The experimental design been completely randomized with six treatments and seven replications. The treatments consisted of 5 diets using the apparent digestibility coefficients corrected for nitrogen

balance (ADCn) values for corn, soybean meal and soybean oil determined in previous trial conducted by SCHNEIDERS et al. (2011), and a diet formulated with metabolizable energy values from the same feed ingredients published by ROSTAGNO et al. (2005). Thus, treatments were divided as follows:

Pre - energy values determined pre (1 to 8 days of age); Start - energy values determined at starter stage (11 to 18 days of age); GroI - energy values determined on phase gro1 (21 to 28 days of age); GroII - energy values determined on phase gro2 (31 to 38 days of age); Final - energy values determined on phase fin (41 to 48 days of age); and Tab - tabulated energy values from ROSTAGNO et al. (2005);

Experimental diets (Tables 1 and 2) were formulated to be isocaloric and isonutritives, meeting the nutritional requirements for fast-growing male broilers chicks for each of the two studied phases (ROSTAGNO et al., 2005). For experimental diet formulation, it was used chemical composition of feeds tabled by ROSTAGNO et al. (2005), exception for digestible amino acids and AMEn (apparent metabolizable energy corrected for nitrogen balance) content of corn, soybean meal and soybean oil. These ingredients were sent to COMCAP/UEM for GE (gross energy) determination, after then, used for ADCn determination in a digestibility trial conducted by SCHNEIDERS et al. (2011). Corn and soybean meal aminograms were determined via NIRS and the amino acids meet the nutritional requirements for broilers published by ROSTAGNO et al. (2005) for each studied stage.

At the end of each phase the animals and feed leftovers were weighed to determine feed intake (FI), average weight gain (GAIN), daily weight gain (ADG) and feed conversion ratio (FCR). Smaller broiler chickens and mortality were taken dailys, being the feed availability adjusted according to animal number in each experimental unit (SAKOMURA & ROSTAGNO, 2007). At each stage it was used two-thermo hygrometer randomly distributed in two boxes, with the purpose of recording the maximum and minimum temperature as well as air relative humidity inside the shed.

Performance results for two phases were analyzed on Statistical Analysis System - SAEG software (UNIVERSIDADE FEDERAL DE VIÇOSA - UFV, 1999), performing analysis of joint variance and within each period SNK test was used at 5% probability to investigate the effects of different feed ingredients energy values, determined with different poultry age on broiler chicks performance.

Table 1 - Chemical and centesimal composition of foods given on the pre starter phase (1 to 7 days).

