Soybean meal substitution by torula yeast (*Candida utilis*) grown on vinasses in pelleted diets for fattening rabbits

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Four diets were evaluated in fattening rabbits of the White New Zealand breed. A completely randomized design with four treatments and 16 replications was used. Treatments consisted of the inclusion in the feed of 0, 5, 10 and 15% of torula yeast (*Candida utilis*) grown on vinasses from alcohol distillery, as soybean meal substitution. After 41 fattening days, the viability (75.00; 87.50; 93.75 and 87.50 %, respectively), live weight at slaughter (2204; 2233, 2193 and 2228 g/animal), average daily gain (37.49; 38.18; 37.40 and 38.03 g/animal), consumption (4912; 4985; 4946 and 4944 g/animal) and conversion (3.24; 3.20; 3.25 and 3.19) did not differ significantly between treatments. The same occurred with the weight and carcass yield, skin, liver, heart and kidneys. It is concluded that diets for fattening rabbits including torula yeast grown on vinasses from alcohol distillery, as partial or total substitute of soybean meal, do not provoke significant changes in the bio-productive indicators of the rabbits at the end of fattening neither on weight and carcass yield and edible organs after slaughter.

Key words: *rabbits, feeding, torula yeast*

In the last years, the amount and productivity of rabbits reared under intensive and semi-intensive conditions has increased significantly, as a result of genetic improvements and policies that stimulate the rearing of this species. As a consequence, the nutritive requirements and the consumption per unit of live weight have been increased. Therefore, the supply of adequate and balanced feeding encouraging feed consumption and that covers the nutritive requirements is important, so as these animals attain the maximum productive potential (La O 2007).

In addition to this growth of the rabbit mass in the world, the international economic crisis has worsened the feeding situation even in developed countries. The constant price rise of grains and cereals has compelled different countries to search for alternative feeds for animal consumption (Del Toro 2009). The situation generated by the high prices of conventional feeds increases the importance of alternative feeding systems. These systems offer true possibilities for producers, especially farmers, for increasing the productivity of their systems which can contribute to feeding security, protect the environment and increase the incomes of producers.

Torula yeast grown on vinasses from alcohol distillery is used as protein source in the diet of monogastric animals of commercial interest. Its excellent nutritional properties, animal growth promoters, have been demonstrated in studies carried out in Cuba by Mora and Lezcano (2008) in pigs and by Rodríguez *et al.* (2010) in poultry.

The studies showed the high potential of this raw material as the only protein source in the diet of the animals. However, in international literature is scarce and poorly studied the use of this protein source in the diet of fattening rabbits. Hence, the objective of this paper was to evaluate the inclusion of torula yeast, grown on vinasses from alcohol distillery, as soybean meal substitute in diets for fattening rabbits of the White New Zealand breed.

Materials and Methods

The study was developed at the Laboratory of Metabolism and Animal Calorimetric, from the Federal University of Minas de Gerais, Brazil. A total of 64 male and female rabbits of the White New Zealand breed, recently weaned with 30 d of age and an average live weight of 665 g/animal was used. Rabbits were housed in wire metabolism cages for fattening rabbits at a rate of one rabbit per cage, according to a completely randomized design. Four treatments and 16 replications were applied. Each treatment was constituted by the same amount of female and male animals. The experiment lasted 41 d and initial live weight, final live weight, viability, average daily gain, consumption and conversion were determined. Viability was analyzed by the method of comparison of proportions, using the Comparpro program, version 1.0 (Font *et al.* 2007). The covariance analysis was applied to the variable final weight. The initial weight was taken as covariable. The analysis of variance was applied to the remaining variables and Duncan's (1955) multiple range test was used. The SPSS 15.0 (SPSS 2008) was employed for this purpose.

Treatments consisted of the inclusion of 0, 5, 10 and 15 % of torula yeast (*Candida utilis*) grown on vinasses from alcohol distillery in the feed substituting the soybean meal. Table 1 shows the inclusion level of each raw material per treatment and their nutritional contribution. The chemical composition of the torula yeast, grown on alcohol distillery wastes is set out in table 2.

Water and feed were supplied *ad libitum*. Water was offered in individual drinking troughs placed inside each cage, while the feed was supplied in granulated form in individual metallic feeders placed in front of each cage. Feeders were refilled according to animal consumption. Throughout the experiment, feed consumption and refusal by each animal were controlled.

