EFFECT OF YEAST β-GLUCANS ON RABBIT PERFORMANCES AND MORTALITY FROM 35 TO 63 DAYS OF AGE

García-Ruiz A.I.[1]*, Pérez-Bonilla A.[1], Pérez de Ayala P. [1], Eissen J.[2]

[1]Nutreco Poultry and Rabbit Research Centre, 45950 Casarrubios del Monte, Toledo, Spain
[2]Trouw Nutrition International BV - Feed Ingredients, Tilburg, The Netherlands
*Corresponding author: ai.garcia@nutreco.com

ABSTRACT

The aim of this work was to study the effect of increasing levels of β-glucans (Fibosel®) in rabbit feed by measuring rabbit performances and mortality from 35 to 63 days of age. Six experimental diets were formulated with increasing levels of β-glucans (0, 50, 100, 150, 200 and 250 ppm of Fibosel®). The trial was performed at the Fattening Rabbit Units from the Nutreco Poultry and Rabbit Research Center facilities. To avoid any disturbance or interference due to mortality on rabbit performance analyses, the effect of increasing levels of β-glucans on rabbit performances was studied in individually housed rabbits, while their effect on mortality was studied in collectively housed rabbits. On individually caged rabbits 7, 5, 5, 4, 4 and 4 rabbits died, respectively, for the control diet and diets containing 50, 100, 150, 200 and 250 ppm of Fibosel®. Performances of individual housed rabbits showed that animals fed diets containing 100 and 150 ppm of Fibosel® reached 9.4, 13.5 and 14.3% higher body weight at 63 days, weight gain and feed intake, as average, respectively, than rabbits fed the control diet. In the group-housed rabbits, a significant effect of Fibosel® on body weight and weight gain was also detected. In this group of animals, rabbits fed diets containing 50 and 150 ppm of Fibosel® showed a 5.5 and 9.8% higher body weight and weight gain, as average, respectively, than rabbits fed the control diet, while rabbits fed the diet of 100 ppm of Fibosel® showed an intermediate value of both parameters among these diet. Although significant differences were not detected, lower mortality rate was obtained in rabbits fed diet-containing 150 ppm of Fibosel® than rabbits fed the control diet (11 vs. 20 dead rabbits, respectively). Therefore, the use of Fibosel® at 150ppm in rabbit diets could be recommended as it improved rabbit growth performances and seems to decrease mortality rates. Further research with Fibosel® will be carried out to corroborate these findings.

Key words: Rabbis, β-glucans (Fibosel®), Performances, Mortality.

INTRODUCTION

In late 1996, a severe digestive disease, know as the Epizootic Rabbit Enteropathy (ERE), appeared in fattening domestic rabbits aging 6-14 weeks. Although the etiological agent has not been identified yet, several researchers have shown the bacterium Gram-positive Clostridium perfringens to be involved in the development of ERE (Le Normand *et al*., 2003; Dewrée *et al*., 2003; Marlier *et al*., 2003; Marlier *et al*., 2006; Szalo *et al*., 2007). This digestive syndrome is highly lethal (30-80% mortality) and has become the main cause of mortality in rabbit farming. This fact joined to the total withdrawal of antibiotics as growth promotors in the European Union, has led to seek for alternatives or replacement strategies i) to control enteric bacterial diseases by the maintenance of gastrointestinal ecosystem or ii) to boost animals' immune systems. From the different existing alternatives, β-glucans due to their immunostimmulatory properties could be considered a good strategy to decrease mortality and safeguard animal performances. The benefits of β-glucans, especially the decrease in mortality and the increase of growth performance, have been observed in swine and poultry (Chae *et al*., 2006; Huff *et al*., 2006; Li *et al*., 2006) and aquaculture (Robertsen *et al*., 1990). However, its effect on rabbit performances and mortality has not been tested before.

The aim of this work was to study the effect of increasing levels of β-glucans (Fibosel®) in rabbit feed by measuring rabbit performances and mortality from 35 to 63 days of age.

MATERIALS AND METHODS

Diets

Six experimental diets were formulated with increasing levels of β-glucans (Fibosel®) supplied by Trouw Nutrition International-Feed Ingredients, Tilburg, The Netherlands. The Fibosel® supplement is highly exposed and activated β-1,3-1,6-glucans isolated from cell wall of a selected yeast strain and processed through an exclusive extraction and activation procedure optimizing their exposure and therefore, recognition by macrophages receptors.

