Relato de caso

Effect of banana peel in replacement to maize in rabbits' fur

Efeito da casca de banana em substituição ao milho no pelo de coelhos

Efecto de la cáscara de banana en sustitución del maíz en pelo de conejos

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ABSTRACT

Rabbits' fur is considered a natural fiber, which is used in textile garment industries. Along with the fur, skin is considered one of the main byproducts from rabbits breeding, and it can be extremely important in the income generation of familiarly farmers. This study aimed to evaluate the effect of the inclusion of banana peels (BP) in replacement to maize on the characteristics of rabbits' fur. A total of 45 rabbits, New Zealand White, from both sexes, weaned at 35 days old, was used and distributed into five treatments, with nine replicates each, in a completely randomized arrangement. The animals were fed one of the following diets: 0BP – control diet without BP or 25BP, 50BP, 75BP and 100BP – experimental diets, with respectively 25%, 50%, 75% and 100% BP in replacement to maize. The biological assay was carried out for 49 days, during which ration and water were provided ad libitum. At the end, 3 rabbits were randomly selected per group, in which a small sample of hair (nape, loin and thigh) was collected to measure the length and skin color analysis was performed, parameters L*, a* and b*. Collected data was tabulated and analyzed, at level of 5% significance, followed by analysis of correlation and regression curves. The results of rabbits' fur length and coloring showed that there were no differences among treatments. Thus, it is concluded that there is the possibility of using alternative ingredients, such as BP, to generate skins with quality similar to those produced with conventional ingredients, without negatively affecting skin characteristics.

Keywords: colorimeter, co-products, cuniculture, fur length

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RESUMO

O pelo do coelho é considerado uma fibra natural, utilizada em indústrias têxteis para confecções diversas. Juntamente com a pele são os principais subprodutos da cunicultura de corte, sendo de extrema importância na geração de renda de produtores familiares. Este trabalho objetivou avaliar o efeito da inclusão de casca de banana (CB) em substituição ao milho sobre as características do pelo de coelhos. Utilizou-se 45 coelhos da raça Nova Zelândia Branco, ambos os sexos, desmamados aos 35 dias, distribuídos em cinco tratamentos com nove repetições cada, em arranjo inteiramente casualizado. Os animais receberam uma das seguintes dietas: 0CB – dieta controle sem CB ou 25CB, 50CB, 75CB e 100CB – dietas experimentais com respectivamente 25%, 50%, 75% e 100% de CB como substituta ao milho. O ensaio biológico teve duração de 49 dias, onde ração e água foram fornecidas à vontade. No final do ensaio, foram selecionados aleatoriamente 3 coelhos por tratamento, para coletar uma pequena amostra de pelo (nuca, lombo e coxa) para medir o comprimento e realizar a análise de coloração, parâmetros L*, a* e b*. Os dados foram tabulados e analisados, a nível de 5 % de significância, seguido pelas análises de correlação e de regressão de curva. Os resultados de comprimento e coloração de pelo obtidos mostraram que não houve diferenças entre os tratamentos. Desta forma, conclui-se que há possibilidade do uso de ingredientes alternativos como a CB, na geração de peles, com qualidade igualmente das geradas com ingredientes convencionais, sem alterar negativamente as características da pele.

Palavras-chave: colorímetro, comprimento do pelo, coprodutos, cunicultura

RESUMEN

El pelo del conejo es considerado una fibra natural, utilizada en industrias textiles para confecciones diversas. Junto con la piel son los principales subproductos de la cunicultura de corte, siendo de extrema importancia en la generación de renta de productores familiares. Este trabajo objetivó evaluar el efecto de la inclusión de cáscara de banana (CB) en sustitución del maíz, sobre las características del pelo de conejos. Se utilizó 45 conejos, Nueva Zelanda Blanco, ambos sexos, destetados a los 35 días, distribuidos en cinco tratamientos con nueve repeticiones cada una, en un arreglo completamente casualizado. Los animales recibieron una de las siguientes dietas: 0CB - dieta control sin CB o 25CB, 50CB, 75CB y 100CB - dietas experimentales con respectivamente 25%, 50%, 75%, y 100% de CB como sustituto al maíz. El ensayo biológico tuvo una duración de 49 días, donde la ración y el agua se suministran a voluntad. Al final del ensayo, se seleccionaron aleatoriamente 3 conejos por grupo, para recoger una pequeña muestra de pelo (nuca, lomo y muslo) para medir la longitud y realizar el análisis de coloración, parámetros L *, a * y b *. Los datos fueron tabulados y analizados, a nivel de 5% de significancia, seguido por los análisis de correlación y de regresión de curva. Los resultados de longitud y coloración de los obtenidos mostraron que no hubo diferencias entre los tratamientos. Por lo tanto, se concluye que existe la posibilidad de utilizar ingredientes alternativos como CB, en la generación de pieles, con la misma calidad que los generados con ingredientes convencionales, sin alterar negativamente las características de la piel.