At the end of the experiment 32 rabbits, eight of each treatment was slaughtered for determining weight and carcass yield, skin, liver, heart, kidneys and full caecum. For processing these indicators an analysis of variance was realized according to a completely randomized design with four treatments and eight replications. Each slaughtered rabbit was considered a replication and Duncan's (1955) multiple range test was used for

Table 1. Raw materials used per treatment and their nutritive contribution (% of natural material)

Feeds (%)	Inclusion level of torula yeast (%)			
	0 (control)	5	10	15
Alfalfa hay meal	32.10	32.10	32.10	32.10
Wheat meal	25.00	25.00	25.00	25.00
Soybean meal	15.00	10.00	5.00	0.00
Powdered torula yeast	0.00	5.00	10.00	15.00
DMSE[1]	15.00	15.00	15.00	15.00
Maize meal	7.70	7.70	7.70	7.70
Soybean oil	2.00	2.00	2.00	2.00
Sugar cane final molasses	2.00	2.00	2.00	2.00
Dicalcium phosphate	0.11	0.11	0.11	0.11
Common salt	0.50	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50
DL methionine	0.09	0.09	0.09	0.09
Calculated contribution				
CP, %	18.00	18.00	18.00	18.00
DE MJ/kg	10.88	10.88	10.88	10.88
ADF, %	17.50	17.50	17.50	17.50
Ca, %	0.60	0.60	0.60	0.60
Total P, %	0.46	0.46	0.46	0.46
Lysine, %	0.78	0.78	0.78	0.78
Methionine + cystine, %	0.54	0.54	0.54	0.54

Diets were formulated according the requirements for the category (De Blas and Mateos 2010)
[1]Disintegrated maize with straw and elder

Table 2. Chemical composition of the torula yeast grown on vinasses from alcohol distillery (% dry matter)

Indicators % DM	Yeast grown on vinasses from distillery
Dry matter	92.53
Organic matter	90.20
CP (N x 6.25)	43.28
GE MJ/kg	16.67
CF	2.11
Calcium	0.93
Total phosphorus	1.61
Lysine	4.5
Methionine + cystine	1.7

Data taken from Rodríguez *et al*. (2010 finding the difference between means.

Results and Discussion

Viability in the treatments evaluated is shown in table 3 and did not present significant difference between treatments. This differs from results obtained by Scheele and Bolder (1987) who observed significant increase in the mortality of young rabbits when they received a pre-weaning feed with 20 % of soybean meal, instead of a protein mixture of plant origin with protein of animal origin (casein, fish meal and of meat). In that connection, Carabaño *et al*. (2005) reported that the feeding change at weaning does not only implies a modification in the protein level of the feed, but also occurs in the source. These authors indicate that milk proteins of easy digestion are changed by plant protein of more difficult digestion and in many cases with the presence of anti-nutritive factors that can damage the intestinal mucosa and increase the nitrogen flow to the caecum. They also mention in this case the diets containing soybean, as one of the sources that produces more ileal protein flow.

Morales (2007) on referring to torula yeast as protein source states that it possess polysaccharides in the cell wall, of beta-glucane and mannan type, that could have effect on the immune system of the animals and on pathogen exclusion at digestive scale. As response to these effects, this author explains that the development of the digestive mucosa is favored and better immune-competition is maintained which reduces mortality risks.

In this study, live weight at slaughter (table 3) surpassed in all treatments the 2 kg established internationally for the commercialization of fattening rabbits and did not differ significantly between treatments. The same occurred with daily live weight gain, consumption and conversion which did not show significant differences according to the substitution level of soybean meal by torula yeast, obtained from alcohol distillery wastes.

The high content of crude protein (43-45 %) of the torula yeast obtained from vinasses from distillery, as well as its amino acid composition, B complex vitamins and minerals (Rodríguez *et al*. 2010), made possible to attain similar productive results to those obtained with conventional diet.