All the experimental diets were formulated to be isonutritive and to meet or exceed the nutrient requirements of growing rabbits (De Blas and Mateos, 1998). Diets were formulated with higher than recommended CP levels as it has been observed that a high nitrogen flow at the end of the small intestine (and therefore entering into the caecum) increases mucoid enteropathy incidence and proliferation of pathogenic bacteria as Clostridium perfringens (De Blas *et al*., 1981; Gutierrez *et al.*, 2003; Chamorro *et al*., 2004, 2005). Fibosel® was added to the feed at different doses (0, 50, 100, 150, 200 and 250 ppm). The ingredient composition and chemical analysis of the diets is shown in Table 1. Diets were pelleted and animals were given ad libitum access to feed and water during all the experiment. Neither feed nor drinking water were medicated with antibiotics.

Table 1: Ingredient and chemical composition of the experimental diets (%)

	A	B	C	D	E	F
Ingredients:						
Wheat Bran	25.706	25.701	25.696	25.691	25.686	25.681
Barley	28.961	28.961	28.961	28.961	28.961	28.961
Sunflower meal, 36% CP	16.725	16.725	16.725	16.725	16.725	16.725
Alfalfa meal, 16% CP	24.084	24.084	24.084	24.084	24.084	24.084
Soybean oil	2.500	2.500	2.500	2.500	2.500	2.500
Sodium chloride	0.500	0.500	0.500	0.500	0.500	0.500
Calcium carbonate	1.000	1.000	1.000	1.000	1.000	1.000
L-Lysine	0.025	0.025	0.025	0.025	0.025	0.025
Mineral-vitamin premix[1]	0.500	0.500	0.500	0.500	0.500	0.500
Fibosel®	-	0.005	0.010	0.015	0.020	0.025
Chemical composition						
Dry matter	91.89	91.89	92.17	92.14	92.31	92.14
Crude protein	18.45	18.37	18.51	18.51	18.38	18.56
Starch	11.58	11.06	12.53	12.20	12.06	12.66
Ash	7.40	7.49	7.56	7.54	7.60	7.57
Crude fibre	13.30	12.81	12.70	12.84	12.96	12.40
Neutral detergent fibre	33.61	32.98	32.48	32.21	32.93	32.45
Acid detergent fibre	17.06	17.55	18.11	17.86	16.90	17.46
Acid detergent lignin	4.67	4.90	5.54	4.98	4.58	4.54

[1] Premix supplyed by Trouw Nutrition España S.A. (Madrid, Spain): mineral and vitamin composition (mg/kg diet): Mg, 290; Na, 329; S, 275; Co, 0,7; Cu, 10; Fe, 76; Mn, 20; Zn, 59,2; I, 1,25; Choline chloride, 250; Riboflavin, 2; Niacin, 20; Vitamin B_6, 1; Vitamin K, 1; Vitamin E, 20 IU/kg; Thiamine, 1; Vitamin A, 8375 IU/kg, Vitamin D_3, 750 IU/kg,

Animals and experimental design

Eight hundred and forty New Zealand x Californian rabbits (originating from strains genetically improved at the Universidad Politécnica of Valencia, Spain) were assigned at random to the experimental treatments at 35 days of age with a weaning weight of 849 ± 154 g. All trial was performed at the Fattening Rabbit Units from the Nutreco Poultry and Rabbit Research Center facilities. In Experiment 1,240 rabbits were housed individually in flat-deck cages measuring 35 x 46 × 30 cm high. In Experiment 2,600 rabbits were group-housed in 120 polyvalent cages (38 × 100 × 30

cm). Growth rate, feed intake and mortality were recorded from 35 to 63 days of age. Heating and forced ventilation systems allowed the building temperature to be maintained at 19 ± 4ºC in the two trials. Rabbits were handled according to the principles for the care of animals in experimentation published by the Spanish Royal Decree 1201/2005.

Chemical analyses

Chemical analysis of the diets was made using the procedures of Association of Official Analytical Chemists (2000) for dry matter (930.15), ash (923.03), Dumas N (968.06), ether extract (920.39), crude fibre (978.10), sugars (974.06) and starch (996.11). Contents of NDF, ADF and acid-detergent lignin were determined according to the sequential method of Van Soest *et al*. (1991).

Statistical analysis

Data were analyzed as a complete random design with level of Fibosel® as the main source of variation and the initial body weight at 35 days of age as a covariate by using the General Linear Model (GLM) procedure of SAS (1990). Mean comparisons among diets were made by using a t-test.