| | | | | | | |
|---|---------|---------|---------|---------|---------|---------|
| Corn (3955kcal CE Kg ⁻¹) | 44.614 | 49.953 | 48.412 | 50.270 | 49.517 | 54.030 |
| Soybean meal (4.199kcal CE Kg ⁻¹) | 40.090 | 39.160 | 39.430 | 39.110 | 39.240 | 38.450 |
| Soybean oil (9399kcal CE Kg ⁻¹) | 8.290 | 3.873 | 5.146 | 3.605 | 4.229 | 0.500 |
| Dicalcium Fosfate | 1.963 | 1.949 | 1.953 | 1.948 | 1.950 | 1.938 |
| Limestone | 0.915 | 0.926 | 0.923 | 0.927 | 0.925 | 0.934 |
| Salt | 0.522 | 0.519 | 0.520 | 0.519 | 0.520 | 0.518 |
| DL-Methionine | 0.387 | 0.380 | 0.382 | 0.380 | 0.381 | 0.375 |
| L-Lysine HCl | 0.314 | 0.330 | 0.325 | 0.331 | 0.328 | 0.341 |
| L-Threonine | 0.162 | 0.163 | 0.163 | 0.163 | 0.163 | 0.164 |
| L-Valine | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 | 0.082 |
| L-Isoleucine | 0.011 | 0.015 | 0.014 | 0.015 | 0.015 | 0.018 |
| Mineral/vitamin premix ¹ | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 |
| Choline Chloride 60% | 0.060 | 0.060 | 0.060 | 0.060 | 0.060 | 0.060 |
| Antioxidant ² | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 |
| Inert ³ | 2.170 | 2.170 | 2.170 | 2.170 | 2.170 | 2.170 |
| TOTAL | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 |
| -----Chemical composition----- | | | | | | |
| Poultry metabol energy (kcal kg ⁻¹) | 2,959 | 2,960 | 2,960 | 2,960 | 2,960 | 2,961 |
| ADCn corn (%) | 70.600 | 74.800 | 76.000 | 78.600 | 79.400 | NA |
| ADCn soybean meal (%) | 46.200 | 54.000 | 49.800 | 48.000 | 47.800 | NA |
| ADCn soybean oil (%) | 85.400 | 94.800 | 91.800 | 92.200 | 98.600 | NA |
| Crude protein (%) | 22.990 | 22.990 | 23.000 | 23.000 | 23.000 | 22.990 |
| Calcium (%) | 0.942 | 0.942 | 0.942 | 0.942 | 0.942 | 0.942 |
| Phosphorous Available (%) | 0.471 | 0.471 | 0.471 | 0.471 | 0.471 | 0.471 |
| Sodium (%) | 0.224 | 0.224 | 0.224 | 0.224 | 0.224 | 0.224 |
| Potassium (%) | 0.859 | 0.857 | 0.857 | 0.857 | 0.857 | 0.855 |
| Methionine dig. poultry (%) | 0.677 | 0.673 | 0.674 | 0.673 | 0.674 | 0.671 |
| Met.+cist. dig. poultry (%) | 0.968 | 0.968 | 0.968 | 0.968 | 0.968 | 0.968 |
| Lysine dig. poultry (%) | 1.363 | 1.363 | 1.363 | 1.363 | 1.363 | 1.363 |
| Isoleucine dig. poultry (%) | 0.886 | 0.886 | 0.886 | 0.886 | 0.886 | 0.886 |
| Leucine dig. poultry (%) | 1.685 | 1.704 | 1.699 | 1.706 | 1.703 | 1.719 |
| Valine dig. poultry (%) | 1.022 | 1.022 | 1.022 | 1.022 | 1.022 | 1.022 |
| Threonine dig. poultry (%) | 0.886 | 0.886 | 0.886 | 0.886 | 0.886 | 0.886 |
| Tryptophan dig. poultry (%) | 0.243 | 0.241 | 0.241 | 0.241 | 0.241 | 0.239 |
| Arginine dig. poultry (%) | 1.441 | 1.432 | 1.434 | 1.431 | 1.432 | 1.424 |
| Phenylalanine dig. poultry (%) | 1.016 | 1.016 | 1.016 | 1.016 | 1.016 | 1.016 |
| Histidine dig. Poultry (%) | 0.564 | 0.565 | 0.565 | 0.565 | 0.565 | 0.565 |

¹Starter premix (4kg T⁻¹): vit. A – 2,500,000UI; vit. D – 625,000UI; vit. E – 6,250UI; vit. K3 – 500mg; vit. B1 – 625mg; vit B2 – 1,625mg; vit. B6 – 875mg; vit. B12 – 4,500mg; Pantothenic acid – 3,750mg; Niacin – 10.50g; Folic acid – 300mg; Biotin – 20mg; Choline – 63.53g; Manganese – 18.74g, Zinc – 17.50g; Organic zinc – 10g; Iron – 11.16g; Copper – 1,996.39mg; Iodine – 187.50mg; Selenium – 75mg; Organic selenium – 25mg; Narazin – 12.50g; Nicarbazin – 12.50g; Enramicin – 2,500mg.

²BHT.

³Sand.

