FIBER QUALITY TO GROWING RABBITS

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ABSTRACT

An experiment was carried out with the goal of studying the influence of fiber quality on performance and metabolic parameters of White New Zealand growing rabbits. The experiment was conducted in the the period September 24 to November 11, 2007. Twenty four animals with forty days of age were utilized and separated in three treatments: TAH, alfalfa (*Medicago sativa*) hay; TCP, citrus pulp and TLB, linseed (*Linum usitatissimun*) bran. The experimental design was completely randomized with three treatments and eight replications, where each animal was consider an experimental unit. The analyzed variables were: slaughter weight, weight gain, feed conversion, empty caecum weight, caecocolic pH and sanguine parameters, such as triglycerides, total proteins, hemoglobin, cholesterol and high density lipoproteins. The animals fed on TCP diet obtained similar results to those fed TAH about slaughter weight, weight gain, feed conversion and caecocolic pH, showing that the high quantity of soluble fiber in the citrus pulp did not affect the animal performance. This treatment also caused accentuated reduction in the circulating hemoglobin and cholesterol levels, which can probably be attributed to the pectin ability to bind and hold iron and bile salts, respectively. The performance results were lower for TLB diet than for the other diets, probably in function of the high hydration capacity of the soluble fiber found in linseed bran. The results showed that fiber quality requires more attention than its quantity about the effects over performance and metabolic responses.

Key words: Sanguine parameters, Caecocolic pH, Bile salts.

INTRODUCTION

Rabbit raise is an important source of primary income in small farms, once it can be conducted in reduced places, with a relatively short production cycle, in comparison to other commercial species. In this activity, 70% of the production cost is from the feeding, usually compost by corn (*Zea mays*), soybean (*Glycine max*) meal and alfalfa hay, which results in high cost of the end product, even meat or fur. This fact demonstrates the importance of increasing the scientific efforts to this issue, pointing out alternatives to the traditional ingredients use, aiming to reduce the competition of aliments among non ruminants species and, at the same time, avoid nutritional disturbs correlated to cereal excess, besides of obtaining the maximum conversion efficiency in commercial product.

A huge variety of by-products from the processing of plant sources, such as oils, crops and fruits, are available in market under the form of brans, pies and hulls. According to Embrapa (2002), Latin America produces more than 500 million tons of by-products per year, where Brazil is responsible to half of this production. A lot of these by-products contain in their composition, besides of dietetic fiber, high levels of protein and energy. Moreover, to rabbits, the dietetic fiber makes the maintenance and the equilibrium of the digestive flora through the digest transit speed, imposing limitations in the utilization of aliments or balanced feeds and influencing the digestion and absorption of other nutrients. Then, the addition of fiber sources in the diet of these animals is obligatory. Although, not only the amount of fiber source, but also the quality, showed from the fractioning of the plant cellular wall constituents must be consider in the feed balancing.

The goal of the experiment was study the influence of quality fiber over performance responses, together with metabolic and physiologic measures of White New Zealand growing rabbits.

MATERIALS AND METHODS

The experiment was conducted in the Rabbit Laboratory of Department of Animal Science, at the Federal University of Santa Maria, Brazil. The period of experiment was from September 24 to November 11, 2007.

Twenty four rabbits White New Zealand, males and females, were weaned at 35 days of age and housed in individually elevated cages from 70 cm of the ground, under open sky.

The experimental design was completely randomized with three treatments and eight replications, where each animal was consider an experimental unit.

The adaptation period was constituted by seven days and the experimental period forty nine days, where there was carried out the weighing of the animals and of the diets to calculate the gain weight, feed intake and feed conversion in the period.

The treatments were constituted by substitution of alfalfa hay to industry by-products, taking in consideration the dietetic fiber of each residue. The diets were formulated to be isofibrous to neutral fiber detergent, varying only the soluble fiber. The treatments were constituted by: TAH=alfalfa hay, as treatment control; TCP=citrus pulp and TLB=linseed bran. They were formulated in branded form and their composition is founded in Table 1.