Palabras-clave: colorímetro, coproductos, cunicultura, longitud del pelo

Introduction

The use of alternative ingredients in animal nutrition has been of great interest to researchers around the world, especially in developing countries where conventional foods are more expensive (Akande, 2015). In this context, studies aiming to increase the efficiency and the use of agro-industrial residues are of great importance, in order to reduce the cost of animal nutrition.

Most of the ingredients used in diets in Brazilian cuniculture occupy agricultural areas that could be used for grain production, such as corn, for human consumption (Klinger et al., 2015). In turn, maize is the main source of energy and a reference in Brazil, used in the feeding of non-ruminant animals, which justifies the search for alternative raw materials to it.

Bananas are among the most produced and consumed fruits, turning this into one of the most important crops in the world (FAO, 2018). Consequently, banana peels (BP), which are usually discarded, have favorable characteristics, since they present promising nutritional value in animal feed and low acquisition cost (Omer, 2009). Anhwange (2008), Romelle et al. (2016) and Jung et al. (2019) state that BP may be a cheap and high-quality source of carbohydrate, presenting a wide range of vitamins and minerals and containing antioxidants and carotenoids.

Previous study conducted by Falcone et al. (2020) have reported that BP can be used as an energy source, replacing maize up to 100% while maintaining similar animal performance. Due to that, giving a correct destination is a way to reduce environmental impacts as well as a way to increase the sustainability of productive systems.

Rabbit skin is considered a byproduct in cuniculture (Machado, 2012), and it often does not gain prominence. However, data has shown that it can be an alternative in the income generation in family farming (Sordi et al., 2016). In this sense, studies on this subject are necessary, even though research on the effect of nutrition on fur quality is still scarce. In this context, the objective of this study was to measure the effects of BP on length and skin color of rabbits fed different levels of BP as a replacement to maize in diets for growing rabbits.

Materials and methods

Animals and location

To develop this study, a total of 45 rabbits, New Zealand White (NZW), from both sexes (22 males and 23 female), was used, and they were weaned at 35 days old.

The animals were allocated randomly, in five groups (9 rabbits per group), in a completely randomized arrangement. The animals were housed in a shed for rabbits, in individual galvanized wire cages – with a dimension of 50x50x50cm – with ceramic feeders and drinkers. Each animal was considered an experimental unit.

The biological essay was conducted in the Cuniculture Laboratory at the Federal University of Santa Maria, located at 29 ° 41 ' S latitude and 53 ° 48' W longitude.

Experimental diets and feeding management

Five experimental diets were formulated. Control diet: 0BP – without banana peels; and experimental diets: 25BP, 50BP, 75BP and 100BP – with respectively 25%, 50%, 75% and 100% of banana peels in replacement to maize. The diets were formulated containing similar nutritional levels (Table 1), in order to match the needs of the corresponding category, according to the AEC (1987). BP were obtained free of charge in Santa Maria, and its bromatological composition was analyzed by AOAC (1995).

Table 1 – Ingredients and chemical composition of ration with banana peels in replacement to maize for rabbits.

	Experimental diets				
Ingredients (%)	0BP	25BP	50BP	75BP	100BP
Maize	18.00	13.50	9.50	4.50	-
Banana peels*	-	4.50	9.50	13.50	18.00
Wheat meal	25.00	25.00	25.00	25.00	25.00
Soy-bean meal	16.75	16.75	16.75	16.75	16.75
Soy-bean oil	2.50	2.50	2.50	2.50	2.50
Rice hull	6.00	6.00	6.00	6.00	6.00
Alfalfa hay	30.00	30.00	30.00	30.00	30.00
Dicalcium phosphate	0.80	0.80	0.80	0.80	0.80
Calcitic limestone	0.25	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50	0.50
Premix	0.20	0.20	0.20	0.20	0.20
Total	100	100	100	100	100

Chemical composition of feed mixtures (%)					
Dry matter	85.92	86.43	86.85	87,04	87,12
Crude ash	7.72	8.60	8.95	9.45	9.96
Crude protein	18.54	18.47	18.40	18.33	18.27
Crude fiber	14.58	15.02	15.47	15.91	16.36
Crude fat	2.81	2.92	3.02	3.13	3.23

Note: 0BP: Diet without banana peels; 25BP, 50BP, 75BP, 100BP: Diets with 25%, 50%, 75%, 100% of replacement of maize for banana peels, respectively. Premix Composition (per diet kilogram): Vitamin A 600,000 IU; Vitamin D 100,000 IU; Vitamin E 8,000; Vitamin K3 200 mg; Vitamin B1 400 mg; Vitamin B2 600 mg; Vitamin B6 200,00 mg; Vitamin B12 2,000 mg; Panthotenic acid 2,000 mg; Choline 70,000 mg; Fe 8,000 mg; Cu 1,200 mg; Co 200 mg; Mn 8,600 mg; Zn 12,000 mg; I 65 mg; Se 16 mg.
*Banana peel containing 6.7% crude protein, 6.44% crude fat and 12% crude fiber.

