EFFECT OF PHYSICAL FORM OF DIET AND FEEDER TYPE ON PERFORMANCE OF GROWING RABBITS

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ABSTRACT

This work aimed to evaluate the influence of different physical forms of diet and types of feeder on the performance and economic viability of growing rabbits. Forty animals (20 males and 20 females) were housed, from 31 to 70 days of age, in individual galvanized wire cages with automatic drinking fountain. A single commercial feed was formulated based on corn, soybean meal, wheat bran, amino acids, vitamins, minerals and additives to meet the nutritional requirements of growing rabbits. A completely randomized study was designed in a factorial scheme 2 *vs* 2 (two physical forms of diet *vs* two types of feeder), with ten replicates per treatment. The physical forms of diet were pelletized or bran, while the feeder types were semi-automatic or manual. Throughout the experiment period, feed and water were provided *ad libitum*. The diets provided, the leftovers and the animals were weighed at the beginning of the experiment (31 days), at 50 days, and at the end of the experiment (70 days) in order to determine the performance variables. The cost of production was determined based on the value of feed in relation to the value of the weight gained by the animals. A significant interaction between treatments was detected for feed conversion (P=0.018) and production cost (P=0.023), from 31 to 70 days of age. In the manual feeder, the best results both for feed conversion and production cost were obtained with the pelletized diet whereas there were no significant differences between feed types when a semi-automatic feeder was used. For the 31 to 50 days phase, the highest values of final weight (P=0.003), weight gain (P=0.011) and feed intake (P=0.005) were obtained with the pelletized diet, but there were no differences (P>0.05) between types of feeder. Similarly, for the 31 to 70 days phase, the highest values of final weight (P<0.001), weight gain (P<0.001) and feed intake (P<0.001) were also obtained with the pelletized diet. Regarding the type of feeder, the only difference (P=0.009) found was for daily weight gain, with the semi-automatic feeder providing the best result. In conclusion, the best results for weight gain of growing rabbits were obtained with the pelletized diet and with the semi-automatic feeder. Feed conversion and production cost were increased with bran feed when a manual feeder was used, whereas there were no differences between pelletized and bran feeds when the feeder used was semi-automatic.

Key words: Feeding, Rabbit breeding, Pelletizing

INTRODUCTION

In rabbit breeding, feeding cost represents around 70% of the total costs, and pelletized diets can further burden the production system due to processing costs, which leads many producers to provide bran diets to rabbits (Toledo *et al.*, 2010). However, pelletization brings significant improvements from a nutritional and microbiological point of view, in addition to increased feed acceptability, as pellets prevent animal selection and reduce dust formation, resulting in higher intake and less waste (Bellaver and Nones, 2000). In addition, because of their feeding behaviour, rabbits are highly sensitive to flours or meal, as fines can enter their respiratory system, causing lung problems (Mendez *et al.*, 1998). Furthermore, performance of monogastrics with the bran-type diet is lower than with pelletized diets (Bellaver *et al.*, 1983; Ferreira *et al.*, 2015), since preheating from pelletizing makes the diet more digestible, which improves nutrient utilization and therefore animal performance

(Andriguetto *et al.*, 2000). Nevertheless, it is not just the physical form of diet that can influence feed intake or growth performance of rabbits. Feed management and the type of feeder can also result in greater animal feed waste, reducing intake and raising costs. Thus, the aim of this work was to evaluate the influence of different physical forms of diet and types of feeder on the performance and economic viability of growing rabbits.

MATERIALS AND METHODS

Animals and experimental design

The experiment was carried out in the Rabbit Breeding Sector of State University of Maringá, located in Paraná State, Brazil (23°21'S, 52°04'W and altitude of 564 m). The entire experimental procedure was previously approved by the Committee of Ethical Conduct for Experimental Animal Use. Forty 31-day old New Zealand White rabbits were used (20 males and 20 females). Animals were individually housed in metabolism cages provided with automatic drinking nipples. A single commercial feed was formulated based on corn, soybean meal, wheat bran, amino acids, minerals, vitamins and additives (Table 1) to fulfil the requirements for growing rabbits (De Blas and Mateos, 2010). After mixing the ingredients, half of the feed was pelletized using a Commercial Industry Pelletizer (Chavantes™, model 40 HP) with capacity from 800 to 1,700 kg/h, with a 4.5 mm matrix and without addition of steam, at an average temperature of 70 °C (60 to 80 °C) for about 50 seconds. The experimental design was completely randomized in a factorial scheme 2 *vs* 2 (two physical forms of diet *vs* two types of feeder), with ten replicates per treatment and each animal as experimental unit. The physical forms of diet were: bran or pelletized, while the feeder types were: manual or semi-automatic.

