

# EVALUATION OF MEAT QUALITY OF WEANED RABBITS ADMINISTERED DIFFERENT CONCENTRATIONS OF PROBIOTIC STRAIN (*Saccharomyces boulardii*)

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**Abstract:** The meat quality and sensory properties of weaned rabbits administered different concentrations/cell count of probiotic *Saccharomyces boulardii* (flora norm) were investigated. A total of 36 mixed breeds of rabbits were randomly divided to four treatments with three replicates and three rabbits per replicate. The weaned rabbits were fed the same diet. Treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> had zero (0) concentration/cell count of probiotic, 1ml each of  $160 \times 10^6$  it is  $1.6 \times 10^8$  cfu/ml concentration of probiotic, 1 ml each of  $80 \times 10^6$  cfu/ml =  $8.0 \times 10^7$  cfu/ml of probiotic and 1 ml each of  $40 \times 10^6$  cfu/ml concentration of probiotic, respectively. The administration of the probiotic was done once every 14 days. Results obtained showed that there was no significant difference in moisture and crude protein content of meat from rabbits while ether extract differed significantly ( $P < 0.05$ ). The physical properties, cooking yield, cooking loss and water holding capacity were not significantly ( $P > 0.05$ ) influenced by concentrations of probiotics while pH and thermal shortening were significantly ( $P < 0.05$ ) influenced. All the sensory parameters measured were significantly ( $P < 0.05$ ) different. It was found that oral administration of probiotic *Saccharomyces boulardii* (flora norm) at 4 mg/ml  $80 \times 10^6$  cfu/ml concentration improved meat qualities and overall acceptability of rabbit meat.

**Key words:** Meat quality, rabbits, administered, probiotic

## Introduction

The anticipated increase in the world's population is to have a severe consequence on food intake especially animal protein intake. According to

*Delgade et al. (2001)*, the yearly requirement for animal protein in the third world is projected to increase from 11 million tons in 1997 to 213 million tons in 2020. This requirement for meat as well as the financial difficulty experienced by the people in the third world is motivating larger attention to rapid growing animals as well as short production interval likes rabbits (*Aduku and Olukosi, 1990*). The demand for safe and quality meat in the market has considerably increased. The producers are eager to use natural and nonchemical supplements which positively affect the animal health, increase productivity and improve meat.

The word probiotic was in 1953 introduced firstly by Kollath (*Isolauri et al., 2002*). Several meanings have been written for the word “probiotic”. The most generally recognized one is “live microorganisms which, if added in sufficient quantity, promote health on the host” (*FAO, 2003*). Application of probiotics can lead in increase of the carcass output and water holding capacity and decrease the meat hardness (*Ceslovas et al., 2005*). In animal nutrition, microorganisms used as probiotic were linked with a proven efficacy on the gut microflora. Administration of probiotic in feed significantly improves the feed intake, feed conversion ratio, daily weight gain and total body weight in pig, chicken, sheep, goat, cattle and equines (*Samli et al., 2007*). Several probiotic strains have been utilized for fermented sausages such as lactic acid producing bacteria, mainly *Lactobacillus*, *Pediococcus* and *Streptococcus* (*Hammes and Knauf, 1994*). In many countries of the world, particularly in Europe, the use of antibiotics in animal food is now banned as a result of residues in meat and meat products, and increase in bacteria resistance in human population. As a result of this, coupled with the increased pressure by consumers and agencies of government to decrease and even eliminate the usage of antibiotics in food producing animals, the usage of antibiotics as growth promoting agent has been banned. This action now created the need to find an alternative for the maintenance of health and production in livestock. This has led to the concept of using probiotics to replace antibiotics (*Fuller, 1997*). Therefore, the aim of this study was to evaluate meat quality of weaned rabbits administered different cell count of strain *Saccharomyces boulardii* (flora norm).

#### Materials methods

The experiment was conducted at the rabbitry section of the Teaching and Research Farm of the Department of Animal Production, School of Agriculture and Agricultural Technology, Federal University of Technology Minna, Niger State, Nigeria. Minna lies between the Latitude 9° 31 and 9° 45 North, and Longitude 6°31 and 6° 45, East of the equator (*Usman, 2011*).