Rabbits received, *ad libitum*, water and non-peletized ration. Each rabbit received randomly one of the 5 diets, during 49 days (until 84 days old). When the animals were 84 days old, average age of slaughter, the collect of fur for analysis was performed.

Fur collection

At the end of the biological essay, three rabbits per treatments, were randomly selected, and a little portion of fur was removed from nape, loin and thigh. This portion of fur was removed through section with a blade, in order to obtain a length from the skin bottom. Length fur measurement was executed with a digital pachymeter. According to Maia et al. (2003), the fur length is defined as the distance between point of insertion in the epidermis and the extreme superior tip.

For color analysis in the fur, six measurements randomly were taken at different points of the sample, in which the parameters of L*, a* and b* were recorded. For this, the MINOLTA SpectraMagicTMNX, Color reader CM-S100w colorimeter was used. It was calibrated using the white standard. It was operated in the CIELAB system, which uses three coordinates: the space L* indicates the luminosity, varying from white (+ L *) to black (-L *); chromatic coordinates a* and b*, in which a* goes from green (- a *) to red (+ a *), and b * varies from blue (-b *) to yellow (+ b *), according to CIE (1976).

Statistical analysis

The fur length and colorimetric data were tabulated through the Microsoft® Office Excel® 2013 program. Then, these parameters were analyzed by the statistical software R, version 3.5.0, at a level of 5%

significance, followed by analysis of correlation and regression curves.

Results and discussion

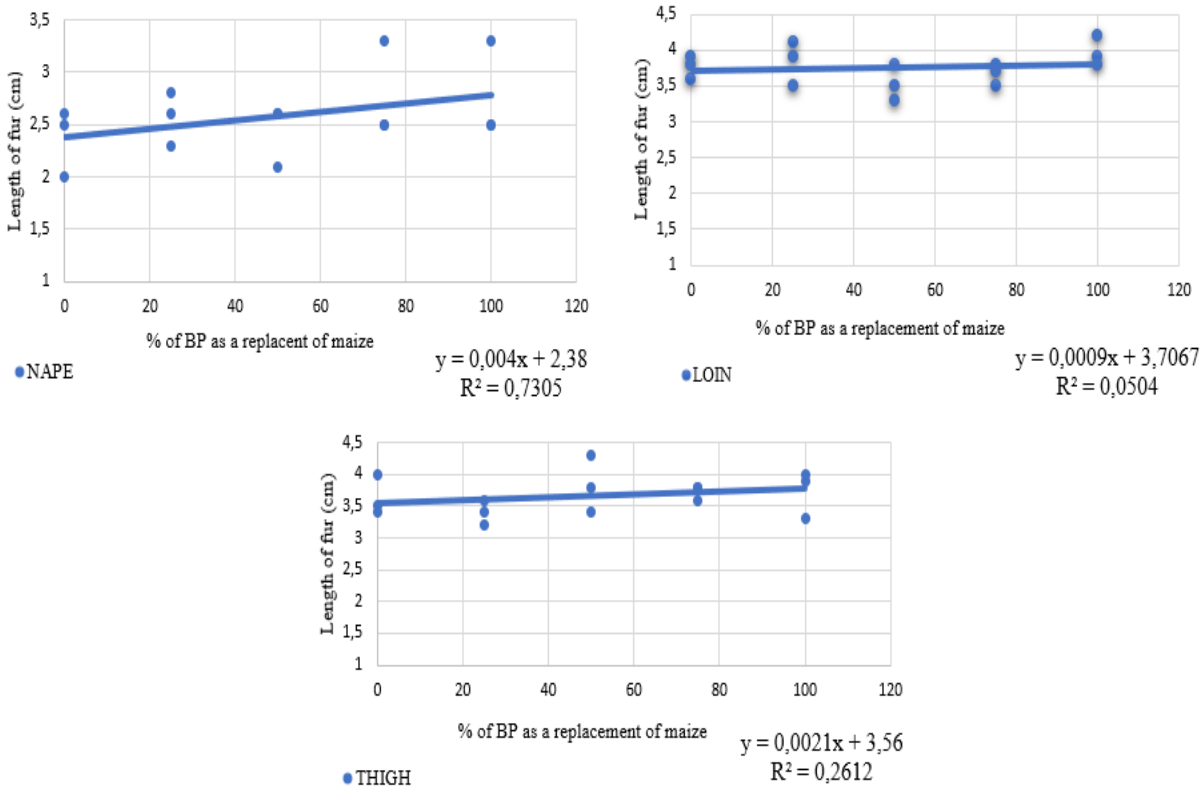
It was observed that fur length of the rabbits was not affected by the experimental diets (Table 2). Data related to the correlation test showed the value ρ was positive. (Figure 1). In this sense, for each 1% BP in substitution to maize, the hair length increased by 0.004cm in nape, 0.0009cm in loin and 0,0021cm in thigh. This replacement was proved to be feasible, since an alternative was sought in order to reduce the cost in production (from the substitution of ingredients), and because it also allowed satisfactory zootechnical responses. In a study by Klinger et al. (2018), sweet potato was used to replace fiber in rabbit diets, in order to evaluate the effect of this alternative ingredient on the fur. According to the authors, no changes were observed in the fur quality, proving the total replacement of alfalfa hay by sweet potato vines is possible.