RESULTS AND DISCUSSION

To avoid any disturbance or interference due to mortality on rabbit performance analyses, the effect of Fibosel® inclusion (from 0 to 250 ppm) on rabbit performances was studied in individually housed rabbits (Table 2) while its effect on mortality was studied in collectively housed rabbits (Table 3). On individually caged rabbits 7, 5, 5, 4, 4 and 4 rabbits died, respectively, for diet A, B, C, D, E and F. From 35 to 63 days of age, a significant effect of Fibosel® on body weight (BW_{63}), daily weight gain (DWG) and daily feed intake (DFI) was detected. Rabbits fed diets C and D (100 and 150 ppm of Fibosel®, respectively) showed a 9.4, 13.5 and 14.3% higher BW_{63}, DWG and DFI, as average, respectively, than rabbits fed the control diet. Rabbits fed diets B, E and F (50, 200 and 250 ppm of Fibosel®, respectively) reached intermediate values of BW_{63}, DWG and DFI among the control diet and the diets C and D.

Table 2: Effect of diet on performance of individually caged rabbits

	Treatment (Fibosel® ppm)						Mean	SEM	P
	A (0)	B (50)	C (100)	D (150)	E (200)	F (250)			
BW_{63}, g	1910b	2053ab	2087a	2093a	2029ab	2013ab	2031	50.2	0.010
DWG, g/d	40.5b	44.6ab	45.9a	46.1a	44.5ab	42.3ab	44.0	1.79	0.041
DFI, g/d	94.4b	106.6ab	108.4a	107.4a	105.9ab	99.0ab	103.7	4.27	0.024
FCR	2.334	2.399	2.366	2.320	2.376	2.367	2.360	0.032	0.379

BW_{63}: body weight at 63 days , DWG: daily weight gain; DFI: daily feed intake; FCR: feed conversion ratio

Results of group-housed rabbits are presented in Table 3. In terms of performances, it should underline that rabbits individually housed showed a 5.4, 6.0, 17 and 10% higher BW_{63}, DWG, DFI and feed conversion ratio (FCR), as average, respectively, than rabbits collectively housed. These differences can be explained by the higher stocking density of the group-housed rabbits respect to the individually housed ones (26.2 vs. 12.3 kg/m^2, respectively). In the group-housed rabbits, a significant effect of Fibosel® on BW_{63} and DWG was also detected. Rabbits fed diets B and D (50 and 150 ppm of Fibosel®, respectively) showed a 5.5 and 9.8% higher BW_{63} and DWG, as average, respectively, than rabbits fed the control diet. Rabbits fed diets C, E and F (100, 200 and 250 ppm of Fibosel®, respectively) reached intermediate values of BW_{63} and DWG among the control diet and the diets B and D. Attending to the mortality rates, although significant differences were not detected, rabbits fed D-diet showed lower mortality rate than rabbits fed the control diet (11 vs. 20 dead rabbits, respectively).

Table 3: Effect of diet on performance of group-caged rabbits

	Treatment (Fibosel® ppm)						Mean	SEM	P
	A (0)	B (50)	C (100)	D (150)	E (200)	F (250)			
BW_{63}, g	1852b	1956a	1913ab	1955a	1931ab	1946ab	1926	35.1	0.022
DWG, g/d	38.8b	42.6a	41.0ab	42.6a	41.7ab	42.2ab	41.5	1.30	0.022
DFI, g/d	83.8	91.7	86.4	92.2	91.0	87.7	88.8	3.28	0.099
FCR	2.168	2.150	2.117	2.155	2.187	2.061	2.139	0.553	0.568
Mortality, %	19.5	19.9	17.5	11.4	16.2	17.4	17.0	4.74	0.402

$BW_{63:}$ body weight at 63 days, DWG: daily weight gain; DFI: daily feed intake; FCR: feed conversion ratio

CONCLUSIONS

The use of Fibosel® at 150 ppm in rabbit diets could be recommended as it improves rabbit growth performances and seems to decrease mortality rates. Further research with Fibosel® will be developed to corroborate these findings.

REFERENCES

Association of Official Analytical Chemists 2000. Official methods of analysis, 17th edition. *Association of Official Analytical Chemists, Arlington, VA, USA.*

Chae B.J., Lohakare J.D., Moon W.K., Lee S.L., Park Y.H., Hahn T.W. 2006. Effects of supplementation of β-glucans on the growth performance and immunity in broilers. *Research in Veterinary Science, 80(3), 291-298.*

Chamorro S., Gómez-Conde M.S., García J., De Blas C., Carabaño R. 2004. Effect of period, medication and dietary protein level on mortality of growing rabbits. *In: Proc. 4th Meeting of COST Action 848, Workshop on nutrition and pathology and prophilaxis, Madrid, Spain*.