#### Source of probiotic and preparation

*Saccharomyces boulardii* (flora norm) used for the experiment was procured from Prisma Pharmaceutical Limited Jubilee House, Merrion Avenue, Stanmore, and Middlesex, U.K. It is a product of Bharat Biotech International Limited, Genome Valley, Shameerpet, and Hyderabad, India. Serial dilution

methods were used to obtain the required inclusion rates for the probiotic in 1 ml of the mixture as described by Donev *et al.* (2008). Description of the dose. Serial dilution and bacterial count 1 (one) sachet of *Saccharomyces boulardii* contains 250mg and 5 (five) billion colony forming units (cfu) of *Saccharomyces boulardii*. Four levels were used; 0, 8 mg/ml, 4 mg/ml and 2 mg/ml respectively. Therefore, 8mg/ml =  $8/250 \times 5,000,000,000 = 160,000,000$  cfu/ml ( $160 \times 10^6$ cfu/ml), 4mg/ml =  $4/250 \times 5,000,000,000 = 80,000,000$  cfu/ml ( $80 \times 10^6$ cfu/ml) and 2mg/ml =  $2/250 \times 5,000,000,000 = 40,000,000$ cfu/ml( $40 \times 10^6$ cfu/ml). After the preparation of probiotic concentration, clean syringe (10 ml) was used to administer the concentration orally.

#### *Experimental rabbits and their management*

The weaned rabbits were bought from the National Veterinary Research Institute (N.V.R.I) Vom, Plateau State, Nigeria. The rabbits were mixed breeds. They were fed with concentrates, forages and clean drinking water *ad-libitum*. The concentrate were pelletized grower mash (Vital feeds, Grand Cereals and Oil Mills Limited, Jos, Nigeria). The forages used were *Tridax*, *Stylosanthes* and cabbage. A day after their arrival, they were given Ivomectin at 0.3 ml subcutaneously against both ecto and endo-parasites. Completely randomized design (CRD) was used for the research. The experiment consisted of four treatments; each treatment had three replicates with each replicate having three rabbits. Treatment one ( $T_1$ ) represented zero level of probiotic, treatment two ( $T_2$ ) represented 8 mg/ml ( $160 \times 10^6$ cfu/ml) of probiotic, treatment three ( $T_3$ ) represented 4 mg/ml ( $80 \times 10^6$ cfu/ml) of probiotic while treatment four ( $T_4$ ) represented 2 mg/ml ( $40 \times 10^6$ cfu/ml) of probiotic respectively. The probiotic was administered orally using a syringe at 1ml per rabbit once every two weeks. The experiment lasted for 8 weeks (56 days).

**Table 1. Doses of probiotic *Saccharomyces boulardii* orally administered to weaning rabbits.**

Treatment	Concentration (ml)
T1	Control ( no probiotic)
T2	8mg/ml ( $160 \times 10^6$ cfu/ml)
T3	4mg/ml ( $80 \times 10^6$ cfu/ml)
T4	2mg/ml ( $40 \times 10^6$ cfu/ml)

The meat quality characteristics of rabbits were determined according to the method of Awosanya (1989). The slaughtering method was approved by the authorities of the Federal University of Technology Minna. After the conclusion of the growth experiment, 12 rabbits were randomly selected from the four treatments, one rabbit from each replicate. Their final live weights were determined and recorded, then fasted overnight by allowing the animals' access to water only. They were then slaughtered using a knife by means of cutting through the jugular vein and carotid artery around the atlas bone. The rabbits were suspended with the head facing down-ward for 20 minutes to ensure complete bleeding. The changes in the shrunk weight and the weight after bleeding were taken as the blood loss. The rabbits were dressed by complete removal of their hairs, skins (pelts); and were cut at the atlanto-occipital joint. The rear legs were cut at the junction linking the tibia calcaneus while the front legs were severed close to the carpal area and the tail (near the base) removed, and their weights taken separately to accomplish evisceration. The meat quality characteristics were determined.

