Apparent metabolizable energy of residues of crabwood (Carapa guianensis) and passion fruit (Passiflora edulis) for broilers

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RESUMO

O objetivo deste estudo foi determinar a composição química, a energia metabolizável aparente e energia metabolizável aparente corrigida por balanço de nitrogênio da dos resíduos de andiroba e maracujá em rações para frangos de corte. Foram utilizados noventa frangos da linhagem Cobb 500 (machos e fêmeas) com 21 dias de idade distribuídos em três tratamentos com seis repetições de cinco aves cada. O delineamento experimental foi em blocos inteiramente casualizados. Os frangos foram alojados em gaiolas de metabolismo individuais recebendo iluminação artificial 24 hs por dia. Dos 14 aos 21 dias de idade, foram ofertadas em período pré-experimental, sendo após este período, realizados cinco dias de coleta total das excretas. A energia bruta e a proteína bruta das dietas experimentais e das excretas foram determinados para calcular a EMA e EMAn de cada resíduo. Os dados coletados do metabolismo energético foram submetidos a analise de variância e as médias comparadas pelo teste de Tukey a 5% de significância. Com base na MS, a EMA e EMAn do resíduo de andiroba e de maracujá determinados neste experimento foram 1.088,50 Kcal/Kg, 1.021,95 Kcal/Kg, 1.031,35 Kcal/Kg e 1.101,75 Kcal/Kg, respectivamente. A partir destes resultados, concluiu-se que os resíduos de andiroba e maracujá podem ser utilizados em rações para frangos de corte. Estes subprodutos apresentam composição química aceitável e potencial para a formulação de rações, porém, são necessários ainda estudos para avaliação do desempenho de frangos de corte alimentados com os supracitados subprodutos.

Palavras-chave: alimento alternativo, composição química, digestibilidade, matéria seca, subproduto

ABSTRACT

The objective of this study was determine the chemical composition, the Apparent Metabolizable Energy and the Apparent Metabolizable Energy corrected for nitrogen balance of Crabwood and Passion fruit residues in diets for broilers. Ninety broilers Cobb 500 (males and females) were used with 21 days of age assigned to 3 treatments with six replicate of cages with 5 birds each. The experimental method was completely randomized design in block arrangement. The broilers were housed in individual metabolic cages (150 x 45 x 45 cm) receiving artificial lighting for 24 hs. Experimental diets were served over a 7 days acclimation period from 14 to 21 days of age, followed by a 5 days of total excreta collection. Crude energy (CE) and CP of the experimental diets and excreta were determined to calculate AME and AMEn for each residue sample. The data collected for energetic metabolism were submitted to analysis of variance and the means compared by Tukey test to 5%. In a DM basis, AME and AMEn of Crabwood and Passion Fruit residues determined in this trial was 1,088.50 Kcal/Kg, 1,021.95 Kcal/Kg, 1,031.35 Kcal/Kg and 1,101.75 Kcal/Kg, respectively. Residues of passion fruit and crabwood can be used in diets for broilers. These have acceptable values of chemical composition and potential for formulating diets, but further studies be necessary to evaluate the performance of broilers fed with these by-products in the diet.

Keywords: Alternative food, by-product, chemical composition, digestibility, dry matter

INTRODUCTION

The poultry diets normally have been formulated based on corn and soybean meal, being which these represents nearly 70% of the production costs. However, frequent fluctuations in the market with regard to the supply and cost of ingredients have led the researchers and producers to search for alternative sources to replace traditional feedstuffs used in this diets.

Inserted in this context, the crabwood (*Carapa guianensis*) and passion fruit (*Passiflora edulis*) are fruits widely marketed in Brazilian Amazon region and other neighboring countries, producing a large amount of organic residues from processing result and with potential for a possible using in the diets for broilers. The crabwood is a canopy tree, reaching up to 30 m tall, and with peculiar fruits (Bernacci *et al.*, 2005), widely distributed throughout the Amazon Region, with the wood used for furniture, construction, and plywood blades, and seeds for oil extraction, for use as an insect repellent (Mendonça & Ferraz, 2007), but with no reports of the use of by-products in animal feed.

Already the passion fruit, from Tropical America, is a common and typically fruit planted in Brazil (Ferrari *et al*., 2004) and with worldwide distribution. The passion fruit seeds meal, produced as a result of juice process, can be used in poultry diets as a source of protein and energy. Togashi *et al*. (2008) showed the use of passion fruit by-products modified the cholesterol levels without affecting the majority of the performance characteristics of the broilers and the seeds and peel of passion fruit reduced the cholesterol contents in the breast and leg of this.