Table 1: Ingredients and chemical composition of the diets

	Treatments		
	TAH	TCP	TLB
Ingredients(%):			
Alfalfa hay	15.00	---	---
Citrus pulp	---	18.02	---
Linseed bran	---	---	20.00
Corn	52.46	44.18	50.00
Soybean meal	23.79	28.11	15.33
Rice hull	5.00	6.52	8.50
Limestone	0.38	0.21	0.90
Salt	0.50	0.50	0.50
M+V Premix	0.50	0.50	0.50
Dicalcium phosphate	0.77	0.66	0.70
Soybean oil	1.60	1.30	3.57
Chemical composition (%DM):			
Digestible energy (kcal/kg)	3507	3500	3500
Crude protein	18.00	18.00	18.00
Fat	3.91	3.84	7.16
Total fiber	28.37	29.07	29.27
Neutral detergent fiber	22.88	20.00	20.49
Soluble fiber	3.99	9.07	8.78
Ca	0.70	0.70	0.73
P	0.45	0.45	0.50

At the end of the experiment, blood was taken from the heart of the animals and, in sequence, they were slaughtered by dazed technique, followed by bleeding, removing of paws, skin, tail, head and viscera. The evaluated parameters were: slaughter weight (SW), weight gain (WG), feed conversion (FC), empty caecum weight (ECW), caecocolic pH (CpH), triglyceride (TRI), total proteins (TPRO), hemoglobin (HEM), cholesterol (CHOL) and high density lipoproteins (HDL).

The results were submitted to analyses of variance and the treatments average compared by Duncan test 5% of significance.

RESULTS AND DISCUSSION

The animals fed with the treatments TAH and TCP obtained higher feed intake and weight gain (Table 2) than the treatment TLB. The lower intake of the treatment TLB probably can be attributed to the high hydration capacity of the linseed bran (7.4 g of absorbed water by each gram of sample against 4.8 g/g of citrus pulp), causing higher permanence of the digest in the gastrointestinal tract, however, with negative effects on digestibility. Accordingly to De Blas and Wiseman (1998), the hydration ability of the fiber increases the digest viscosity and decreases the nutrients digestibility, by making difficult the enzymes action and the diffusion of substances connected to the digestive process. This fact is reported to swine and poultry, where the researches indicate that the use of linseed or its by-products, negatively affect the utilization of the diet nutrients, weight gain and feed conversion, especially when the levels of inclusion of this ingredient are increased (Ortiz *et al*., 2001; Santos *et al*., 2005), which is attributed to the presence of high hydration indigestible mucilage, expressively increasing the digest viscosity. So, the quantity and quality of dietetic fiber are nutritionally important to rabbits, not just by energy supply by fermentative activity of the caecum, but mainly because of their effects on viscosity and regulation of digest transit, indispensable to nutrients digestibility and normality of digestive physiology in this specie (Gidenne, 1992).

Table 2: Performance measures of growing rabbits: slaughter weight (SW), weight gain (WG) and feed conversion (FC)

	Treatment		
Variable	TAH	TCP	TLB
SW (g)	$2085^{ab} \pm 159.14$	$2186^{a} \pm 87.80$	$1922^{b} \pm 209.64$
WG (g)	$1141^{a} \pm 105.71$	$1247^{a} \pm 99.14$	$882.2^{b} \pm 142.15$
FC	$3.24^{a} \pm 0.14$	$3.57^{b} \pm 0.24$	$3.91^{c} \pm 0.28$

[a] Different letters in the same line differ by Duncan test (P<0.05)

Although correlated with the cell wall chemical nature of the fiber aliments, differences were not observed to empty caecum weight among the treatments (Table 3). Gidenne (1996) comments that keeping constant the dietetic fiber level, the higher caecum development observed with more digestible fiber sources by the intestinal microflora is due to more intensive chemical stimulus, like the increase in the concentration of volatile fatty acids (VFA) from microbial action. About the caecocolic pH (Table 3), the treatment TLB showed lower values, which can be attributed to the effects mentioned before.