RESULTS AND DISCUSSION

No significant effect ($P>0.05$) was observed on FI, GAIN and ADG; however, significant effect ($P<0.05$) was observed for FCR in pre-starter phase (Table 3). Poultry fed diets formulated with metabolizable energy values determined with chicks at 1-8 days old, showed better FCR, showing the importance of formulating diets with energy values

determination at pre-start phase, because chicks of 1-7 days of age showed less ability to metabolization, digestion and absorption of nutrients and hence energy.

In a trial conducted by LARA et al. (2008), who investigate different dietary energy levels on performance of male and female broiler chicks, founded that higher energy levels provides better FCR both males and females. In the present assay, diets were formulated to be isocaloric, with no differences

Table 2 - Chemical and centesimal composition of the foods given on the starter phase (8 to 22 days).

| Component | pre | start | gro1 | gro2 | final | tab |
|---|---------|---------|---------|---------|---------|---------|
| Corn (3955kcal CE kg ⁻¹) | 50.474 | 55.466 | 54.232 | 56.039 | 55.558 | 59.763 |
| Soybean meal (4.199kcal CE kg ⁻¹) | 33.930 | 33.250 | 33.420 | 33.170 | 33.240 | 32.670 |
| Soybean oil (9399kcal CE kg ⁻¹) | 8.950 | 4.652 | 5.714 | 4.160 | 4.572 | 1.851 |
| Dicalcium Fosfate | 1.879 | 1.864 | 1.867 | 1.862 | 1.863 | 0.949 |
| Limestone | 0.891 | 0.901 | 0.898 | 0.902 | 0.901 | 0.909 |
| Salt | 0.507 | 0.504 | 0.505 | 0.504 | 0.504 | 0.503 |
| DL-Methionine | 0.312 | 0.304 | 0.306 | 0.303 | 0.303 | 0.296 |
| L-Lysine HCl | 0.276 | 0.284 | 0.282 | 0.285 | 0.284 | 0.290 |
| L-Threonine | 0.129 | 0.127 | 0.127 | 0.127 | 0.127 | 0.125 |
| L-Valine | 0.052 | 0.048 | 0.049 | 0.048 | 0.048 | 0.044 |
| L-Isoleucine | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Mineral/vitamin premix ¹ | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 | 0.400 |
| Choline Chloride 60% | 0.060 | 0.060 | 0.060 | 0.060 | 0.060 | 0.060 |
| Antioxidant ² | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 | 0.020 |
| Inert ³ | 2.120 | 2.120 | 2.120 | 2.120 | 2.120 | 2.120 |
| TOTAL | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 | 100.000 |
| -----Chemical composition----- | | | | | | |
| Poultry metabol energy (kcal kg ⁻¹) | 3,050 | 3,050 | 3,050 | 3,050 | 3,050 | 3,050 |
| ADCn corn (%) | 70.600 | 74.800 | 76.000 | 78.600 | 79.400 | NA |
| ADCn soybean meal (%) | 46.200 | 54.000 | 49.800 | 48.000 | 47.800 | NA |
| ADCn soybean oil (%) | 85.400 | 94.800 | 91.800 | 92.200 | 98.600 | NA |
| Crude protein (%) | 20.446 | 20.521 | 20.523 | 20.529 | 20.523 | 20.586 |
| Calcium (%) | 0.899 | 0.899 | 0.899 | 0.899 | 0.899 | 0.899 |
| Phosphorous Available (%) | 0.449 | 0.449 | 0.449 | 0.449 | 0.449 | 0.449 |
| Sodium (%) | 0.218 | 0.218 | 0.218 | 0.218 | 0.218 | 0.218 |
| Potassium (%) | 0.762 | 0.764 | 0.763 | 0.764 | 0.764 | 0.765 |
| Methionine dig. poultry (%) | 0.677 | 0.673 | 0.674 | 0.673 | 0.674 | 0.671 |
| Met.+cist. dig. poultry (%) | 0.844 | 0.844 | 0.844 | 0.844 | 0.844 | 0.844 |
| Lysine dig. poultry (%) | 1.189 | 1.189 | 1.189 | 1.189 | 1.189 | 1.189 |
| Isoleucine dig. poultry (%) | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 |
| Leucine dig. poultry (%) | 1.543 | 1.567 | 1.561 | 1.570 | 1.568 | 1.588 |
| Valine dig. poultry (%) | 0.892 | 0.892 | 0.892 | 0.892 | 0.892 | 0.892 |
| Threonine dig. poultry (%) | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 | 0.773 |
| Tryptophan dig. poultry (%) | 0.212 | 0.211 | 0.211 | 0.211 | 0.211 | 0.210 |
| Arginine dig. poultry (%) | 1.267 | 1.264 | 1.265 | 1.264 | 1.264 | 1.262 |
| Phenylalanine dig. poultry (%) | 0.907 | 0.911 | 0.910 | 0.911 | 0.911 | 0.914 |
| Histidine dig. Poultry (%) | 0.507 | 0.511 | 0.510 | 0.512 | 0.512 | 0.515 |

