

Effects of *Saccharomyces cerevisiae* Yeast on Tibia Bone Characteristics in Rabbits

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Abstract: The effect of feeding different levels of yeast *Saccharomyces cerevisiae* on tibial bone characteristics of the New Zealand rabbits was studied. An experiment of 85 days duration was conducted with male 5-6 weeks old rabbits. There were 3 dietary treatments each consisting of 7 rabbits in each. The treatments were containing 0 (control), 2 and 4 g kg⁻¹ yeast (*Saccharomyces cerevisiae*) in their diet, respectively. At the end of the experiment the right tibia of rabbits were dissected from the surrounding tissues and used for bone force and stress measurements. Results show that there is no effect of feeding with different level of *Saccharomyces cerevisiae* yeast on body weight, tibia weight and length, bone force and stress values of tibia of the rabbits.

Key words: New Zealand rabbits, *Saccharomyces cerevisiae* yeast, tibia, bone characteristics, measurements, feeding

INTRODUCTION

Saccharomyces cerevisiae is well-known yeast used in the food industry and has biologically valuable proteins, Vitamin B complex, important traces minerals and several unique plus factors. Many other beneficial factors identified such as ability to enhancement of phosphorus availability (Glade and Biesik, 1986; Brake, 1991; Moore *et al.*, 1994) and utilization by animals (Thayer *et al.*, 1978; Erdman, 1989; Pagan, 1990), reduction in cases of disease infection (Line *et al.*, 1997) in addition, improvement of feed efficiency (Day, 1997; Onifade and Babatunde, 1996; Celik *et al.*, 2008; Vamanu *et al.*, 2008; Payandeh and Kafilzadeh, 2007; Patra, 2012). Moreover, it has now been demonstrated that this yeast can cause different forms of invasive infection (McCullough *et al.*, 1998; Eddy *et al.*, 1997; Cassone *et al.*, 2003) frequently after administration as a probiotic for the treatment of antibiotic-related diarrhea (Bleichner *et al.*, 1997). Santin *et al.* (2001) reported that manna oligosaccharides and fructo-oligosaccharides in the cell wall of yeast assist the balance of the the gastro-intestine by maintaining or reestablishing the conditions of eubiosis in the digestive tube. Some researchers (Hayat *et al.*, 1993; Bradley and Savage, 1985) have attributed the increase in mineral retention and better bone mineralization of broilers supplemented with manna oligosaccharide probiotic.

The *osteocalcin* gene is regulated in mammalian osteoblasts by 1,25 (OH) 2D3-dependent and independent mechanisms. It is so important bone formation. Also it is showed that *Saccharomyces cerevisiae* cells engineered to produce active 1,25 (OH) 2D3 receptor (Donald *et al.*, 1989). Osteoporosis and bone fraction are common

problem in public health (Cooper and Melton, 1992; Schapira *et al.*, 1995). In both cases, nutrient is a major factor (Bonjour *et al.*, 1996). This research therefore has the objective of evaluating the effects of feeding different levels of supplemental yeast (*Saccharomyces cerevisiae*) on bone strength in adult New Zealand rabbits.

MATERIALS AND METHODS

Twenty one, 5-6 weeks old adult, male New Zealand rabbits (Experimental Animals Breeding and Research Center, Uludag University, Bursa, Turkey) were used in the experiments. The experimental protocols were approved by the Animal Care and Use Committee of Uludag University and were in accordance with the National Institute of Health Guide for the Care and Use of Laboratory Animals (Protocol No.: 06.05.2008-2008-7/5). Rabbits were housed five per cage in controlled conditions of temperature (20-24°C), humidity (60-70%), lighting (12 h light/dark cycle) and provided with food (16% protein and 2500 kcal kg⁻¹ energy) and water *ad libitum*. Animals divided into three groups; 0, 2 and 4 g kg⁻¹ *Saccharomyces cerevisiae* yeast added in their diet, respectively for 85 days. *Saccharomyces cerevisiae* yeast (5×10⁹ centrifugal units g⁻¹, YEASACC1026) bought from Alltech Biotechnology Center, Nicholasville, Kentucky.

At the end of the experiment, the rabbits were killed humanely by decapitation. The right tibia was immediately dissected from the surrounding tissues and kept frozen in plastic bags at -20°C until necessary measurements. Frozen tibia was later thawed at room temperature for 1 h (Crenshaw, 1986). Bone weight (Precisa XB 4200C, Zurich, Switzerland) and length (digital compass, Mitutuyo



Fig. 1: Cross section of the Tibia, I Section: P = Proximal section), II Section: C = Medial section), III Section: D = Distal section

Corporation, Kawasaki, Japan) were measured. Physical bone characteristics were determined by three-point bending test commonly used to assess bone strength in poultry (Crenshaw *et al.*, 1981). Thus, diaphyseal shaft was divided into 3 sections (proximal, mid and distal) having a thickness of 0.6 cm by using an Instron Universal Testing Machine (Model 4301, Instron Corp., Canton, MA 02021) fitted with a 5 kN load cell (Fig. 1). Bones were placed dorsal side up on support 7 cm apart. The centre of each bone was aligned with the breaking probe which approached at 25.4 mm min⁻¹. Ultimate bone breaking force (Newtons-N) and stress (Megapascals-MPa) were determined for each tibia.

