EFFECT OF ENZYME COMPLEX SUPPLEMENTATION ON DIET DIGESTIBILITY AND GROWTH PERFORMANCE IN GROWING RABBITS

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Abstract - Effect of addition to diet of two commercial enzyme complex (Porzyme and Bio-Feed Alpha) mainly containing ß-glucanase and α-amylase were studied. A control barley-based diet containing 27 % of starch, 15% of CP and 30% of NDF was formulated to meet or exceed requirements of growing rabbits. Other two experimetal diets were made by adding 1 kg/Tm of Porzyme and Bio-Feed, respectively, to the control diet. One hundred and sixty two New Zealand x California rabbits were used to determine growth rate, feed conversion rate and mortality, from weaning (30 d, 610 ± 4.6 g of average weight) to 72 days old. A group of 18 (30 days old) rabbits (6 per diet) were used to determine apparent digestibility and ileum starch content. Enzyme addition did not significantly affect growth rate and feed conversion rate (34.1 g/d and 2.6 g/g DM as average, respectively). Two rabbits died during the growth trial. Diarrhoea was the cause and rabbits belonged to Control and Porzyme diet. Addition of enzymes to diet did not affect any digestibility coefficient except NDF ($P < 0.01$). Digestibility coefficient of NDF increased 30 and 40% in diets Porzyme and Bio-Feed, respectively, in relation to Control diet. Fecal digestibility of starch was almost total (99.7% as average) and we did not find significant differences among diets. Ileum starch content was low (2.2, 2.6 and 5.4% of DM for Control Porzyme and Bio-Feed diets, respectively). Our results suggest that hydrolases necessaries for enzymatic conversion of complex nutrients into available forms are present in the rabbit digestive tract.

INTRODUCTION

Barley is the main grain included in rabbit diets in Spain. However, their inclusion in the diet is limited due to the apparent low digestive utilization of starch at ileum by young rabbits (BLAS, 1986). Endosperm wall of barley contains ß-glucans that may limit the utilization of nutrients (mainly starch and protein) found in it, as it occurs both in young pigs and poultry (CHESSON, 1993). The addition of commercial enzymes products, based in ß-glucanase activity, to diets containing barley improves their utilization in broilers. However, the inclusion of ß-glucanases failed to improve the utilization of barley-based diets in rabbits (TOR-AGBIDYE et al, 1992). Some types of commercials enzyme products contain other hydrocarbonases, in addition to ß-glucanase. These enzymes may complete the hydrolysis of cell wall components (cellulose and arabinoxylan) maximizing the release of endosperm nutrients (CHESSON, 1993). Also, multi-enzyme products containing amylase activity may be useful to improve the host's own digestive capacity.
The purpose of the present work was to study the effect of commercial enzymes supplemetation on growth performance and digestibility, in young rabbits fed barley-based diet.

MATERIAL AND METHODS

Diets

A control barley-based diet was formulated to meet or exceed the requirements of growing rabbits according to LEBAS (1994). Ingredients and chemical composition are shown in Table 1. Two additional experimental diets were made by addition to control diet of two commercial enzyme complexes, Porzyme SP (Finnfeeds International LTD, UK) and Bio-Feed Alpha (Novo Nordisk), in the proportion of 1 kg/Tm, respectively. The composition and the declared enzymes activity of these products are shown in Table 2. All diets were pelleted at 85 °C. Heat stability (up to 85 °C) of Porzyme was guaranteed for the supplier.

Table 1 : Ingredient and chemical composition of control diet

Item	(%)
Ingredient, %	
Barley	44.87
Barley straw	3.66
Lucerne 17	39.06
Soybean meal 44	9.84
Salt	0.40
Dicalcium phosphate	1.67
Super L-510-R[a]	0.50
Chemical composition, % DM	
DM	89.7
Ash	9.1
Starch	27.0
CP	15.0
NDF	30.3
ADF	17.3
CF	14.7

[a] Provided by TROW IBERICA SA. Mineral and vitamin composition (mg kg^{-1}): Mg 260; S 275; Co 0.7; Cu 10; Fe 80; Mn 20; Zn 60; I 1.3; vitamin E 20; vitamina K 1; vitamin B_1 1; vitamin B_2 2; vitamin B_6 1; niacin 20; coline 260; vitamina A 8375 UI; vitamin D 670 UI.
CP : crude protein. NDF: neutral detergent fibre. ADF: acid detergent fibre. CF: crude fibre.