#### *pH of rabbit meat*

The pH of meat samples were determined according to the method of Marchiori and deFelicio (2003) using a pH meter (Model 191, Knick, Berlin Germany). A 10 g sample of meat was homogenized in 90 ml distilled water using a blending machine (model 242, Nakai, Japan) at speed 5. The pH meter was standardized using buffers 4 and 7, after which the pH reading of the meat samples were taken.

#### *Water holding capacity (WHC)*

The water holding capacity of meat samples were determined using the method described by Kauffman *et al.* (1992). A section of the meat from the chunk and shank were cut, weighed and kept in a container. Water holding capacity was carried out by cutting a portion of meat weighing approximately 10 g. The sample was pressed using a screw jack until all the free water was expelled. The meat sample was then removed, unwrapped and re-weighed. The difference in weight of meat sample represents the weight of expelled fluid and expressed as a percentage of the initial sample weight and recorded as water holding capacity of the meat.

#### *Cooking yield and cooking loss*

The cooking yield and cooking loss were determined using the method described by Kauffman *et al.* (1992). A portion of the chuck and Shank were selected for broiling. Broiling was done in an open gas oven. The racks were covered with perforated aluminum foils for ease of drainage; the oven was preheated for 5 minutes, before loading samples, which was boiled to a temperature of 72°C as measured with a skewer meat thermometer. The sample was allowed to

cool to room temperature, excess fluid was mopped up with paper serviette and their weights were taken and recorded. The difference between the pre-cooked weight and post weight was the cooking loss. While the cooking yield was calculated as cooked weight/thawed weight x100.

### *Sensory Evaluation of Meat from the Hind Limb of Rabbits*

Lean meats from the hind limb from each treatment group were used to evaluate the sensory attributes. Various cuts of the meat were made into bite sizes and boiled in water without salt at 80 °C for 10 minutes. The meat samples were left to cool to room temperature and then served in coded plates to a 20-member panelist comprising of staff and students of Federal University of Technology Minna, Nigeria who are familiar with rabbit meat. The order of presentation of the samples to the panelist was randomized. The Panelists were instructed to evaluate the meat for appearance, taste, juiciness, chewiness, texture, aroma and overall acceptability on a 9-point Hedonic scale (where 1= dislike extremely and 9=like extremely). Panelist were served with cold water after each evaluation of the meat sample to rinse their mouth to avoid carryover effect during sensory evaluation.

### *Proximate Composition*

The moisture, crude protein and ether extract content of meat samples from the hind limb were determined according to AOAC (2000) method.

### *Statistical analysis*

Data obtained were subjected to analysis of variance (ANOVA) and differences among means were compared Duncan's Multiple Range Test at 5% probability level. All computations were made by statistical software SPSS (version 6).

## **Results**

The meat quality of weaned rabbits orally administered different doses of probiotic (*Saccharomyces boulardii*) is presented in Table 2. The table revealed that the cooking yield, cooking loss and the water holding capacity of the rabbit meat were not significantly ( $P>0.05$ ) influenced by the count cell of probiotic (*Saccharomyces boulardii*). However, the pH values and the thermal shortening of the rabbit meat were significantly ( $P<0.05$ ) influenced by the different cells count of probiotic (*Saccharomyces boulardii*). The pH of rabbit meat in T<sub>1</sub> (6.79) and T<sub>3</sub> (6.75) are similar but significantly ( $P<0.05$ ) higher than those of T<sub>2</sub> (6.63) being the least. Furthermore, the outcome revealed that the thermal shortening was significantly ( $P<0.05$ ) higher in T<sub>1</sub> (5.42%), and the least value for thermal shortening was obtained in T<sub>3</sub> (1.70 %). The proximate composition of the meat of

