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Substituting Rabbit All-Purpose Foodstuff by Brewing Bran Meal (*Hordeum distichum*) to Reach Optimal Female Weigt at First Breeding

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ABSTRACT

Forty-eight Cuban Brown genotype female rabbits with an initial liveweight of 567,0 ± 12 g were sampled to determine their growth rate at rabbit raising facilities from this species breeding center in Santiago de Cuba. A completely randomized design with four treatments and six replicas each was used to evaluate the effect of partially substituting rabbit all-purpose foodstuff by brewing bran meal (*Hordeum distichum*) at 0 %, 7 %, 14 %, and 21 % inclusion levels. This diet was also supplemented with *Phil nodiflora* L. forage, mineral salts, and water *ad libitum*. Treatments did not affect dry matter consumption. Food conversion rate increased due to the greater inclusion level percentage (P < 0,05); in turn, final liveweight decreased because of commercial foodstuff substitution.

Key Words: *female rabbits, substitution, foodstuff, brewing brand meal*

INTRODUCTION

All rabbit meat producing breeds demand a wide range of qualities; high reproductive capacity, optimum feed conversion, precociousness, vigor, good health, market acceptance, and others. Rabbits are very productive, very proliferous, which can reach 2 kg of live weight in 6-8 weeks after weaning. Along with the nutritional value of their meat, rabbit raising is a popular productive activity (Rodríguez, 2006 and Fabio, 2007). Rabbits can be fed with forage and by-products from industry, along with commercial feeds as supplements (Dairo *et al*., 2012 and García *et al.*, 2012).

The grain from barley (*Hordeum distichum*) is used to make malted beverages and for cooking. It is internationally used to feed swine and equines. Barley bran meal is a local alternative in the east part of Cuba (Santiago de Cuba, Holguín and Camagüey) due to the large volumes produced every year. The national production of rabbit meat demands stable and sustained production of replacement females at optimum ages and weights, which are the result of wise nutritional strategies that favor good use of high growth rate of the species, up to 90 days old (Rodríguez *et al*., 2002); likewise, important reductions of grain imports are accomplished. The purpose of this paper is to substitute commercial rabbit feed with barley bran meal.

MATERIALS AND METODS

This work was carried out in rabbit breeding facilities in the province of Santiago de Cuba. The mean climatic conditions were characterized by a temperature of 27.6 ºC; relative humidity of 67.3 %; and rainfall of 80.6 mm, according to observations in the experimental area. Forty-eight Pardo Cubano female rabbits were used in the 70-day study, aged 33 ± 2 days. The animals were adapted to the nutritional changes for two weeks and started the experimental phase weighing 567.0 ± 12 g. Four treatments were set up, using two animals per cage. Stuve Mod.EMY0 precision balance 0.11 ± g was used for weekly individual weighing.

Treatments

- T_1: Control: 80 % commercial feed (PC) + 20 % wheat bran meal + Turkey Tangle Frogfruit forage (*Phyla nodiflora* L*)*.
- T_2: 73 % commercial feed (PC) + 7 % barley bran meal (*Hordeum distichum*) + 20 % wheat bran + Turkey Tangle Frogfruit forage (*Phyla nodiflora* L*)*.
- T_3: 66 % commercial feed (PC) + 14 % barley bran meal (*Hordeum distichum*) + 20 % wheat bran + Turkey Tangle Frogfruit forage (*Phyla nodiflora* L*)*.
- T_4: 59 % commercial feed (PC) + 21 % barley bran meal (*Hordeum distichum*) +

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20 % wheat bran + Turkey Tangle Frogfruit forage (*Phyla nodiflora* L*).*

The nutrient balance according to treatment contribution and chemical composition of feeds and mixtures used, are shown in tables 1 and 2 (NRC, 1990).

The daily ration was supplied at 9 % live weight, as daily consumption of Dry matter, weekly adjusted (Martens and Villamide, 1998). Feed was supplied twice a day: at 7:00 a.m. and 5:00 p.m. Water was administered *ad libitum*. Several parasite control measures were established during the experimental phase. Barley drying and preparation was performed according to the *Manual for formulation and manufacturing of Cuban traditional feeds* (Rodríguez *et al.,* 1988). The cost data from rabbits, feeds, medication and salaries were collected from the economics department at the Livestock Enterprise in Santiago de Cuba.

The Statistics for Windows software, version 6.2 was used in the analysis. Simple variance analysis was performed. Mean comparison analysis was applied by Tukey multiple test.

RESULTS AND DISCUSSION

The productive alternatives that permit partial substitution of commercial feeds with non-conventional raw materials and contribute to satisfy the nutritional requirements of rabbits without disrupting the animals' normal behavior, are a choice for the economy and profitability of productive systems. López *et al.* (2012) refer to the achievement of good results using glycine and other non-legume plants in the rabbit diet for reproduction and fattening (*Morus alba* Linn; *Tithonia diversifolia* (Hemsl.) Gray and *Boehmeria nivea* (L. Gaud).

With the exception of Turkey Tangle Frogfruit forage (*Phila nodiflora* L*),* the content of dry matter in feeds and mixtures is over 90%. Similar results have been reported by Betancourt (2007). The values achieved for gross protein (PB) are higher than the values reported by Leyva *et al*. (2009), Funes (1996) and Funes and Pérez (1976), who referred to gross protein values of 16-18 and 11.3 %. DNF of barley bran was 81.76 %, which gives nutritional advantages to the species.

Dry matter consumption per treatment (Table 3) had no significant differences (P < 0.01), therefore, the levels of partial substitution used seem to have no influence on this indicator.