Table 1: Basal diet for growing rabbits (natural matter)

Ingredients	**Amount (%)**
Wheat bran	64.16
Corn	25.73
Soybean meal, 46% CP	7.14
Limestone	1.818
Salt	0.400
Mineral and vitamin premix[1]	0.500
L-Lysine HCl (78.5%)	0.158
DL-Methionine (98.5%)	0.042
Coccidiostatic[2]	0.060
Total quantity	100.00
Chemical composition calculated	
Dry matter (%)	88.50
Crude protein (%)	15.40
Digestible energy (Mcal/kg)	2.40
Acid detergent fibre (%)	12.25
Calcium (%)	0.800
Total phosphorus (%)	0.739
Methionine + Cysteine (%)	0.590
Lysine (%)	0.780

[1]Premix provided per kg of diet: vitamin A, 12,000 IU; vitamin D_3, 1,000 IU; vitamin E acetate, 50 mg; vitamin K_3, 2 mg; biotin, 0.1 mg; Fe, 100 mg; Cu, 20 mg; Mn, 50 mg; Co, 2 mg; I, 1 mg; Zn, 100 mg; Se, 0.1 mg; BHT, 100 mg; [2] Robenidine, 66 mg.

Performance

Throughout the experimental period (from 31 to 70 days of age), feed and water were provided *ad libitum*. Feed provided, leftovers and animals were weighed at the beginning of the experiment (31 days), at 50 days, and at the end of the experiment (70 days) in order to calculate feed intake, weight gain and feed conversion. To calculate the production cost of the treatments (in American dollars, U$), the average prices of the inputs from Maringá-Brazil were used. The production cost of diets per kilogram of live weight gain (Yi) was determined, according to Bellaver *et al.* (1985), as follows:

Yi = (Qi x Pi) / Gi , where:

Yi = feed cost per kilogram of live weight gain for the i-th treatment;
Pi= price per kilogram of feed used for the i-th treatment;
Qi= amount of feed intake for the i-th treatment;
Gi= weight gain for the i-th treatment;

Statistical analysis

The UNIVARIATE procedure was applied to evaluate the presence of outliers. The normality of experimental errors and the homogeneity of variances between treatments for the various variables were previously evaluated using the Shapiro-Wilk and Levene tests (SAS, 2010), respectively. Analysis of variance (ANOVA) was performed using the procedure General Linear Models of the statistical software SAS (SAS Inst. Inc., Cary, NC, USA). For performance variables, the initial weight was used as a covariate. Test F was applied on the different physical forms of diet, as well as for the different feeder types. For all analyses, a significance level (P) of 0.05 was adopted.

RESULTS AND DISCUSSION

Growth performance results are shown in Table 2. A significant interaction (Table 3) between treatments was detected for feed conversion (P=0.018) and production cost (P=0.023), from 31 to 70 days of age. It was found that in the manual feeder the best results both for feed conversion and production cost were obtained with the pelletized diet whereas there were no significant differences between feed types when a semi-automatic feeder was used.

Table 2: Performance of growing rabbits fed different diets in different feeders

Variables	Feeder		Diet		SEM[1]	P-value		
	Semi-automatic (n=20)	Manual (n=20)	Pelletized (n=20)	Bran (n=20)		Feeder x Diet	Feeder	Diet
31 to 50 days of age								
Initial weight (g)	663	643	629	679	-	-	-	-
Final weight (g)[2]	1053	998	1089[a]	967[b]	25.91	0.361	0.630	0.003
Weight gain (g/d)[2]	17.8	17.7	20.6[a]	15.2[b]	0.96	0.820	0.780	0.011
Feed intake (g/d)[2]	43.3	42.6	48.2[a]	38.2[b]	1.63	0.378	0.928	0.005
Feed conversion	2.55	2.49	2.40	2.63	0.32	0.376	0.754	0.316
Production cost (U$/kg gained)	0.86	0.86	0.84	0.88	0.08	0.313	0.773	0.365
31 to 70 days of age								
Initial weight (g)	663	643	629	679	-	-	-	-
Final weight (g)[2]	1660	1528	1746[a]	1443[b]	28.77	0.399	0.220	<0.001
Weight gain (g/d)[2,3]	24.6[A]	20.6[B]	26.9[a]	18.2[b]	0.50	0.163	0.009	<0.001
Feed intake (g/d)[2]	40.7	35.8	42.0[a]	35.1[b]	1.25	0.124	0.375	<0.001
Feed conversion[4]	1.64	1.88	1.60	1.93	0.05	0.018	0.036	<0.001
Production cost (U$/kg gained)[4]	0.73	0.77	0.72	0.79	0.04	0.023	0.014	<0.001

1- Standard error of mean.