The use of alternative foods in broilers diets is conditional to the knowledge of their nutritional value, where the chemical analysis and energy values are the start point for determining the nutritional potential of foods. Considering the necessity of information regarding the chemical composition and energy values of alternative foods fed to broilers in several country, the objective of this study was determine the chemical composition, the Apparent Metabolizable Energy and the Apparent Metabolizable Energy corrected for nitrogen balance of Crabwood and Passion fruit residues in diets for broilers.

MATERIAL AND METHODS

The study was conducted at Laboratory of Studies and Research in Production and Nutrition of Poultry and Swine of Federal University of Amazonas - Campus Parintins, and chemical analysis at the Laboratory of Animal Nutrition of Federal University of Amazonas-Campus Parintins

and in the Laboratory of enterprise CBO Analysis - Campinas, São Paulo, Brazil).

Ninety broilers Cobb 500 (males and females) were used with 21 days of age assigned to 3 treatments with six replicate of cages with 5 birds each. The experimental method was completely randomized design in block arrangement. The broilers were housed in individual metabolic cages (150 x 45 x 45 cm) receiving artificial lighting for 24 hs.

The experimental diets (Table 1) consists in a basal diet with corn-soybean meal and two test diets with Crabwood and Passion fruit residues each. The alternative ingredients were obtained from a commercial source where replaced 30% of the basal diet. The diets were formulated according the recommendations of Rostagno *et al*. (2011).

The experimental period consisted in seven days of adaptation and five days of total excreta collection with birds were submitted to 3hs of fasting before the first and on the last day of excreta collection. The birds were weighed in housing, in the beginning of the collection period and in the end of the experimental period. And the feed provided for the birds were weighted at the beginning and at the end of the experimental period.

The AME (Apparent Metabolizable Energy) and AMEn (Apparent Metabolizable Energy corrected for nitrogen balance) was evaluated by the balance procedure in which food intake over a period, is related to the excreta output over the same period, total collection excreta, with the basal diet replaced by 30% of Crabwood residue and Passion fruit residue (Matterson *et al*, 1965; Sakomura & Rostagno, 2007). The excreta were collected twice daily and stored at -16 °C. On the last day of the experimental period, the excreta produced during the interval between the last meal and the end of the fasting period were equally considered to analyses.

Table 1. Ingredients and nutritional composition of referential diet.

Ingredients	Composition (kg)
Corn 7.88	60.05
Soybean meal 46%	32.92
Soybean oil	4.20
Dicalcium phosphate	1.41
Calcitic limestone	0.84
L-Lysine	0.22
Premix vit. min.[1]	0.25
Choline chloride	0.11
Total	100
Nutrients	Nutritional levels
Metabolizable energy (kcal/kg)	3,150
Crude protein (%)	19.80
Calcium (%)	0.758
Phosphorus available (%)	0.324
Lysine (%)	1.131
Methionine (%)	0.452

[1] Valores fornecidos por Cruz et al. (2006).

[2] Valores fornecidos por Rostagno et al. (2011).

[3] Foi determinada através do método de cálculo para energia metabolizável aparente conforme descrito por Rostagno et al. (2011), onde obteve-se o valor em $kcal/kg^{-1}$

Were analyzed in the experimental feeds and in the collected excreta: the dry matter (DM), crude protein (CP), ether extract (EE), neutral detergent fiber (NDF), acid

detergent fiber (ADF), mineral matter (MM) and Organic Matter (OM) according the techniques described by Silva and Queiroz (2002).

The data collected for energetic metabolism were submitted to analysis of variance and the means compared by 5% Tukey test using the GLM procedure of the computer program Statistic Analysis System (2008).

RESULTS AND DISCUSSION

The values of chemical composition of feedstuffs are shown in Table 2. Considering the composition of the residues, can assign a proteinaceous classification to passion fruit residue (above 20% CP) and energetic classification to residue of crabwood residue (good carbohydrate content and ether extract level). Already the AME and AMEn of Crabwood and Passion fruit are shown in Table 3. On a Dry Matter basis, the results for AME and AMEn of Crabwood and Passion Fruit residues, determined in this study, were 1,088.50 Kcal/Kg and 1,021.95 Kcal/Kg, and 1,021.95 Kcal/Kg and 1,101.75 Kcal/Kg, respectively.

The chemical composition for the residue of passion fruit for DM, NDF and ADF nutrients was similar to those determined for Rostagno *et al*. (2011), who obtained 90.69% of DM, 68.04% of NDF and 64.92% ADF, respectively.

Table 2. Centesimal composition in DM of passion fruit and crabwood residues.

