World Rabbit Science

World Rabbit Sci. 2009, 17: 35 - 38

SHORT COMMUNICATION: EFFECT OF SUBSTITUTING HYDROPONIC GREEN BARLEY FORAGE FOR A COMMERCIAL FEED ON PERFORMANCE OF GROWING RABBITS

Morales M.A., Fuente B., Juárez M., Ávila E.

Centro de Enseñanza, Investigación y Extensión en Producción Avícola, Facultad de Medicina Veterinaria y Zootecnia, Universidad Nacional Autónoma de México, Salvador Díaz Mirón s/n, Col. Zapotitlán, Deleg. Tlahuac, 13209 México, D.F., Mexico.

Abstract: The effect of replacing a commercial feed with hydroponic green barley forage (HGBF) was studied on productive performance and carcass yield of growing New Zealand rabbits. Four mixed diets based on a pelleted commercial feed (15.7% crude protein and 12.3% crude fiber) were made by substituting wet HGBF (containing 16.1% dry matter, 2.18% crude protein and 2.36% crude fiber) for the commercial feed (0, 10, 20 and 30%). Sixty-four rabbits, 35 d of age and with an average body weight of 917±9.7 (standard error) g were assigned to the 4 treatments and caged in groups of 4 rabbits (2 females and 2 males/cage). HGBF was grown for 15 d, and administered immediately after harvesting, including the radicular pad (roots and seed) and leaves. Feed intake and growth rate from 35 to 70 d of age were recorded. The rabbits were then slaughtered and the dressing-out percentage computed. Both dry matter feed intake and growth rate decreased linearly by 0.75±0.091 g/d (P<0.001) and 0.20±0.040 g/d (P<0.001) per unit of HGBF increase. Rabbits consumed daily all the HGBF offered 0, 2.3, 4.6 and 7.0 g DM for 0, 10, 20 and 30% substitution level, respectively. Feed conversion (average 3.26±0.026) and carcass yield percentage (average 58.1±0.32 %) were not affected by treatments. It was therefore concluded that replacing pelleted commercial feed by wet HGBF impaired growth performances.

Key Words: hydroponic green barley forage, performance, growing rabbits.

INTRODUCTION

Hydroponic green forage is the product of the germination of cereal grains such as oats, maize, barley, wheat, rice and sorghum. This process takes place during a 9–15 d period, using solar energy and mineral nutrient solution (FAO, 2001). Cement, galvanized sheet, glass, fiberglass, plastic or wooden trays or platters covered with polyethylene with a height of 2 to 5 cm are used for the process, placed on a wooden or metal frame, in a vertical or horizontal arrangement (FAO, 2001; Samperio, 1997). At harvest, the plant is 15 to 20 cm in height, consisting of stem and green leaves. The animal consumes the whole plant including seed and roots (Resh, 1992). Because of its aspect, color, taste and texture, it is considered a highly palatable feed that promotes digestibility of other nutrients (FAO, 2001).

This study aimed to evaluate replacing a commercial feed by hydroponic green barley forage (HGBF) in growing-finishing rabbits by measuring productive performance and dressing-out percentage.

Correspondence: B. Fuente, benjaminfuente@yahoo.com.mx
Received *April 2007* - Accepted *February 2008*

MATERIALS AND METHODS

Sixty-four New Zealand 35 d old rabbits, with an average initial weight of 917±9.7 (standard error) g were assigned to the 4 treatments and caged in groups of 4 rabbits (2 females and 2 males/cage). A pelleted commercial feed was used as control diet (C0). The other three treatments were obtained by replacing 10, 20 and 30% of pelleted control feed by wet HGBF (C10, C20 and C30, respectively). Animals were supplied with (% pelleted feed/ % wet HGBF): 90/10, 80/20 and 70/30. The recommendations established by Maertens and Villamide (1998) were used to estimate the amount of pelleted balanced feed and HGBF used in each treatment. Chemical composition of commercial feed and HGBF is shown in Table 1. The amounts of pelleted commercial feed and HGBF offered per week in each treatment are shown in Table 2. Pelleted feed and HGBF were provided in different feeders. A 5 d adaptation period was allowed from 30 to 35 d of age before the experiment began.