rabbits orally administered probiotic (*Saccharomyces boulardii*) is shown in Table 3. The result revealed that different cells count of probiotic (*Saccharomyces boulardii*) orally administered to the weaned rabbits did not significantly ( $P > 0.05$ ) influenced the moisture and crude protein content of the rabbit meat. However, the ether extract of the rabbit meat was significantly ( $P < 0.05$ ) influenced by the different cells count of the probiotic. The result showed that ether extract was significantly ( $P < 0.05$ ) higher in meat of weaned rabbit in  $T_3$  (9.51%), but statistically ( $P > 0.05$ ) similar to those in  $T_4$  (8.49%), while the lowest ether extract was obtained in meat sample of the weaned rabbit in  $T_1$  (6.31%). The sensory evaluation of rabbit meat orally administered probiotic *Saccharomyces boulardii* is shown in Table 4. All sensory items studied were significantly ( $P < 0.05$ ) influenced by various cell counts of probiotic *Saccharomyces boulardii* orally administered to the weaning rabbit. The result showed that all the parameters measured (colour, tenderness, juiciness, flavour and over all acceptability) had a similar trend. The meat from rabbits orally administered probiotic ( $80 \times 10^6$  cfu/ml =  $8.0 \times 10^7$ ) in  $T_3$  had the highest sensory scores compared to all other treatments which are similar.

**Table 2. Meat quality characteristics of rabbits orally administered *Saccharomyces boulardii* (flora norm)**

Parameter	T1	T2	T3	T4	SEM	LS
pH	6.79 <sup>a</sup>	6.63 <sup>d</sup>	6.75 <sup>a</sup>	6.72 <sup>ab</sup>	0.02	*
Thermal shortening (%)	5.42 <sup>d</sup>	2.15 <sup>c</sup>	1.70 <sup>b</sup>	2.77 <sup>a</sup>	2.48	*
Cooking yield (%)	71.70	73.93	72.57	74.13	0.98	N/S
Cooking loss (%)	28.30	26.07	27.42	25.87	0.98	N/S
Water holding capacity (%)	25.49	25.45	21.84	23.84	0.78	N/S

a,b,c: Mean denoted by different superscript are significantly differing ( $P < 0.05$ )

$T_1$  = 0 ml of probiotic *Saccharomyces boulardii*

$T_2$  = 1ml of  $160 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

$T_3$  = 1ml of  $80 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

$T_4$  = 1ml of  $40 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

SEM = Standard error of mean

LS = Level of significant

N/S = Not significant

**Table 3. Proximate composition of rabbit meat orally administered *Saccharomyces boulardii* (flora norm)**

Parameter (%)	T1	T2	T3	T4	SEM	LS
Moisture content	67.00	67.49	65.1	66.49	0.48	N/S
Crude protein	28.30	27.85	30.80	28.00	0.58	N/S
Ether extract	6.31 <sup>c</sup>	7.05 <sup>bc</sup>	9.51 <sup>a</sup>	8.49 <sup>ab</sup>	0.42	*

a,b,c: Means denoted by various superscript are significantly different (  $P < 0.05$  )

T1 = 0 ml of probiotic *Saccharomyces boulardii*

T2 = 1ml of  $160 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered oral

T3 = 1ml of  $80 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

T4 = 1ml of  $40 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

SEM = Standard error of mean

LS = Level of significance

N/S = Not significant

**Table 4. Sensory properties of rabbit meat orally administered *Saccharomyces boulardii* (flora norm)**

Parameter	T1	T2	T3	T4	SEM	LS
Colour	5.75 <sup>b</sup>	6.25 <sup>b</sup>	7.10 <sup>a</sup>	5.90 <sup>b</sup>	0.13	*
Tenderness	6.00 <sup>b</sup>	6.05 <sup>b</sup>	7.60 <sup>a</sup>	6.15 <sup>b</sup>	0.13	*
Juiciness	6.10 <sup>b</sup>	6.21 <sup>b</sup>	7.80 <sup>a</sup>	6.20 <sup>b</sup>	0.15	*
Flavour	6.25 <sup>b</sup>	6.30 <sup>b</sup>	7.80 <sup>a</sup>	6.20 <sup>b</sup>	0.13	*
Overall acceptability	6.25 <sup>b</sup>	6.60 <sup>b</sup>	8.10 <sup>a</sup>	6.65 <sup>b</sup>	0.14	*

a,b: Mean denoted by various superscript are significantly differing (  $P < 0.05$  )

