Probiotic Effect on Meat Quality and Carcass Parameters of Iranian Zandi lambs

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Abstract

This study was aimed to assess the effect of probiotic (Saccharomyces Cerevisiae SC47 in the form of live yeast) on Iranian lamb meat quality and carcass parameters. A total of twenty-seven 90-day-old male weaned zandi lambs with initial body weight 27.1±0.38 kg, were allocated to 3 dietary treatments in a completely randomized design with 3 replicates and 3 observations per each. Dietary treatments were as follows: Control Diet (CD): basal diet without yeast; Low Yeast (LY): basal diet with 3 g yeast per lamb per day; High Yeast (HY): basal diet supplemented with 4.5 g yeast per lamb per day. Basal diet was containing commercial concentrate and hay according to NRC, 1985. Lambs were raised under environmentally controlled conditions and were fed 84 day by diets. The highest level of organic matter was for HY group and the lowest one was for CD group ($P<0.05$). Fat and dry matter were greater in HY group but differences between groups were not statistically significant (P-Value respectively: 0.056 and 0.059). The highest level of Ash was for CD group and the lowest one was for HY group ($P<0.05$). No significant differences were detected in muscle fatty acid profile between groups ($P> 0.05$). The lowest amount of tallow was for CD group and the highest ones for HY group (P-Value: 0.055). It is concluded that Saccharomyces Cerevisiae SC47 in the form of live yeast had no specific significant effect on meat quality and carcass traits of Iranian Zandi lambs.

Keywords: Fattening Zandi lambs, Meat quality; Carcass traits; Live yeast.

Introduction

Lamb meat is an excellent component of a healthy diet with easy digestion and absorption (Milewski, 2006). Lamb meat is a high quality protein source, containing all of the essential amino acids (Brzostowski and Tański, 2006) and it is also a rich source of many vitamins and minerals, including vitamin B12, iron, and zinc (Milewski, 2006) that needed for growth and maintenance. Also Lamb meat may contain varying amounts of fat which has a small amount of conjugated linoleic acid (CLA) with several health benefits (Brzostowski and Tański, 2006). Lamb meat quality and carcass parameters are influenced by several factors, such as breed, sex, slaughter weight and diet (Titi et al., 2008). But the point it is that healthy meat obtained when lambs are fed with healthy diets based on organic feed. Different feed additives were added to animal's diet with the aim of increase breeding, health and quality of products in animal breeding. For several years antibiotics were the most important feed additives that were used. There is currently a world trend to reduce the use of antibiotics in animal food due to the contamination of meat products with antibiotic residues (Menten, 2001), as well as the concern that some therapeutic treatments for human diseases might be jeopardized due to the appearance of resistant bacteria (Dale, 1992). Recently, alternatives for substituting these traditional growth promoters have been evaluated and probiotic and prebiotics are examples of these promoters (Heinrich et al., 2003). One of the most common feed additives in ruminants, are Saccharomyces cerevisiae yeast (SC). Depending on production technology, they can be administered in the form of a probiotic containing live cells or a prebiotic comprising dead cell (Dobicki et al., 2007). The use of SC as a probiotic began during the 1940's and 1950's. Live yeast consumes free oxygen in the rumen with respiration, so provides an anaerobic environment in rumen for metabolic function (Newbold et al. 1995). The main target of using yeast for lamb is to increase the breakdown of dietary fiber and protein that lead to increase microbial protein as a main source of amino acids in the small intestinal. Moreover, SC yeast has biologically valuable proteins, vitamin B-complex, important traces minerals and several unique plus factors. Many beneficial effects identified such as improve performance (Dabiri et al. 2016a) and concentration of plasma biochemical indicators (Raghebian et al., 2016), improvement in nitrogen efficiency in the rumen via lower BUN measurement in fattening lambs (Dabiri et al. 2016a) and suckling lambs (Dabiri et al. 2016b), effects on ruminal pH (Thrune et al. 2009), enhance the immune response (Keyser et al. 2007), reduction in cases of disease infection (Line et al. 1997). However, the results of using the SC on meat and carcass quality of ruminants are contradictory because of this fact that in many cases no influence or opposing and many unclear results have been shown. For this reason, the objective of the current study was to determine probiotic effect on one of Iranian (Zandi breed) lamb meat quality and carcass parameters.

Material and methods

Animals, diets, and experimental design

A total of twenty-seven 90-day-old male weaned zandi lambs with initial body weight 27.1±0.38 kg, that were grouped based on body weight and allocated to 9 floor pens (250 ×150 cm) covered with wheat straw, the used to assess the effect of probiotic (Saccharomyces Cerevisiae SC47 in the form of live yeast) on Zandi lamb meat quality and carcass parameters. The lambs were allocated to 3 dietary treatments in a completely randomized design with 3 replicates and 3 observations per each. Dietary treatments were as follows: Control Diet (CD): basal diet without yeast; Low Yeast (LY): basal diet with 3 g yeast per lamb per day; High Yeast (HY): basal diet supplemented with 4.5 g yeast per lamb per day. Ingredients and final chemical composition of basal diet according to the dietary nutrient requirements for lambs (NRC, 1985), are provided in Table 1.