In similar studies, Scapinelo *et al*. (1996) gradually substituted the soybean meal by *Saccharomyces spp.* yeast, obtained from sugar cane final molasses in rations for growing rabbits. These authors did not find damage in the performance of animals, with the inclusion of 15.4 % of yeast, as total replacer of soybean meal. However, Carregal and Fonseca (1990) working with growing rabbits obtained better weight gain and feed conversion when the ration contained 75 % protein from soybean meal and 25 % of yeast protein. In this sense, Gutiérrez *et al*. (2002) observed that the substitution of soybean meal by animal plasma in starter feeds for young rabbits has a positive effect on the morphology of the intestinal mucosa, feed consumption and growth. This is in agreement with the results of Scheele and Bolder (1987) who recommended mixing plant origin protein with other of animal or microbial nature in the diet, since in this way, according to these authors, mortality is reduced and the productive indicators are favored.

The lack of significant differences in the bio-productive results, as well as the nutritional quality of the diets supplied, made possible that the carcass weight as well as that of the skin, liver, heart, kidneys and full caecum (table 4) did not show significant differences between treatments. Neither there were significant differences in the yield of these organs (table 5). These results are due to the fact that the four groups had similar final weight at slaughter, the same age and degree of maturity. In this sense, Butterfield (1988) indicated that when various groups of animals coincide in the degree of maturity, the carcass composition and remaining organs present little variability.

Vásquez and Martínez (2009) slaughtered White New Zealand rabbits fed conventional diets reaching 53 % carcass yield, values that surpassed those attained in this study. However, these authors slaughtered animals with older age than that registered in this study. According to Ramírez (2004) this determines higher carcass yield, since in the first growth stages of the rabbit, viscera develop faster than other components. If rabbits are slaughter at a young age, carcass yield would be poorer. Also, as stated by this author, carcass yield tends to increase slightly with age, as the muscle tissue is more developed and the adipose tissue is mainly accumulated at the dorsal

Table 3. Productive indicators of rabbits at 41 d of fattening

Indicators	Inclusion levels of torula yeast, %				SE ±
	0 (Control)	5	10	15	
Viability	75.00	87.50	93.75	87.50	8.69
Initial LW (30 d), g/rabbit	665.00	660.00	664.00	667.00	22.62
LW (71 d), g/rabbit	2204.00	2233.00	2193.00	2228.00	71.94
LW gain, g/rabbit	37.49	38.18	37.40	38.03	1.58
Total consumption, g	4912.00	4985.00	4946.00	4944.00	184.31
Conversion	3.24	3.200	3.25	3.19	0.10

$P < 0.05$ (Duncan 1955)

Table 4. Carcass weight, skin, liver, heart, kidneys and caecum of rabbits slaughtered at 71 d of age

Indicators, g	Inclusion levels of torula yeast, %				SE ±
	0 (Control)	5	10	15	
Carcass weight	1139.00	1132.00	1167.00	1121.00	47.28
Skin weight	242.05	241.61	245.00	232.35	11.42
Liver weight	96.37	88.02	87.96	96.97	9.13
Heart weight	4.69	5.17	5.06	4.65	0.28
Kidneys' weight	15.90	16.69	16.07	15.72	0.79
Full caecum weight	111.86	118.20	116.57	117.69	5.10

$P < 0.05$ (Duncan 1955)

Table 5. Carcass yield, skin, liver, heart, kidneys and caecum of rabbits slaughtered at 71 d of age

Indicators, %	Inclusion levels of torula yeast, %				SE ±
	0 (Control)	5	10	15	
Carcass yield	49.93	49.73	50.44	50.67	0.38
Skin yield	10.61	10.65	10.57	10.53	0.33
Liver yield	4.19	3.82	3.79	3.80	0.21
Heart yield	0.21	0.23	0.22	0.21	0.01
Kidneys' yield	0.70	0.73	0.70	0.71	0.02
Full caecum yield	4.92	5.22	5.05	5.33	0.19

$P < 0.05$ (Duncan 1955)

region of the animal.

In studies published by Leyva (2010) in which alternative diets were used in fattening rabbits of the White New Zealand breed, carcass and edible viscera yields were found that are similar to those observed in the control treatment with conventional diets, even though the final weight in this latter was higher. This is justified by the slaughter age which was at 125 d for all treatments.

It is concluded that diets for fattening rabbits including torula yeast grown on vinasses from alcohol distillery, as partial or total substitute of soybean meal, do not create significant changes on the bio-productive indicators of rabbits at the end of fattening, or in the weight and carcass yield and edible organs after slaughter.

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