T1 = 0 ml of probiotic *Saccharomyces boulardii*

T2 = 1ml of  $160 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

T3 = 1ml of  $80 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

T4 = 1ml of  $40 \times 10^6$  cfu/ml of probiotic *Saccharomyces boulardii* administered orally

SEM = Standard error of mean

LS = Level of significant

## Discussion

The non-significant differences in water holding capacity, cooking yield and cooking loss among various inclusion rates of *Saccharomyces boulardii* is in line with the result of *Pelicano et al. (2003)*. The authors reported no difference in water holding capacity and cooking loss among different levels of probiotic tested. *Contreras – Castillo et al. (2008)* reported that lower water holding capacity is an indication of nutrient loss in the exudates, resulting in a tough and less tender meat. The authors also reported a significant difference in pH. The result was in agreement with the findings of *Bonai et al. (2008)*. The authors in a study used a different doses of probiotic *Bacillus cereus vartoyoi* reported pH values of 6.3 - 6.8 of the rabbit meat which falls within the pH values obtained in our study.

The values of moisture content and crude protein observed in the current study falls within the values (63.6 – 76.8% moisture, 20.38 – 29% crude protein and 0.33 – 14.6% ether extracts reported by *Pla et al. (1996)*. The significant effect on ether extract could have been due to manipulation in nutrition for domesticated rabbit as reported by *Olorunsanya et al. (1999)* and *Jiya (2012)*. The authors observed that the hare rabbits solely survive on herbs in the wild, which could have been responsible for the higher percentage of fats normally observed with the domesticated rabbits. The highest scores for colour, tenderness, juiciness, flavour and overall acceptability in the result of rabbit meat administered 1ml of  $80 \times 10^6$  cfu/ml of probiotic (*Saccharomyces boulardii*) agrees with the reports of *Savković et al. (2005)*. The authors reported improvement for juiciness, as well as the tenderness in the sensory attributes of meat administered probiotic - supplemented diets.

## Conclusion

Oral administration of probiotic strain *Saccharomyces boulardii* (flora norm) at  $80 \times 10^6$  cfu/ml concentration/ cell counts improved meat qualities and overall acceptability of rabbit meat.

## Evaluacija kvaliteta mesa zalučenih zečeva pod uticajem različitih koncentracija probiotskog soja (*Saccharomices boulardii*)

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## Rezime

U ovom radu je ispitivan kvalitet mesa, kao i senzorna svojstva odbijenih zečeva pod uticajem različitih koncentracija/broja ćelija probiotika *Saccharomices boulardii* (standarda flore). Ukupno 36 grla mešanih rasa zečeva je podeljeno nasumično u četiri tretmana sa tri ponavljanja i tri zeca po ponavljanju. Odbijeni zečevi su hranjeni istim obrokom. Tretmani T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> i T<sub>4</sub> su imali nulu (0) koncentraciju broj ćelija probiotika, po 1 ml od  $160 \times 10^6$  što je %  $1.6 \times 10^8$  cfu/ml koncentracija probiotika, po 1 ml od  $80 \times 10^6$  cfu/ml =  $8.0 \times 10^7$  cfu/ml probiotika i po 1 ml svaki od  $40 \times 10^6$  cfu/ml koncentracije probiotika, respektivno. Probiotik je davan životinjama svakih 14 dana. Dobijeni rezultati pokazuju da nije postojala značajna razlika u sadržaju vlage i sirovog proteina u mesu zečeva dok se ekstrakt



etra značajno razlikovao ( $P < 0,05$ ). Fizičke osobine, prinos kuvanja, kalo kuvanja i kapacitet zadržavanja vode nisu bili značajno ( $P > 0,05$ ) pod uticajem koncentracija probiotika, dok su pH i termalni tretman bili pod značajnim uticajem ( $P < 0,05$ ). Svi mereni senzorni parametri bili su signifikantno ( $P < 0,05$ ) različiti. Utvrđeno je da je oralno davanje probiotika *Saccharomyces boulardii* (standard flore) koncentracije 4 mg/ml  $80 \times 10^6$  cfu/ml poboljšalo kvalitet mesa i ukupnu prihvatljivost mesa.

**Ključne reči:** kvalitet mesa, zečevi, davanje, probiotik

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