HGBF was produced on the premises of the Research Center by hydroponics without substrate technique, watering daily with a nutritive solution that contained 300 ppm N, 40 ppm P and 200 ppm K (Ortega, 1990). Variables such as temperature, humidity and light were not controlled. 45×34.5×4.5 cm galvanized sheet trays were seeded with 1 kg of seed per tray and were given a 15 d growth period. Forage was immediately offered after harvest, including radicular pad (roots and seed) as well as leaves. Chemical analyses of the commercial feed and HGBF were performed with the commercial feed according to AOAC (2000): moisture (procedure 967.19), ash (900.02a-b), ether extract (920.39b), crude protein (955.04) and crude fibre (962.09).

Rabbits were kept in cages measuring 90×60×40 cm, equipped with two hopper-type feeders and automatic nipple drinkers. Average temperature in the area was 16 ºC (not recorded in this study). Feed consumption was obtained daily by weighing the amount offered and the amount remaining per cage and rabbits were weighed weekly. Feed conversion was obtained from the sum of the dry HGBF intake and dry matter intake of pelleted commercial feed divided by rabbit weight gain. Digestive problems did not occur during the study. On day 35 of the experiment (70 d of age) all animals were weighed and slaughtered by cervical dislocation and bleeding from the jugular vein. Rabbits were slaughtered in accordance with animal welfare norms, without previous feed withdrawal. The hot carcasses were weighted in order to obtain the dressing-out percentage (Blasco *et al*., 1993).

The linear effect of HGBF was studied by using regression. Statistical analysis was performed using the experimental design software of the Agronomy Faculty of the University of Nuevo Leon, Version 2.5 (Olivares, 1994).

Table 1: Proximal chemical analysis of pelleted commercial feed and hydroponic barley green forage (% dry matter basis).

	Commercial feed	Hydroponic green barley forage
Moisture, % as fed	8.87	83.9
Crude protein	17.2	13.5
Ether extract	3.58	2.55
Crude fibre	13.5	16.3
Nitrogen free extract	52.8	62.9
Ash	12.8	4.8
Digestible energy kcal/kg DM[1]	2510	2420

[1]Estimated according to the formula cited by Cheeke (1995).

Table 2: Amount of balanced feed and wet hydroponic barley green forage (HGBF) offered daily per rabbit during the 5 weeks of the experiment[1].

	C0		C10		C20		C30	
week	Commercial feed (g)	HGBF (g)	Commercial feed (g)	HGBF (g)	Commercial feed (g)	HGBF (g)	Commercial feed (g)	HGBF (g)
1	91	0	81.9	9.1	72.8	18.2	63.7	27.3
2	121	0	108.9	12.1	96.8	24.2	84.7	36.3
3	146	0	131.4	14.6	116.8	29.2	102.2	43.8
4	167	0	150.3	16.7	133.6	33.4	116.9	50.1
5	184	0	165.6	18.4	147.2	36.8	128.8	55.2

[1] C0, C10, C20 and C30: replacement of the comercial feed by HGBF at 0, 10, 20 and 30%.

RESULTS AND DISCUSSION

Results for production performance and carcass yield in rabbits, during the 35 d experiment with the addition of HGBF are shown in Table 3. Animals in all the treatments consumed daily all HGBF added but pelleted feed always remained in the feeder. Pelleted feed intake decreased linearly with HGBF inclusion ($P<0.001$). When the amount of total feed consumed was calculated, it was found that total dry matter feed intake was also linearly reduced ($P<0.001$) by 0.75±0.091 g/d per additional unit of HGBF. This might be accounted for by the bulk of wet HGBF, which could have limited feed intake of the pelleted diet. As a consequence, the estimated dietary digestible energy and total crude protein offered to the animals decreased with HGBF inclusion (1.29, 1.21, 1.13 and 1.05 MJ/d, respectively, and 21.1, 19.9, 18.3 and 17.0 g crude protein/d, respectively). Weight gain also decreased linearly ($P<0.001$) by 0.20±0.040 g/d per additional unit of HGBF. However, feed conversion ratio was not affected by HBGF inclusion (3.26±0.02 on average), nor was dressing-out percentage (58.1±0.3 %, on average). These results suggest that the reduction of dietary crude protein and digestible energy intake when HGBF increased failed to meet the rabbits' requirements and impaired their performance.