¹Starter premix (4kg T⁻¹): vit. A – 2,500,000UI; vit. D – 625,000UI; vit. E – 6,250UI; vit. K3 – 500mg; vit. B1 – 625mg; vit B2 – 1,625mg; vit. B6 – 875mg; vit. B12 – 4,500mg; Pantothenic acid – 3,750mg; Niacin – 10.50g; Folic acid – 300mg; Biotin – 20mg; Choline – 63.53g; Manganese - 18.74g. Zinc – 17.50g; Organic zinc – 10g; Iron – 11.16 g; Copper – 1,996.39mg; Iodine – 187.50mg; Selenium – 75mg; Organic selenium – 25mg; Narazin – 12.50g; Nicarbazin – 12.50g; Enramicin – 2,500mg.

²BHT Sand.

in energy levels used among experimental diets. However, different apparent digestibility coefficients corrected for nitrogen balance of corn, soybean meal and soybean oil were used, according to age, in diet formulation leading to a high soybean oil inclusion on EVP pre diet, thus resulting in better FCR.

In order to evaluate the effect of different metabolizable energy and crude protein levels on

broilers performance at 0-8 weeks old, HANUSHI et al. (2012) conducted a assay in a 3x3 factorial arrangement (2,400; 2,600 and 2,800kcal kg⁻¹ x 16, 18 and 20% CP). There was a difference for energy levels on parameters weight gain, FI and FCR. Animals fed diets with 2,400kcal kg⁻¹ energy levels had significantly lower performance compared to animals fed with higher energy levels. The authors

Table 3 - Performance values determined with broiler chicken at pre starter phase (1 to 7 days).

| Characteristic | pre | start | gro1 | gro2 | final | tab | SEM ⁰ |
|--|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|------------------|
| BW ¹ (g bird ⁻¹) | 46.490 | 46.470 | 46.160 | 46.450 | 46.760 | 47.050 | 0,114 |
| FI ² (g bird ⁻¹) | 153.570 | 156.920 | 160.800 | 167.140 | 163.120 | 167.670 | 2,087 |
| FCR ³ (g g ⁻¹) | 0.858 ^a | 0.934 ^b | 0.921 ^b | 0.951 ^b | 0.940 ^b | 0.958 ^b | 0,013 |
| GAIN ⁴ (g bird ⁻¹) | 132.440 | 121.710 | 128.490 | 129.200 | 127.080 | 127.900 | 1,306 |
| ADG ⁵ (g bird ⁻¹ day ⁻¹) | 18.920 | 17.390 | 18.360 | 18.460 | 18.150 | 18.270 | 0,187 |

*Means followed by the same letters in the same row. Do not differ by SNK test at 5%.

⁰Standard error of the mean.

¹Body weight at the 1st day.

²Feed intake.