Table 3: Empty caecum weight (ECW) and caecocolic pH (CpH)

	Treatment		
Variable	TAH	TCP	TLB
ECW (g/100 g live weight)	$2.09^{ns} \pm 0.05$	$2.04^{ns} \pm 0.04$	$2.11^{ns} \pm 0.16$
CpH	$6.90^{a} \pm 0.16$	$7.05^{a} \pm 0.22$	$6.52^{b} \pm 0.19$

[a] Different letters in the same line differ by Duncan test (P<0.05)

The animals submitted to the treatment TCP showed circulating levels of triglycerides and cholesterol expressively lower than the other treatments, due to the large quantity of pectin in this by-product. The pectin is a galacturonic polymer found in the interior of white peel of different fruits, especially in citric ones. Several studies had demonstrated the hypocholesterolemic effect of pectin over the reduction of seric and hepatic levels of total cholesterol, because it increases the quantity of bile salts and total fat excreted in the feces (Mourão *et al*., 2005). Decreasing the enterohepatic circulation of bile salts in the digestive tract, the organism mobilizes cholesterol to produce new bile salts, essential to the fat metabolism (formation of micelles), consequently decreasing the rate of seric cholesterol from the organism (Jimenez-Vergara *et a*l., 1999).

The hemoglobin quantity was affected by the high bind ability of the pectin, present in the citrus pulp (945 mg Cu^{++}), which decrease the availability of many minerals, inclusively iron. The iron, making part of the molecule, is essential to the hemoglobin production that, among other functions, is responsible for the oxygen transport to the cells. This is verified in Table 4, where the treatment TCP

showed lower hemoglobin levels, in comparison to the treatments TAH and TLB. To this last one, the bind capacity is 497 mg Cu^{++}, practically half of the pulp value.

Another explanation to the cholesterol reduction caused by the consumption of the feed TCP is based on the fact that the fermentation of the soluble fiber in the caecocolic region produces fatty acids of short chain (acetate, butyrate and propionate), which can decrease the hepatic synthesis of cholesterol, through the inhibition of the HMGCoa reductase, enzyme involved in the cholesterol biosyntheses (Glore *et al*., 1994). The HDL has as mainly function remove the excess of cholesterol from the extra hepatic tissues conducting it to the liver to posterior excretion, decreasing the risk of some diseases, such as arterioscleroses, for example. The treatment TCP was the one which showed higher HDL level, verified in Table 4.

Table 4: Blood parameters: triglycerides (TRI), total proteins (TPRO), hemoglobin (HEM), cholesterol (CHOL) and high density lipoproteins (HDL)

	Treatment		
Variable	TAH	TCP	TLB
TRI (mg/dL)	$56.58^{a} \pm 6.55$	$37.94^{b} \pm 4.33$	$52.86^{a} \pm 5.33$
TPRO (g/dL)	$5.70^{ns} \pm 0.38$	$5.72^{ns} \pm 0.39$	$6.06^{ns} \pm 0.22$
HEM (g/dL)	$8.99^{b} \pm 0.20$	$4.99^{c} \pm 0.55$	$11.56^{a} \pm 0.40$
CHOL (mg/dL)	$113.21^{a} \pm 12.30$	$66.23^{b} \pm 0.93$	$134.10^{a} \pm 16.96$
HDL (mg/dL)	$38.52^{b} \pm 3.31$	$51.02^{a} \pm 4.33$	$25.15^{c} \pm 1.78$

[a] Different letters in the same line differ by Duncan test ($P<0.05$).

CONCLUSIONS

The fiber quality had a large influence on performance and metabolic parameters of rabbits, and must be taken into account when diets for these animals are formulated.

Despite of citrus pulp contain high quantity of pectin, this did not affect the evaluated parameters when compared to the control diet. Although the linseed bran, due to of its high hydration ability, is not recommendable to rabbits feeding in the inclusion level of 20% in the diet.

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