For Bernardini *et al*. (1995) rabbits are the best source of animal nutrition for humans, after chicken and turkey. Hence, the age and weight of rabbit incorporation to reproduction is an important factor to measure the efficiency of its reproductive system. According to the same authors, the females should be ready for reproduction between 105-120 days of age, with a live weight over 2 100 g. The research demonstrated that weight is decreased as more barley meal is included. However, the weights achieved are greater than the incorporation weight in 7-14 %, and similar inclusion level is achieved (21 %), with significant differences (P < 0.05) among the treatments.

Ponce de León, (1994) referred to daily mean gains of 30 g/animal/day and 2.5 kg of live weight between 90-100 days of age, using diets with forage/concentrate proportion of 60:40 and feed supplied *ad libitum*. Nieves *et al.* (2001) evaluated the diet acceptability with increasing levels of white mulberry (*Morus alba*) in male rabbits with weights below 2.16; 2.03; 1.95 and 1.97 kg. The final weight achieved according to treatments (Table 3) has significant differences (P < 0.01) and the inclusion levels (7; 14 and 21 %), reached 94.2; 88.2 and 82.4 %, respectively, regarding the values reached by the control. These results are better than Quintero (2006), who evaluated arborescent legumes for rabbit nutrition and reported final weights of 1 550 and 1 608 g when matarraton forage was used, supplemented with polished rice powder and sorgho.

The mean daily gain had no significant differences. The results are slightly below Rubio *et al.* (2002) in White New Zealand rabbits of different sexes, treated with soybean hay. They managed to get daily mean gains of 29.01 ± 1.3 in males, and 31.8 ± 1.3 in females; greater than results reported by Montejo *et al*. (2010), using feed made through traditional methods, with *Albizia lebbeck* and sweet potato forage meal, 70.9 % of dry matter to be consumed with gains slightly over 16 g/animal/day. Nieves *et al*. (2009) concluded that daily weight gain was higher in animals fed with leucaena (29.49 ± 6.10) and mulberry (26.00 ± 6.20), in comparison with naranjillo (21.85 ± 5.62 g/rabbit).

Several scientific articles coincide in that acceptable feed conversion should range between 3 and 3.5 kg of feed/kg per live weight (PV) (Xiccato *et al.,* 2002 and Quintero, 2006). All the treatments differ among them ($P < 0.05$) in terms of feed conversion, with acceptable values for inclusion levels of 7 and 14 %, respectively (Table 3).

The substitution levels of 7; 14 and 21 % do not differ for the production value, but have differences ($P \leq 0.05$) regarding the control. The other economic indicators have no differences (Table 4).

CONCLUSIONS

The inclusion of barley bran meal as substitute of commercial feed is a bio productive response and a production value acceptable which can be used as productive alternatives.

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Table 1. Nutrient balance according to treatment contributions during the test

Indicators/treatments	1	2	3	4
		Total contribution		
PB, *g*	1 096.1	1 097.1	1 103.6	1 110.1
FB, *g*	976.1	950.7	959.0	967.4
EM, *MJ*	71.6	71.1	70.9	70.5
		Total request		
PB, *g*	1 079.5	1 073.9	1 073.8	1 073.7
FB, *g*	944.5	939.7	939.6	939.5
EM, *MJ*	70.0	69.7	69.6	69.6
		Balance		
PB, *g*	16.6	23.2	29.8	36.4
FB, *g*	31.6	11.0	19.4	27.9
EM, *MJ*	1.6	1.4	1.3	0.9

Table 2. Chemical composition of diets and feeds used

Level of substitution	MS	PB	FND	C	MO	PBO	ED
	%	%	%	%	%	%	Mj/kg
Control	91.60	23.19	32.58	5.26	94.74	24.48	5.36
7 %	91.68	24.98	39.06	5.71	94.29	26.49	5.80
14 %	91.82	23.99	45.20	5.55	94.45	25.40	5.57
21 %	91.63	25.01	29.52	6.21	93.79	26.67	5.84
Barley bran	92.63	27.96	81.76	4.19	95.81	29.18	6.46
Wheat bran	90.63	14.59	26.52	5.23	94.77	15.40	3.33
Feed TP	91.06	20.96	20.94	5.63	94.37	22.21	4.83
Turkey Tangle Frogfruit	18.6	16.1	19.1	5.23	-	-	1.85

Source: Main Biochemical Laboratory Laboratorio Central Bioquímica del Instituto Ciencia Animal, Cuba

Table 3. Growth, consumption and feed conversion in replacement female rabbits with different diets

Level of substitution	Consumption MS, g	Intitial weigh, g	Final weight, g	% versus control	GMD g/animal/día	Feed conversion
0 %	6 767.0	569.0	2 513.1[a]	100.0	27.6	3.21[a]
7 %	6 711.9	573.3	2 366.3[b]	94.2	25.6	3.46[b]
14 %	6 711.7	576.6	2 216.7[c]	88.2	23.5	3.77[c]
21 %	6 711.5	560.3	2 071.0[d]	82.4	21.6	4.13[d]
EE (±)	1.70	41.0	176.0	-	3.58	1.70
CV (%)	3.31	7.61	2.62	-	4.41	3.31

Different letters on the same column differ for $P < 0.01$ and $P < 0.05$

Table 4. Main economic indicators of the alternative proposed

Indicators/inclusion levels	UM	Control	7 %	14 %	21 %
Production value	Weight	526.61a	487.95b	455.08b	423.72b
Economic gain	Weight	164.28	127.79	97.26	68.17
Cost/weight	Weight	0.69	0.74	0.79	0.84
Cost/benefit	Weight	0.45	0.35	0.27	0.16
Feed cost/100 g gain	weight	0.25	0.26	0.26	0.27

Different letters in the same row differ for $P \leq 0.05$