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Nutritional value of cottonseed meal for swine in the finishing phase

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Abstract: The aim of this study was to determine the digestibility coefficients of the nutritional components of cottonseed meal for pigs in the finishing phase. Fourteen castrated male commercial pigs with average initial weight of 56.29 ± 2.49 kg were used. The animals were housed individually in cages for metabolic study (experimental unit) in a randomized complete block design (defined by initial weight) with two treatments and seven replications per treatment. The treatments consisted of a reference diet, formulated to meet the minimum nutritional requirements of pigs in the finishing phase, and a test diet, consisting of 75% of the reference diet and 25% of cottonseed meal. The total feces collection method was used. The values of chemical and digestible composition of cottonseed meal were 88.78; 93.82; 6.18; 21.11; 19.26; 4.29 and 44.09%; and 57.78; 48.62; 0.48; 2.82; 5.83; 2.58 and 28.86% for dry matter (DM), organic matter (OM), mineral matter (MM), neutral detergent fiber (NDF), acid detergent fiber (ADF), ether extract (EE) and protein (CP) respectively. The values are close to those found in the literature, exception for the protein that presented higher value, however the digestibility was relatively low. Cottonseed meal has high nutritional value, but with low digestible values.
Keywords: protein food, nutrition, pig farming

Introduction

Nutrition plays an important role within the swine production system, being essential in providing nutrients for the maximum expression of the productive potential.

Corn and soybean meal are the main energy and protein sources, respectively, of pig feed, being decisive in the final cost of production (MOREIRA et al., 2006). Due to the changing prices of these ingredients, there is a constant search by producers, companies and researchers for foods that can replace them efficiently (REZENDE, 2012). Some researches have been carried out (RESENDE et al., 2012; MELLO et al., 2012; PAIANO et al., 2014; NASCIMENTO et al., 2018) to evaluate the use of cottonseed meal as an alternative food to soybean meal.

Although it is a co-product, available on the market and at a lower cost, its use in pig feed is limited by the nutritional factors that this food may have, such as the presence of gossypol, high fiber content and low amount of essential amino acids, in addition to the great variation in the quality and quantity of the protein (PRAWIRODIGDO et al., 1997).

The nutritional quality of cottonseed meal may vary according to the processing (CARDOSO, 1998) and the variety of the plant (REZENDE et al., 2012), resulting in bran with low fiber and high protein content.

In view of the above, the aim of this study was to determine the digestibility coefficients of the components of the cottonseed meal for pigs in the finishing phase using the total feces collection method.

Methods

The experiment was carried out in the metabolic studies laboratory at the Federal University of Rondonópolis.

Fourteen male castrated pigs of commercial lineage were used, with an initial age of 102 days and average weight of 56.29 ± 2.49 kg. The animals were housed individually in cages for metabolic study (experimental unit), similar to those described by Pekas (1968), in a randomized complete block

experiment (defined by initial weight) with two treatments and seven repetitions per treatment.

At the beginning of the test, the animals were weighed and distributed between two diets, the reference diet (RD) being formulated to meet the requirements indicated by Rostagno et al. (2017), considering the energy concentration of 3348 kcal EM / kg of feed, for male pigs, with high genetic potential and the test diet, comprising 75% of the reference diet and 25% of cottonseed meal (Table 1).

Table 1. Centesimal and nutritional composition of the reference diet

Ingredients, %	**Reference diet**
Corn, chirera	80.74
Soybean meal (46% CP)	15.09
Dicalcium phosphate	0.80
Calcitic limestone	0.50
Soy oil	1.38
Sodium chloride	0.40
Vitamin premix (1)	0.30
Mineral premix (2)	0.10
L-Lysine HCL (80%)	0.35
DL-Methionine (99%)	0.10
L-Threonine (98%)	0.09
L-Tryptophan (99%)	0.05
Inert	0.10
Total	100.00
Calculated composition (3)	
Metabolizable Energy kcal / kg	3348
Moisture, %	11.57
Protein, %	13.34
Fiber, %	2.14
Calcium, %	0.52
Available phosphorus, %	0.24
Digestible lysine, %	0.80
Met. + Cys. digestible, %	0.49
Digestible threonine, %	0.52
Digestible tryptophan, %	0.17
Sodium, %	0.17

[1] Vitamin premix - amount per kg of feed: 2.68 mg of folic acid, 2.244 mg of pantothenic acid, 5 mg of biotin, 5.386 mg of niacin, 101 mg of selenium, 1.178.000 IU of vitamin A, 168 mg of Vitamin B1, 6.565 mcg of Vitamin B12, 897 mg of Vitamin B2, 168 mg of Vitamin B6, 303.000 IU of Vitamin D3, 1.346.63 IU of Vitamin E and 673 mg of Vitamin K3. [2] Mineral premix - quantity per kg of product: 168 mg of Cobalt, 15 g of Copper, 24.93 g of Iron, 1.416.80 mg of Iodine, 40 g of Manganese, 74.97 g of Zinc. 3 Nutritional values of ingredients according to ROSTAGNO et al., (2017).

The total feces collection method was used and the experiment lasted 11 days, six days of adaptation to the cages and determination of individual feed consumption and five days of feces collection.

During the adaptation period, a quantity of feed of known weight was provided and the leftovers were counted for the calculation of consumption based on the metabolic weight ($LW^{0.75}$). To avoid losses and facilitate ingestion, the rations were duly weighed and moistened in a 1: 1 ratio and provided twice a day (8:00 am and 5:00 pm).

