Journal of Animal and Veterinary Advances 11 (10): 1518-1521, 2012
ISSN: 1680-5593

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

Ilker Arican
Department of Anatomy, Faculty of Veterinary Medicine, Uludag University,
16059 Gorukle Bursa, Turkey

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 fruct-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 (5×10^9 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 Kholeghipour, 2008). Oguz and Sakine submitted bodyweight decreases with increase of yeast in diet. Whereas Seevaratnam *et al*. (1989) and Gheisari and Kholeghipour (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.

ACKNOWLEDGEMENTS

This study was funded by the Research Fund (2008165). The researcher thanks Dr. Huseyin Yildiz and Dr. Nurten Galip for their editorial assistance in the preparation of the manuscript.

REFERENCES

Akhavan-Salamat, H., H.A. Ghasemi, A.H. Khaltabadi-Farahani and M. Kazemi-Bonchenari, 2011. The effects of *Saccharomyces cerevisiae* on performance and nutrients digestibility in broilers fed with diet containing different levels of phosphorous. Afr. J. Biotechnol., 10: 7526-7533.

Bleichner, G., H. Ble'haut, H. Mente and D. Moyse, 1997. *Saccharomyces boulardii* prevents diarrhea in critically ill tube-fed patients. Intensive Care Med., 23: 517-523.

Bonjour, J.P., M.A. Schurch and R. Rizzori, 1996. Nutritional aspects of hip fractures. Bone, 18: 139S-144S.

Bradley, G.L. and T.F. Savage, 1985. The effect of cerevisiae on turkey poult performance and the retention of gross energy and selected minerals. Anim. Feed Sci. Technol., 55: 1-7.

Brake, J., 1991. Lack of effect of all live yeast culture on broiler, breeders and progeny performance. Poult. Sci., 70: 1037-1039.

Cassone, M., P. Serra, F. Mondello, A. Girolamo, S. Scafetti, E. Pistella and M. Venditti, 2003. Outbreak of *Saccharomyces cerevisiae* subtype *boulardii* fungemia in patients neighboring those treated with a probiotic preparation of the organism. J. Clin. Microbiol., 41: 5340-5343.

Celik, K., A. Uzatici and A.E. Akin, 2008. Effects of dietary humic acid and *Saccharomyces cerevisiae* on performance and biochemical parameters of broiler chickens. AJAVA., 3: 344-350.

Cooper, C. and J. Melton, 1992. Epidemiology of osteoporosis. Trends Endocrinol. Metab., 3: 224-229.

Crenshaw, T.D., 1986. Reliability of dietary Ca and P and bone mineral contents as predictors of bone mechanical properties at various time periods in growing swine. J. Nutr., 116: 2155-2170.

Crenshaw, T.D., E.R. Peo Jr., A.J. Lewis and B.D. Moser, 1981. Bone strength as a trait for assessing mineralisation in swine: A critical review of techniques involved. J. Anim. Sci., 53: 827-835.

Day, E.J., 1997. Effect of Yeast Culture on Tibia Bone in Three Week Old Broiler Chickens Fed Graded Level of Inorganic Phosphorus. Missisipi State University, Stark Villiams.

Donald, P., J. Mcdonnell, P. Wesley, T.R. Butt and B.W. O 'Malley, 1989. Reconstitution of the Vitamin D-responsive osteocalcin transcription unit in *Saccharomyces cerevisiae*. Mol. Cell. Biol., 9: 3517-3523.

Eddy, J.T., M.K. Stamatakis and E.H. Makela, 1997. *Saccharomyces boulardii* for the treatment of *Clostridium difficile* associated colitis. Ann. Pharmacother, 31: 919-921.

Erdman, J.W., 1989. Phytic Acid Interactions with Divalent Cations in Foods and in Gastro Intestinal Tract. In: Mineral Absorption in Monogastric Gastro-Intestinal Tract, Dintizisand, F.R. and J.A. Laszlo (Eds.)., Plenum Press, New York, ISBN: 0306432005 pp: 161-170.

Ghasemi, H.A., A.M. Tahmasbi, G. Moghaddam, M. Mehri, S. Alijani, E. Kashefi and A. Fasihi, 2006. The effect of phytase and *Saccharomyces cervisiae* (Sc47) supplementation on performance, serum parameters, phosphorous and calcium retention of broiler chickens. Int. J. Poult. Sci., 5: 162-168.