Table 2 : Enzyme activities (units/g) as delcared by each supplier

Enzyme	Porzyme SP	Bio-Feed Alpha
Cellulase	10	-
ß-glucanase	250	250
Xylanase	400	-
a-amylase	1000	75

Growth trial

One hundred and sixty two New Zealand x California rabbits were used in this trial and assigned at random to the treatments. Rabbits received the experimental diets from weaning at 30 days (610 ± 4.6 g) until they reached a total experimental period of 42 days. After weaning rabbits were given *ad libitum* access to feed.
Rabbits were located in two types of cages, 90 rabbits were placed in individual cages (30 per diet) and 72 rabbits in double cages (24 per diet). Cages were flatdeck type measuring 60 x 25 x 33 cm (individual cages) and 60 x 50 x 33 cm (double cages).
In order to study the effect of diet on growth rate and feed conversion rate, feed intake and weight of rabbits were recorded at days 7, 14 and 42. During this trial mortality was recorded from the beginning to the end of the experimental period.
Building heating systems and forced ventilation allowed the temperature to be maintained between 15 and 23 °C.

Digestibility trial and sampling of digesta

A group of 18 New Zealand x Californian growing rabbits were alloted at random to diets Control, Porzyme and Bio-Feed (6 per diet) to determine the apparent digestibility of dry matter (DM), crude fiber (CF), acid detergent fiber (ADF), neutral detergent fiber (NDF), starch, and crude protein (CP). The animals were weaned at 25 d and fed experimental diets for 5 days. Following this period of adaptation to each diet, total fecal output were recorded for each rabbit over a 5 consecutive days and coprophagy was not prevented. Throughout digestibility trial, rabbits were housed in individual metabolism cages (33 x 41 x 55 cm) that allowed separation of faeces and urine.
After the digestibility trial, rabbits were killed by cervical dislocation and the last 12 cm of terminal ileum were emptied by gentle squeezing and content of individual segments were weighted and collected in order to determine starch content.
Faeces and ileum content were stored at -18 °C until analysed. Two rabbits fed with control diet were eliminate for diarrhoea and lack of adaptation to the diet respectively.

Analytical methods

Faeces samples were thawed at room temperature and dried in a force draught oven at 80 °C for 48 h. Chemical analysis of diets and faeces was made by the method of VAN SOEST (1963) for ADF, ROBERTSON and VAN SOEST (1981) for NDF, LONGSTAFF and MCNAB (1986) for starch, and AOAC (1984) for DM, CP and CF.

Statistical analysis

Growth trial. Data were analysed using the GLM procedure of SAS (1985). The model included as independent variables diet and type of cage. The interaction diet x type of cage was also considered. Ducan test was used for means comparisons. Weaning weight were used as linear covariate.
Digestibility trial. Data were analysed using the same procedure that during growth trial but in the model the effect of diet was only considered. Statistical analysis for ileum starch was not made because we did not collect enough sample per animal and we made a pool with each diet (6 rabbits per diet).

RESULTS AND DISCUSSION

Type of cage had not significant effect on growth rate or feed conversion rate. Interaction type of cage x diet was not significant. The covariate weaning weight had significant effect for growth rate in each period considered and for feed conversion rate during the period 0-42 days. Table 3 shows adjusted least square means for feed conversion rate and growth rate for all diets.

Table 3 : Effect of diet on growth rate (g/d) (n=160) and feed conversion rate (g/g DM) (n=110)

Days	Control	Porzyme	Bio-Feed	SEM	Diet	Type of cage	Inter[a]
Growth rate							
0-7	33.6	35.5	34.8	1.3	NS	NS	NS
7-14	33.2	33.81	34.6	1.4	NS	NS	NS
0-42	33.8	34.4	33.7	0.9	NS	NS	NS
Feed conversion rate							
0-7	2.2	2.1	2.1	0.06	NS	NS	NS
7-14	2.6	2.6	2.5	0.06	NS	NS	NS
0-42	3.3	3.3	3.3	0.05	NS	NS	NS

SEM: Pooled standard error of the means ; [a]:Diet x Type of cage ;NS : Non significant effect (P > 0.05)

Two rabbits died during the growth trial. Diarrhoea was the cause and rabbits belonged to Control and Porzyme diet.
Enzymes addition had not significant effect on growth rate or feed conversion rate, although during the 7 first days Bio-Feed diet improved feed conversion rate around 5%. These results are in agreement with the lack of response in DM digestibility when enzymes products are added to diet (Table 4).