Chamorro S., Gómez-Conde M.S., Pérez de Rozas A.M., Badiola I., Carabaño R., De Blas C. 2005.Efecto del nivel y tipo de proteína en piensos de gazapos sobre los parámetros productivos y la salud intestinal. *In: Proc. XXX Symposium de Cunicultura de ASESCU, Valladolid, Spain, 135-142.*

De Blas J.C., Perez E., Fraga M.J., Rodríguez M., Gávez J.F. 1981. Effect of diet on feed intake and growth of rabbits from weaning to slaughter at different ages and weights. *Journal of Animal Science, 53, 1225-1232.*

De Blas J.C., Mateos G.G. 1998. Feed Formulation. *In: De Blas C., Wiseman J. (Eds). The Nutrition of the Rabbit. CABI Publishing. CAB International, Wallingford Oxon, UK, 241-253.*

Dewrée R., Licois D., Coudert P., Lassence C., Vindevogel H., Marlier D. 2003. L'entéropathie épizootique du lapin (EEL) : étude du rôle des infections par *Clostridium perfringens* dans l'étio-pathogénie de ce syndrome. *In: Proc. 10èmes Journ. Rech. Cunicole, 2003 November, Paris, France, 251-254.*

FEDNA 2003 Tablas FEDNA de composición y valor nutritivo de alimentos para la fabricación de piensos compuestos (Second Edition). *Ed. Fundación Española para el Desarrollo de la Nutrición Animal, Madrid.*

Gutierrez I., Espinosa A., García J., Carabaño R., De Blas J.C. 2003. Effect of source of protein on digestion and growth performance of early-weaned rabbits. *Animal Research, 52, 461-471.*

Huff G.R., Huff W.E., Rath N.C., Tellez G. 2006. Limited treatment with β-1,3/1,6 glucan improves production values of broiler chickens challenged with *Escherichia coli. Poultry Science, 84 (4), 613-618.*

Le Normand B., Le Guenec J., Moalic P.Y. 2003. Contribution à l'étude toxinotypique des souches de *Clostridium perfringens* isolées dans l'entéropathie épizootique du lapin (EEL). Relation avec la clinique observée. *In: Proc. 10èmes Journ. Rech. Cunicole, 2003 November, Paris, France, 239-241.*

Li J., Li D.F., Xing J.J., Cheng Z.B., Lai C.H. 2006. Effects of β-glucan extracted from *Saccharomyces cerevisiae* on growth performance and immunological and somatotropic responses of pigs challenged with *Escherichia coli*. lipopolysaccharide. *J. Anim.Sci., 84, 2374-2381.*

Marlier D., Dewrée R., Licois D., Coudert P., Lassence C., Poulipoulis A., Vindevogel H. 2003. L'Entéropathie Epizootique du Lapin (EEL) : un bilan provisoire des résultats après 20 mois de recherches. *In: Proc. 10èmes Journ. Rech. Cunicole, 2003 November, Paris, France, 247-250.*

Marlier D., Dewrée R., Lassence C., Licois D., Mainil J., Coudert P., Meulemans L., Ducatelle R., Vindevogel H. 2006. Infectious agents associated with epizootic rabbit enteropathy: isolation and attempts to reproduce the syndrome. *Vet. J., 172, 493-500.*

Robertsen B., Rorstad G., Engstad R., Raa J. 1990. Enhancement of non-specific disease resistance in Atlantic salmon. Salmo salar L., by a glucan from *Saccharomyces cerevisiae* cell walls. *J. Fish Disease, 13, 391-400.*

SAS 1991. SAS/STAT User's Guide (Release 6.03). *SAS Inst. Inc., Cary NC, USA.*

Spanish Royal Decree 1201/2005 2005. Sobre protección de los animales utilizados para experimentación y otros fines científicos. *Boletín Oficial del Estado. 252, 34367-34391.*

Szalo I.M., Lassence C., Licois D., Coudert P., Poulipoulis A., Vindevogel H., Marlier D. 2007. Fractionation of the reference inoculum of epizootic rabbit enteropathy in discontinuous sucrose gradient identifies aetiological agents in high density fractions. *Vet. J., 173, 652-657.*

Van Soest J.P., Robertson J.B., Lewis B.A. 1991. Methods for dietary fiber, neutral detergent fiber and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci., 74, 3583-3597.*