Fractions	Composition*	
	Passion fruit residue	Crabwood residue
Dry matter, %	91.36	89.24
Humidity, %	8.64	10.76
Mineral matter, %	2.38	3.38
Organic matter, %	97.62	96.62
Crude Protein, %	21.08	11.31
Ethereal extract, %	10.01	15.62
Nitrogen free extract, %[1]	66.53	69.69
Neutral detergent fiber, %	67.70	42.96
Acid detergent fiber, %	63.69	33.90
Hemicellulose, %[1]	4.01	9.06

[1] Values measured by the equations proposed by Van Soest (1994).
* Analyses performed in the Laboratory of Animal Nutrition of Department of Animal Science of Federal University of Amazonas – Campus Parintins.

Evaluating separately the passion fruit residue (peel and seed) Togashi *et al*. (2008) determined values of CP to peel and seed 12.45% and 14.45%, respectively, similar than observed by Lousada Junior *et al*. (2006), Rostagno *et al*. (2011) and Ferrari *et al*. (2004) for peel and seed residue.

The value of EE determined in passion fruit residue was higher than those reported by Pereira *et al*. (2009) that determined 2.4% for peel of and 1.0% for peel and seed residues together.

The AME value obtained in this study for passion fruit residue, when compared with Rostagno *et al*. (2011), showed lower results. However, this value was determined for the fruit full (2,978.26 kcal/kg in DM), while the value obtained in this study was 1,956.91 kcal / kg in DM. Probably the high energy value of passion fruit residues (peel and seeds)

Table 3. Mean values of Apparent Metabolizable Energy (AME) and Apparent Metabolizable Energy corrected for nitrogen balance (AMEn) and Coefficient of Apparent Digestibility of Dry Matter (CADDM) of passion fruit and crabwood residues.

Fractions	Passion fruit residue	Crabwood residue
CADDM (%)	77,89^{b}	86,75^{a}
AME (Kcal/Kg in DM)*	1,021.95^{Ab}	1,088.50^{Aa}
SD[1]	8.54	6.45
AMEn (Kcal/Kg in DM)*	1,101.75^{Bb}	1,031,35^{Ba}
SD[1]	7.15	5.83

[1]SD – Standard Deviation.

* Means followed by uppercase letters differ in columns and lowercase in lines each other for values of AME and AMEn, by Tukey test (P<0.05).

observed in literature was because these it's rich in oil.

Already for the crabwood residue, the value of CP was similar or exceeding of conventional feedstuffs used in poultry diets (Rostagno *et al.,* 2011). The results for DM (89.24%), CP (11.31%) and MM (3.38%) are similar to determined by Silva *et al*. (2013) that to evaluate peels and kernels of crabwood, determined values for DM around 73% and 68%, for CP between 5% and 12% and for MM between 1% and 3%, respectively.

For the values of humidity, observed that crabwood residue have higher humidity than that passion fruit, because principally the passion fruit pulp have the biggest water concentration of the fruit, and the pulp don't be in the composition of the residue and by-products of this fruit. In contrast, the processing of crabwood remove only the oil, without water, being found traces of oil in residue of this fruit.

The crabwood residue, based on NDF and ADF, showed lower levels of fiber, important nutrient in maintaining the rate of passage of food in the gastrointestinal tract, but in higher concentrations can limit consumption and compromising animal performance according Connel (1981). Bett (1999) affirming yet that the consequent reduction in growth rate and feed conversion cause worsening of efficiency of broilers metabolism.

According Brumano *et al*. (2006), the young birds have less ability to digest and absorb fiber, due to not having fully developed digestive system. And Freitas *et al*. (2005) explain yet that the effect of age showed that the higher digestibility of dry matter obtained with adult birds is greater due the digestive capacity of these birds in relation to young birds.

The agroindustrial residues in particular suffer different actions that contribute to changes in your chemical composition, what according to Albino &

Silva (1996), Butolo (2002), and Generoso *et al*. (2008) is due the agroindustrial by-products be obtained in different conditions of processing, that interferes in the chemical composition of foods to using in diets for animals.

Pereira *et al*. (2009) claims that the values of the chemical composition of fruit residues are variable due to changes in the processes of industries, quality of fruits, the incorporation of residues and the greater or lesser inclusion of peels and/or seeds.

As well as the chemical composition the energy values of crabwood residue are scarce. But according to the obtained values the AME of residue crabwood is greater than or approaching of described for Rostagno *et al*. (2011) for as wheat bran (1,795 Kcal / Kg DM), corn gluten meal 21% CP (1,813 kcal / kg in DM) and soybean peels (858 Kcal / kg of DM). But it's far below to the conventional values found in ingredients generally used in poultry diets how corn, soybean meal, vegetable oils and others that have MEA between 2,500 and 8,000 kcal/kg in DM.

CONCLUSIONS

In conclusion, the residues of passion fruit and crabwood can be used in diets for broilers. These have acceptable values of chemical composition and potential for formulating diets, but further studies be necessary to evaluate the performance of broilers fed with these by-products in experimental diets.

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