Table 4 : Effect of diet on aparent digestibility coefficientes (%) (n=16) and ileum starch content (% DM)

Item	Control	Porzyme	Bio-Feed	SEM	Signification level
DM	70.4	70.0	69.7	0.9	NS
CP	78.3	81.5	77.7	2.0	NS
CF	14.4	20.2	14.2	2.3	NS
ADF	23.2	23.4	24.1	2.5	NS
NDF	29.8[a]	38.6[b]	41.3[b]	2.2	**
Starch	99.6	99.9	99.7	2.0	NS
Ileum starch	2.2	2.6	5.4	-	-

SEM : Pooled standard error of the means ; NS : Non significant effect of diet (P > 0.05) ; **: P < 0.01

Addition of enzymes to diet did not affect any digestibility coefficient except for NDF (P < 0.010) (Table 4). Digestibility coefficient of NDF increased 30 and 40% when rabbits fed Porzyme and Bio-Feed diets, respectively. This enhanced in NDF digestibility probably be bound up with cell wall hemicellulose components, because we did not observed any significant difference on ADF digestibility coefficient. TOR-ARGBIDYE et al (1992) did not observe significant differences neither

digestibility coefficients nor growth performances (growth rate and feed conversion rate) when a barley-based diets were supplemented with an enzyme product containing ß-glucanase. These authors suggest that adequate microbial hydrocarbonases production in the digestive tract of rabbits may avoid negative effect of ß-glucans. MAROUNEK et al (1995) recorded ß-glucosidase, pectinase, xylanase and cellulase activity in the small intestine and in the cecum of 4 weeks-old rabbits.

Starch fecal digestibility was almost total (99.7% as average) and we did not find siginificant differences among diets. The lack of effect of a-amylase addition to diet suggests that the host's own enzyme capacity is enough to digest 27% starch from barley. Similar values (99% as average) were found by BLAS (1986) with rabbits aged 5 weeks fed barley-based diet containing 31% of starch. BLAS et al (1990) and GIDENNE and PEREZ (1993), also observed that starch from barley was completely digested in weaned rabbits. Ileum starch content for control diet was higher than that recorded in feces (2.2 vs 0.6% DM). However, the low ileum starch content suggests also large digestibility before the cecum. BLAS (1986) found larger starch ileal content (4.2% on DM) at 28 days old rabbits fed diet containing 31% of starch. When enzyme complex, with amylase activity, were added to the diets ileum starch content keeped low although we observed greater values for Bio-Feed diet (5.40%) than Control (2.2%) and Porzyme diets (2.6%). However, more studies are necessary to confirm the lack of effect of amylase supplementation at ileum.

In this trial, addition of Porzyme and Bio-Feed to diets high in starch (27.5% as average) and moderate in fiber content based in barley, lucerne and soybean meal did not improved the growth performance (growth rate and feed conversion rate).

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Ejecto de la suplementación enzimática sobre la digestibilidad de la dieta y los parámetros productivos durante la etapa de cebo - En éste trabajo se ha estudiado el efecto de la suplementación enzimática de dos productos comerciales (Porzyme y Bio-Feed Alpha) en una dieta para conejos en crecimiento. Estos complejos enzimáticos contenían ß-glucanasas y a-amilasas. Se formuló una dieta control cuya fuente de almidón fue la cebada y que cubría las necesidades de los conejos en crecimiento (27% almidón, 15% PB y 30% FND, sobre MS). Además se formularon otras dos dietas experimentales iguales a la dieta control a las que se añadió 1kg/Tm de Porzyme o Bio-Feed Alpha, respectivamente. Durante la prueba de crecimiento se utilizaron un total de 162 conejos New Zealand x California destetados a los 30 d (610 ± 4.6 g de peso medio) a los que se controló la velocidad de crecimiento, el índice de conversión y la mortalidad hasta una edad de 72 días. Otro grupo de 18 conejos (30 días de edad) fueron utilizados para determinar la digestibilidad aparente y contenido en almidón en el íleon. La adición de enzimas no tuvo un efecto significativo ni sobre la velocidad de crecimiento ni sobre el índice de conversión (34,1 g/d y 2,6 como media respectivamente). Sólo dos conejos murieron durante la prueba, uno de la dieta control y otro de la dieta con Porzyme. La adición de enzimas sólo afectó ($P < 0.01$) a la digestibilidad de la FND, digestibilidad que se incrementó un 30 y un 40% para la dieta Porzyme y Bio-Feed con respecto al Control. La digestibilidad del almidón fue prácticamente total (99,7% como media). El contenido en almidón del íleon fue bajo (2.2, 2.6 y 5,4% sobre MS para las dietas control, Porzyme y Bio-Feed, respectivamente). Estos resultados sugieren que el tracto digestivo del conejo dispone de las hidrolasas necesarias para actuar sobre nutrientes más complejos.