From the consumption data in the adaptation period and based on the metabolic weight ($LW^{0.75}$), the amounts of feed provided to each animal during the collection period were calculated. At the beginning and at the end of the collection period, 1% ferric oxide was added to the diets as a fecal marker. Feces were collected and weighed once a day and subsequently frozen.

After the collection period, the feces of each animal were thawed, homogenized to obtain a composite sample from each animal. Then, the feces were subjected to pre-drying in an oven with forced air circulation at 55º C for 72 hours. Then, the feces were milled and sieved with a 1 mm sieve. The samples of feed and cottonseed followed the same procedures described for samples of feces.

The feces, feed and cottonseed samples were analyzed at the Bromatology Laboratory of the Federal University of Rondonópolis, regarding the levels of DM, OM, MM, EE, NDF, FAD and CP, according to AOAC (2000). From the determined values, the apparent digestibility coefficients of DM, OM, MM, EE, NDF, FAD and CP were calculated using the equations proposed by Matterson et al. (1965), as well as the respective digestible components of the control, test and cottonseed feed.

This study was submitted to the Ethics Committee on the Use of Animals (CEUA), under process No. 2310108.327837 / 2017-57, from the Federal University of Mato Grosso and approved on the principles of ethics

Results and discussion

Data of apparent digestibility coefficients of the reference and test diets for pigs in the finishing phase were described in Table 2.

The chemical composition of cottonseed meal (Table 3) showed values similar to those found by Yu et al. (1996), who worked with pigs in the growth phase, observed values of 87.8% for DM, 21% for NDF, 12.8% for FAD and 2.1% for EE.

Rezende et al. (2012), when evaluating cottonseed meal with or without the addition of enzymes in the diets for pigs in the growth phase, obtained values of chemical composition higher than those found in the present study for DM (93.39%), NDF (54.02 %), FAD (32.02%) and EE (9.01%), however, the CP (24.90%) was lower. Nascimento

et al. (2018), also worked with pigs in the growth phase and observed higher values in the chemical composition for DM (92.76%), NDF (47.30%), FAD (24.10%) and EE (5.82%), while MM (4.60%) and CP (25.60) were lower.

The CP value found in the present study was higher than those found in the literature, but digestibility was relatively low (65.46%). Tankisley Jr., (1992) and Ezequiel (2002) correlated this smaller amount of protein to the amount of shells it can contain in the by-product. Nascimento et al., (2018) mentioned that the type of soil cultivated, the processing or even the care during transport and storage, can influence the components of this ingredient.

Table 2. Digestibility coefficients of the reference and test diets

Components	Reference feed	Test feed
Dry matter	80.93	82.05
Organic matter	89.41	84.01
Mineral matter	90.51	31.59
Neutral detergent fiber	50.28	70.59
Fiber in acid detergent	88.71	65.11
Ethereal extract	81.31	61.31
Protein	58.52	79.78

Tabela 3. Chemical composition in dry matter (DM), apparent digestibility coefficients (ADC) and digestible components of cottonseed meal

Components	Total composition	ADC, %	Digestible composition
DM/ DMD, %	88.78	65.08	57.78
OM/OMD, %	93.82	51.82	48.62
MM/MMD, %	6.18	12.01	0.74
NDF/NDFD, %	22.90	22.31	5.11
FAD/FDAD, %	17.78	19.85	3.53
EE/EED, %	4.29	58.29	2.50
CP/CPD, %	44.09	65.46	28.86

In the present study, the cottonseed meal used went through two oil extraction processes, crushing and solvent removal (benzene), which may be contributing to the increase in the ingredient's protein, but not to the digestibility of this component, which was smaller. According to Hogberg and Lindberg (2004) the non-starch polysaccharides present in the ingredients make it difficult to digest the protein elements of the diet.

There is a lot of fluctuation in the chemical composition of cottonseed meal, which may be correlated to the high fiber content present in the ingredient. According to Knudsen et al. (1993), fiber can affect digestibility in different ways, depending on solubility. In addition, Li et al. (1996) reported that cottonseed meal is less digestible because it has varying amounts of non-starch polysaccharides.

Gomes et al. (2007) evaluated the effects of increased hay (8% inclusion of NDF in the diet) on the digestibility and performance of pigs in the finishing phase, observed a reduction in the DM digestibility coefficient (77.79%). In addition, the authors concluded that the replacement of a highly digestible carbohydrate source with another source of less digestibility, rich in non-starch polysaccharides, may result in a reduction in the DM digestibility coefficient.

The apparent digestibility of NDF, FAD and EE of cottonseed meal showed relatively low digestibility values 22,31; 19.85 and 58.29%, respectively. According to Dierick et al. (1989), NDF and FAD are components of low digestibility, as they are made up of insoluble hemicellulose, cellulose and lignin, which have low fermentability in the digestive tract of swine. Cottonseed meal has a low amount of EE in its composition (4.29%), which may have contributed to the low digestibility of this component.

According to Figueiredo et al. (2012), older animals have a more developed digestive system and may have a greater capacity to take advantage of dietary ingredients. Even though the animals are in the finishing phase, being able to make better use of the diet components, this behavior was not observed in the present study.

Conclusion

Cottonseed meal has a high nutritional value, but with relatively low digestible values. Thus, when using an industry co-product, it is necessary to know

its nutritional values to formulate a diet with better precision.

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