³Feed conversion ratio.

⁴Average weight gain.

⁵Daily weight gain.

concluded that providing a diet with 2,600kcal kg⁻¹ and 16% CP would be ideal for optimal growth of poultry at starter phase.

For starter phase (8-21 days) no significant effects for FI (Table 4). However, for FCR, GAIN and ADG, significant difference (P<0.05) was observed.

The GAIN and ADG were on average 21g and 1.5g d⁻¹ higher, respectively, for broilers fed with pre-starter, starter and growth phases. However, diets formulated with starter and growth 1 energy values did not differ statically from diets formulated with growth 2 and finishing phases.

The ADCn values determined in digestibility assay conducted by SCHNEIDERS et al. (2011) for each age, make the diets formulated to performance trial, since isocaloric for all ages included different energetic feedstuffs (corn and

oil). Different inclusions contributed to energy metabolism, where, diets which have greater soybean oil inclusion (mainly in pre-start phase), were better used, significantly improving (P>0.05) the performance because lipids metabolism for energy generation is much faster than the carbohydrates metabolism (corn starch) for the same purpose.

The founded results are correlated to those discussed by MENDES et al. (2004) during 1-21 days. VASCONCELOS & SANTOS (1997) and NASCIMENTO et al. (1998) also reported improvements in GAIN and FCR with increased dietary levels of energy; however, reported no differences for feed at this stage. However, MAIORKA et al. (1997) also evaluating different dietary energy levels for broilers reported no differences on performance variables within 7 to 21 days old.

Table 4 - Performance values determined with broiler chicken at starter phase (8 to 21 days).

| Characteristic | pre | Start | gro1 | gro2 | final | tab | SEM ⁰ |
|--|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|------------------|
| BW ¹ (g bird ⁻¹) | 171.300 | 171.230 | 171.330 | 171.360 | 171.330 | 171.720 | 0,064 |
| FI ² (g bird ⁻¹) | 1006.030 | 1043.880 | 1042.940 | 1054.820 | 1044.810 | 1043.850 | 6,308 |
| FCR ³ (g g ⁻¹) | 1.275 ^a | 1.343 ^b | 1.332 ^b | 1.386 ^b | 1.369 ^b | 1.392 ^b | 0,016 |
| GAIN ⁴ (g bird ⁻¹) | 789.470 ^a | 777.170 ^{ab} | 782.970 ^{ab} | 761.440 ^{bc} | 763.730 ^{bc} | 750.560 ^c | 5,487 |
| ADG ⁵ (g bird ⁻¹ day ⁻¹) | 56.390 ^a | 55.510 ^{ab} | 55.920 ^{ab} | 54.390 ^{bc} | 54.550 ^{bc} | 53.610 ^c | 0,392 |

*Means followed by the same letters in the same row. didnot differ by SNK test at 5%.

⁰Standard error of the mean.

¹Body weight at the 8th day.

²Feed intake.

³Feed conversion ratio.

⁴Average weight gain.

⁵Daily weight gain.

CONCLUSION

Diets formulated with energy values obtained on digestibility assays with different ages had significant effect on broiler performance at different ages. This demonstrated the great importance of considering the nutrients digestibility according to poultry's age.

BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

We authors of the article entitled "Performance of broiler chickens at pre starter and starter phases using diets with different metabolizable energy values of ingredients, at different ages" declared, for all due purposes, that the project that gave rise to the present data was submitted for evaluation of the Ethics Committee of the "Universidade Estadual do Oeste do Paraná (UNIOESTE)", but we are aware of the content of the Brazilian resolutions of the Conselho Nacional de Controle de Experimentação Animal (CONCEA) <<http://www.mct.gov.br/index.php/content/view/310553.html>> if it involves animals.

Thus, the authors assume full responsibility for the present data and are available for possible questions, if they would be required by the competent authorities.

ACKNOWLEDGEMENT

To Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) for financial support to perform this research.

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