2- Means followed by distinct lowercase letters on the same row differ significantly for Diet (F test).

3- Means followed by distinct uppercase letters on the same row differ significantly for Feeder (F test).

4- Significant interaction between Feeder and Diet.

For the 31 to 50 days phase, the highest values of final weight (P=0.003), weight gain (P=0.011) and feed intake (P=0.005) were obtained with the pelletized diet, but there were no differences (P>0.05) between types of feeder for any of the variables evaluated. Similarly, for the 31 to 70 days phase, the highest values of final weight (P<0.001), weight gain (P<0.001) and feed intake (P<0.001) were also obtained with the pelletized diet. Regarding the type of feeder, the only difference (P=0.009) was for daily weight gain, with the semi-automatic feeder providing the best result.

Table 3: Interaction Feeder x Diet in growing rabbits from 31 to 70 days of age

Feeder	**Semi-automatic**		**Manual**		**SEM[1]**	**P-value**
Diet	**Pelletized**	**Bran**	**Pelletized**	**Bran**	**(n = 10)**	
Feed conversion	1.58[b]	1.72[b]	1.61[b]	2.15[a]	0.05	0.018
Production cost (U$/kg gained)	0.72[b]	0.74[b]	0.71[b]	0.84[a]	0.04	0.023

1- Standard error of mean
2- Means followed by distinct lowercase letters on the same row differ significantly

Ferreira *et al.* (2015) stated that bran feed should be avoided for rabbits, since the shape of their dental arch makes it difficult for them to grasp small particles, thus inducing the animal to dig in the feeder to select the food. In addition, the presence of very fine dust in the bran feed can cause sneezing, runny nose and other breathing problems. In the present study, however, no respiratory problems were diagnosed on the animals. Regarding the types of feeder, Maertens (2009) commented that its correct dimensioning can contribute to reduce feed conversion ratio in rabbits, as it allows a mitigation of feed waste. This fact becomes even more important in certain categories, such as pregnant does, which naturally tend to dig.

CONCLUSIONS

The best results for weight gain of growing rabbits were obtained with the pelletized diet and with the semi-automatic feeder. Feed conversion and production cost were increased with bran feed when a manual feeder was used, whereas there were no differences between pelletized and bran feeds when the feeder used was semi-automatic.

REFERENCES

Andriguetto J.M., Perly L., Minardi I, Flemming J.S., Vinne J.U., Flemming R., Souza G.A., Andriguetto J.L., Dutra, M.J., Steifert C.R. 2000. Normas e padrões de nutrição e alimentação animal: revisão 2000. DTPA-SDR-MAARA, Curitiba, Brazil.

Bellaver C., Fialho E.T., Protas J.F.S., Gomes, P.C. 1985. Radícula de malte na alimentação de suínos em crescimento e terminação. *Pesq. Agr. Bras., 20, 969-974.*

Bellaver C., Konsen E.A., Freitas A.R. 1983. Tipos de rações e comedouros para suínos. Comunicado Técnico 54, EMBRAPA-CNPSA, Concórdia, Brazil.

Bellaver C., Nones K. 2000. A importância da granulometria da mistura e da peletização da ração avícola. *In: Proc. 4º Simpósio Goiano de Avicultura, 2000 July, Goiânia, Brazil, 57-78.*

De Blas J.C., Mateos G.G., 2010. Feed Formulation. *In: De Blas C., Wiseman J. (Eds). The Nutrition of the Rabbit. 2nd edition. CABI Publishing. CAB International, Wallingford Oxon, UK, 222-232.*

Ferreira W.M., Saad F.M.O.B., Pereira R.A.N. 2015. Fundamentos da nutrição de coelhos. 2nd Ed. Belo Horizonte, Brazil.

Maertens L., 2009. Possibilities to reduce the feed conversion in rabbit production. *In : Proc. Giornate di Coniglicultura, 2009 April, Forli, Italy, 1-9.*

Mendez J., Rial E., Santomá G. 1998. Feed manufacturing. *In: De Blas C., Wiseman J. (Eds). The Nutrition of the Rabbit. CABI Publishing. CAB International, Wallingford Oxon, UK, 215-239.*

SAS. 2010. SAS/STAT User's Guide (Release 9.2). *SAS Inst. Inc., Cary NC, USA.*

Toledo G.S.P., Eggers D.P., Silva L.P. 2010. Use of soybean hulls in the replacement of alfafa hay in non pelletized diet for growing rabbits. *In: Proc. 4th American Rabbit Congress, 2010 September, Cordoba, Spain.*