Energy and protein are the most important factors required to obtain maximum weight gain (Lebas, 1989). Santoma *et al*. (1989) proposed that feed should contain around 10.5 MJ digestible energy/kg DM. They reported that diets offered *ad libitum* with at least 9.5 MJ/kg DM digestible energy (DE) optimized

Table 3: Effect of balanced dry base feed replacement with hydroponic barley green forage (HGBF) on productive parameters of growing rabbits (mean±SEM) (n=4 cages/treatment except for dressing-out performance, where n=16 rabbit/treatment).

	Treatments				
	C0	C10	C20	C30	*P*-value
Daily dry matter intake, g/rabbit					
Total (pelleted feed+HGBF)	123±2.6	116±3.3	108±1.4	101±0.2	< 0.001
Pelleted feed	123±2.6	113.8±3.1	103.2±1.3	93.6±0.2	< 0.001
HGBF[1]	0	2.3	4.6	7.0	
Daily weight gain, g/rabbit	36.9±1.8	36.0±0.8	33.0±0.6	31.2±0.3	0.006
Feed conversion ratio, g intake/g gain	3.33±0.03	3.22±0.08	3.26±0.07	3.23±0.02	0.25
Dressing out percentage, %	58.6±0.1	58.3±0.5	58.0±0.4	57.5±0.3	0.23

[1]Animals consumed all HGBF and thus there is no standard error.

performance. Fraga *et al*. (1989) calculated that a rabbit with an average growth rate of 35 g/d required around 1.09 MJ/d and 17.3 g crude protein/d. According to this, our results would not be explained by a crude protein or digestible energy deficit but might be accounted for by rabbit requirements higher than those of the mentioned studies and/or an amino acid deficit. Similar results were obtained by Huang *et al*. (1988) using *Arachis pintoi* and *Digitaria sp*. as feed ingredients in rabbit diets. On the other hand, it has also been shown that growth in rabbits decreases with diets with low levels of fibre (De Blas *et al*, 1986). In this trial, dietary crude fibre level remained around 13.5%, which are inside the range recommended by De Blas *et al*. (1986).

In conclusion, replacing pelleted commercial feed by wet HGBF impaired feed intake and growth performance but did not affect feed conversion and dressing-out percentage.

REFERENCES

AOAC. 2000. Official Methods of Analysis. *17ª ed. Association of Official Analytical Chemists. Washington DC.*

Blasco A., Ouhayoun J., Masoero G. 1993. Harmonization of criteria and terminology in rabbit meat research. *World Rabbit Sci., 1: 3-10.*

Cheeke P.R.. 1995. Alimentación y nutrición del conejo. *Ed. Acribia. Zaragoza, España.*

De Blas J.C., Santoma G., Carabono R., Fraga M.J. 1986. Fiber and starch levels in fattening rabbit diets. *J. Anim. Sci., 63: 1897-1904.*

FAO (Organización de las Naciones Unidas para la Agricultura y la Alimentación). 2001. Manual técnico forraje verde hidropónico. *Santiago de Chile, Chile.*

Fraga M.J. 1989. Necesidades de nutrientes. *In: De Blas J.C., (ed). Alimentación del conejo. 2ª ed. Mundi-Prensa, Madrid, España, 61-74.*

Huang X.S., Zheng Z.D., Fang J.M., Wu J.C., Fu C.Z. 1998. Nutrition improvement for rabbits by feeding orchard-growing forage on hilly red soils. *J. Fujian Acad. Agric. Sci., 13: 102-107.*

Lebas F. 1989. Besoins nuttritionnels des lapins. *Cuni-Sciences, 5: 1-27.*

Maertens L., Villamide M.J. 1998. Feeding systems for intensive production. *In: De Blas C., Wiseman J. (eds). The nutrition of the rabbit. CABI Publishing, London., 255-271*

Olivares S.E. 1994. Paquete de diseños experimentales FAVANL *(programa computacional) versión 2.5. Marin (NL): Universidad Autónoma de Nuevo León.*

Ortega O.F.J. 1990. Evaluación nutricional en laboratorio de forraje hidropónico de cebada. *Tesis de Licenciatura, Universidad Nacional Autónoma de México, México.*

Resh H.M. 1992. Cultivos hidropónicos. *3ª ed. Mundi-Prensa España.*

Samperio R.G. 1997. Hidroponía básica. *Ed. Diana, México.*

Santomá G., De Blas J.C., Carabaño R., Fraga M.J. 1989. Nutrition of rabbits. *In: Recent Advances in Animal Nutrition. Haresing W., Cole D.J.A.. (Eds). Buttherworths. UK, 109-138.*