Gheisari, A.A. and B. Kholeghipour, 2008. Effect of dietary inclusion of live yeast (*Saccharomyces cerevisiae*) on growth performance, immune responses and blood parameters of broiler chickens. Revista electronica de Veterinaria, 9: 1695-7504.

Glade, M.J. and L.M. Biesik, 1986. Enhanced nitrogen retention in yearling horses supplemented with yeast culture. J. Anim. Sci., 62: 1635-1640.

Hayat, J., T.F. Savage and L.W. Mirosh, 1993. The reproductive performance of two genetically distinct lines of medium white turkey hens when fed breeder diets with and without a yeast culture containing *Saccharomyces cerevisiae*. Anim. Feed Sci. Tech., 43: 291-301.

Line, J.E., J.S. Bailey, N.A. Cox and N.J. Stern, 1997. Yeast treatment to reduce Samonella and Camylebacter population associated with broiler, chickens subjected to transport stress. Poult. Sci., 76: 1227-1231.

McCullough, M.J., K.V. Clemons, J.H. McCusker and D.A. Stevens, 1998. Species identification and virulence attributes of *Saccharomyces boulardii* (nom.inval.). J. Clin. Microbiol., 36: 2613-2617.

Moore, B.E., K.E. Newman, P. Spring and F.E. Chandler, 1994. The effect of yeast culture (Yea Sace 1026) in microbial populations digestion in the cecumand colon of the equine. J. Anim. Sci., 72: 1-1.

Onifade, A.A. and G.M. Babatunde, 1996. Supplemental value of dried yeast in a fibre diet for broiler chicks. Anim. Feed Sci. Tec., 62: 91-96.

Pagan, J.D., 1990. Effect of yeast culture supplementation on nutrient digestibility in mature horses. J. Anim. Sci., 68: 371-375.

Park, S.J., N.J. Kim, S.C. Kwon, S.J. Lee and J.M. Cho, 1995. Efficiacy tests of recombinant human growth hormone produced from *Saccharomyces cerevisiae*. J. Biochem. Mol. Biol., 28: 437-442.

Paryad, A. and M. Mahmoudi, 2008. Effect of different levels of supplemental yeast (*Saccharomyces cerevisiae*) on performance, blood constituents and carcass characteristics of broiler chicks. Afr. J. Agric. Res., 3: 835-842.

Patra, A.K., 2012. The use of live yeast products as microbial feed additives in ruminant nutrition. Asian J. Anim. Vet. Adv., 7: 366-375.

Payandeh, S. and F. Kafilzadeh, 2007. The effect of yeast (*Saccharomyces cerevisiae*) on nutrient intake, digestibility and finishing performance of lambs fed a diet based on dried molasses sugar beet-pulp. Pak. J. Biol. Sci., 10: 4426-4431.

Rao, S.V.R., V.R. Reddy and V.R. Reddy, 1999. Enhancement of phytate phosphorus availability in the diets of commercial broilers and layers. Anim. Feed Sci. Technol., 79: 211-222.

Santin, E., A. Maiorka, M. Macari, M. Grecco, J.C. Sanchez, T.M. Okada and A.M. Myasaka, 2001. Performance and intestinal mucosa development of broiler chickens fed diet containing *Sccharomyces cerevisiae* cell wall. J. Applied Poult. Res., 10: 236-244.

Schapira, D., S. Linn, M. Sarid, S. Mokadi, A. Kabala and M. Silbermann, 1995. Calcium and vitamin D enriched diets increase and preserve vertebral mineral content in aging laboratory rats. Bone, 16: 575-582.

Seevaratnam, S., C.T. Ravirajan, K. Balasubramaniam, V.S. Varman, M. Jayaratnam and K. Jayaseelan, 1989. Feeding trials on rabbits using a *Saccharomyces cerevisiae* strain. J. Natl. Sci. Counc. Sri Lanka, 17: 73-82.

Thayer, R.H., R.F. Burket, R.D. Morrison and E.F. Murray, 1978. Efficiency of utilization of dietary phosphorus by caged turkey breeder hens when fed rations supplemented with live yeast culture. Animal Science Research Report MP-103, Oklahoma State University, Stillwater, OK., USA.

Vamanu, E., A. Vamanu, O. Popa, T. Vassu and R. Ghindea *et al*., 2008. Effect of the yeast and bacteria biomass on the microbiota in the rumen. Pak. J. Biol. Sci., 11: 2217-2223.