Body weight and bone properties of rabbits in the groups were analyzed using ANOVA with the General Linear Model procedure of SPSS® Computer Software 10.00. Results presented in the tables for the body weight and bone properties are expressed as mean values±SE.

RESULTS AND DISCUSSION

As it was shown in Table 1, feeding with different level of *Saccharomyces cerevisiae* yeast had not any effect on body weight, tibia weight and length of the rabbits. Furthermore feeding with different level of *Saccharomyces cerevisiae* yeast did not produce any difference on bone force and stress values of Proximal (P), mid (C) and Distal (D) sections of tibia (Table 2).

The data shows that there is no effect of feeding with different level of *Saccharomyces cerevisiae* yeast on body weight, tibia weight and length, bone force and stress values of tibia of the rabbits.

The effect of *Saccharomyces cerevisiae* on rabbit weight had already been studied by researchers

Table 1: Body weight, tibia weight and length of rabbits feeding with *Saccharomyces cerevisiae*

N:7	Body weight (g)	Tibia weight (g)	Tibia length (mm)
Control	2444.91±88.44	8.72±0.18	104.08±1.26
2 g kg ⁻¹	2558.60±99.11	8.68±0.33	103.41±2.59
4 g kg ⁻¹	2509.29±80.03	8.70±0.22	104.22±1.11
ANOVA	NS	NS	NS

Table 2: Breaking force and stress values of Proximal (P), Mid (M) and Distal (D) sections of tibia

N:7	Breaking force (N)	Stress (MPa)
Control		
P	1862.14±241.59	310.34±40.26
C	1848.14±142.12	308.02±24.85
D	1627.14±237.90	271.18±39.63
2 (g kg⁻¹)		
P	1801.28±137.57	300.21±22.93
C	2051.16±93.910	323.11±15.65
D	1938.66±249.01	341.85±41.50
4 (g kg⁻¹)		
P	1785.33±203.27	297.55±33.88
C	1857.28±220.76	308.40±36.97
D	1648.42±135.77	276.41±23.02
ANOVA	NS	NS

NS: Not Significant

(Seevaratnam *et al.*, 1989; Paryad and Mahmoudi, 2008; Gheisari and Kholehipour, 2008). Oguz and Sakine submitted bodyweight decreases with increase of yeast in diet. Whereas Seevaratnam *et al.* (1989) and Gheisari and Kholehipour (2008) studies obtained no effect. Sonsank on quails and Paryad and Mahmoudi (2008) on broilers showed statistical increase on bodyweight with addition of 1.5% yeast. In the study, the rabbits in the group that added 2 g kg⁻¹ yeast had more body weight according to control group. However, this has not showed statistical significance. Furthermore, there is no effect between 2 and 4 g kg⁻¹ addition of *Saccharomyces cerevisiae* yeast on body weight.

Contrary to the findings obtained by Paryad and Mahmoudi (2008), Rao *et al.* (1999) and Park *et al.* (1995) in the present study feeding with different level of *Saccharomyces cerevisiae* yeast did not produce any difference on tibia weight and length.

To the best of their knowledge, there is no documentation about bone force and stress in rabbits so far. Akhavan-Salamat *et al.* (2011) submitted that addition of yeast increases bone calcium values and this improves bone force in broilers. However, Ghasemi *et al.* (2006) reported *Saccharomyces cerevisiae* yeast had no effect on tibia of broilers.

Present study showed feeding with different level of *Saccharomyces cerevisiae* yeast did not produce any statistical difference on bone force and stress. Nonetheless, breaking force showed the highest value in the 2 g kg⁻¹ yeast added rabbit group. Also, the medial section showed the highest results in this group.

As a result, feeding different levels of yeast *Saccharomyces cerevisiae* showed no statistical effect on bodyweight and morphological characteristics of tibial bone of the New Zealand rabbits.

In the mechanical bone characterization tests, it was determined that the yeast culture had not any effect bone force. However, bone force results obtained the group feeding with 2 g kg⁻¹ yeast had better than other groups.

CONCLUSION

This study shows that in the first time, effect of feeding with different level of *Saccharomyces cerevisiae* yeast on bone mechanical characteristics in rabbit other than its beneficial effects as a food supplement.

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