Table 2 – Fur length of rabbits fed different levels of banana peels in replacement to maize.

	Experimental diets					
	0BP	25BP	50BP	75BP	100BP	P value
Nape (cm)	2.36±13.5	2.56±9.8	2.43±11.8	2.76±16.6	2.76±16.6	0.57
Loin (cm)	3.76±4	3.83±7.9	3.53±7.1	3.66±4.1	3.96±5.2	0.23
Thigh (cm)	3.63±8.8	3.4±5.8	3.83±11.7	3.73±3	3.73±10.1	0.54

Note: 0BP: Diet without banana peels; 25BP, 50BP, 75BP, 100BP: Diets with 25%, 50%, 75%, 100% of replacement of maize for banana peels, respectively. Means followed by coefficient of variation.

Figure 1 – Rabbit's fur length (x) due to banana peels levels as a replacement to maize (y) in the diets.



Falcone et al. (2020) in a biological assay with growing rabbits studied increasing levels of BP as a replacement for maize and concluded that up to 100% BP can successfully replace maize in diets for growing rabbits. The study did not indicate differences in animal performance (weight gain, feed intake and feed conversion) and the finding was that residues as banana peel, which generates environmental liabilities and takes massive density of nutrients, can be used in diets for rabbits. In this context, these results support this study since BP presents applicability potential on rabbits' diets.

The skin of the rabbits is lined by hair follicles, which produce fur or wool; it consists of a protein compound, called keratin. Zhao et al. (2017) report that studies are conducted in order to identify the molecular mechanisms of skin development. These authors, in recent studies, have verified that the genetic factors have great part in the development of the skin. In contrast, non-genetic factors, such as nutrition, are important to be considered as influence on skin/hair quality.

These results are also attributed to the similar level of crude protein (18%) presents in all five treatments. Ke-liang et al. (2004) tested different levels of crude protein (CP) in rabbit diets, found positive results at levels of 18% CP for good fur growth. Development process of fur is directly related to availability of amino acids are the most important nutrients to fur growth process.

The mean values found in the analysis of color components (L*, a*, b*) showed that the different diets did not alter the quality of skin color (Table 3). The values of luminosity (L*) observed were all + L *, that is, close to 100, which means characteristic light colors, close to pure white. These data are desired, since there were no changes in coloration, and the skin can be used as an alternative in the income generation (Bonamigo et al. 2017).

Table 3 – Fur coloring of rabbits submitted to different levels of banana peels in replacement to maize.

	Experimental diets					
	0BP	25BP	50BP	75BP	100BP	P value
L*	93.91±0.2	92.51±1.4	93.91±0.3	93.43±1	93.14±0.6	0.27
a*	1.33±0.7	1.42±23.2	1.51±9	1.41±12.7	1.88±11.2	0.06
b*	6.27±1.1	6.38±16.7	6.41±2	6.33±6.4	6.5±5.7	0.98

Note: 0BP: Diet without banana peels; 25BP, 50BP, 75BP, 100BP: Diets with 25%, 50%, 75%, 100% of replacement of maize for banana peels, respectively. Means followed by coefficient of variation.

Thus, these results demonstrate the possibility of using alternative ingredients, of low or no cost, in the production of rabbit hides, with the purpose to maintain the desired quality standard. In this context, the use of co-products has been a promising tool in raising rabbits (Oseni and Lukefhar, 2014). These results also correspond to the real need for sustainable programs, which aim to minimize environmental impacts and, at the same time, to help family farming (Potrich et al., 2017), proving to be a model with potential in the productive chain.

Conclusion

It was concluded, after this study, that banana peels can replace up to 100% of maize in diets for rabbits, without

negatively affecting any characteristic on the fur.

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