Table 1: Ingredients and chemical composition of basal diet

Ingredients %		Chemical composition	
Alfalfa hay	13	Dry matter (%)	88.6
Wheat straw	2	Crude protein (%)	16.6
Barley	60	TDN (%)	77.9
Soybean meal	6	ME (Mcal/Kg)	2.81
Wheat	12	Calcium (%)	0.54
Wheat bran	5	Phosphorus (%)	0.32
Limestone	0.5	Potassium (%)	0.89
Mineral and vitamin premix	1	Ca / P ratio	1.68
Sodium bicarbonate	0.5		

The mineral-vitamin premix contained (per kg): 500 mg Cu; 6500 mg Zn; 100 mg I; 10 mg Co; 10 mg Se; 1000 mg Mn; 4000 mg Fe; 12500 mg Antioxidant; 2,000,000 IU vitamin A; 220,000 IU vitamin D; 2,500 IU vitamin E.

Diet chemical composition was analysed according to standard methods (AOAC, 2005) to determine nutrient intake throughout the experiment. The lambs were raised in a closed hall under environmentally controlled conditions (30±1°C and 60% relative humidity with a natural light program and well ventilated environment) and were fed 84 day by diets. Basal diet was included commercial concentrate and hay. The lambs were adapted to feed about 2 weeks. Lambs were fed three times a day (7:00 h, 13:00 h and 19:00 h) with a total mixed ration (TMR) diet. Each pen had an automatic water cup so they had free access to water all times.

Sampling, measurement and analyses

On day 84 of age, three lambs per each treatment were slaughtered randomly. After slaughter carcasses were chilled at 4^{o}C for 18 h and then carcass were separated and weight of all parts and offal were recorded. For evaluation of Meat quality, samples were taken between 9 to 11 ribs to determine crude protein (CP), dry matter (DM), fat, ash, urea, pH and intramuscular fatty acid profiles. The proximate chemical composition of meat was determined according to standard methods (AOAC, 2005).

Statistical analysis

Statistical analyses were carried out using the General Linear Model (GLM) procedure of the Statistical Analysis System software (SAS) for Windows version 9.1 (SAS Institute Inc., Cary, NC) in a completely randomized design with three treatments and three replicates. The Kolmogorov-Smirnov test was used to confirm normal distribution of data. Duncan's Multiple Range test was used to compare the means. Effects between the control and experimental groups were considered significant when P value was <0.05 and finally results were presented as means with standard error of the means (SEM).

Results and discussion

Meat quality and fatty acid profile

Means and SEM for effect of different levels of live yeast on meat quality and fatty acid profile of zandi lambs are presented in Table 2 and 3 respectively. The stress conditions that animal are in, especially in pastures, effect on the biological responses of probiotic additives. Thus if the animals are kept in optimum conditions with low stress, gastrointestinal microbial flora stay in balance condition and so considerable difference between animals with or without probiotics may not appear. However in this study, dry matter and fat content of meat were greater in HY group but differences between groups were not statistically significant (P-Value respectively: 0.059 and 0.056). Live yeast causes a slight increase in fat content of meat. Intramuscular fat, as an integral component of meat, affects the sensory properties (Campo et al., 2003). However, the increase in fat content had no significant effect. The highest level of organic matter was found for HY group and the lowest one was found for CD group (P<0.05). Comparison of CP, pH and Water/CP ratio Showed that there was no significant difference among treatments (P> 0.05). Amount of pH from 5.5 to 5.9 is optimal for meat (Schieffer and Scharner, 1977) and low value of water/ protein ratio, indicating a high degree of ripeness (Brzostowski and Tański, 2006). The highest level of Ash was for CD group and the lowest one was for HY group (P<0.05). No significant differences were detected in urea between groups (P> 0.05) and it was negative in all samples. In agreement with our results, Gomes et al., 2009 and Hinman et al., 1998 also did not find any improvement in meat quality traits after yeast addition to steers diets.

Table 2: Effect of different levels of yeast supplement on meat quality of zandi lambs

Item	Treatment			SEM
	Control	Low Yeast	High Yeast	
Dry matter (%)	43.18	44.35	47.22	1.049
Organic matter (%)	97.65[b]	98.84[a]	99.13[a]	1.099
Crude protein (%)	22.17	21.02	21.32	0.680
Fat (%)	18.09	21.40	24.85	1.882
Ash (%)	2.35[a]	1.16[b]	0.87[b]	0.263
pH	5.90	5.80	5.86	0.022
Urea	Neg.	Neg.	Neg.	-
Water/CP ratio	2.56	2.64	2.47	0.010

CP, crude protein.SEM: standard error of the means a ,b Means within a row with different superscripts are significantly different (P<0.05).

Intramuscular fat gain by altering the concentration of essential fatty acids such as linoleic acid and conjugated linoleic acid can leave a positive impact on health (Ulbricht and Southgate, 1991; Fritsche and Steinhart, 1998). But no significant differences were detected in meat fatty acid profile and it was similar in all samples and groups (P> 0.05). Samples meat of CD group contained more saturated fatty acids compared others groups (P>0.05). Comparison of unsaturated fatty acids Showed that the highest level was for HY group and the lowest one was for CD group (P>0.05). The highest UFA/SFA ratio and PUFA/MUFA ratio were for HY group and the lowest one was for CD group (P>0.05). Omega 3 and 6 were greater in HY group but differences between groups have not been statistically significant. Based on Milewski and Zaleska, 2011 study, optimal range of omega6/omega3 ratio is 4-6. But in this study, it was less than this range. In agreement with our results, Milewski and Zaleska, 2011 also did not find any improvement in meat fatty acid profile after yeast addition to lamb diets.

Table 3: Effect of different levels of yeast supplement on muscle fatty acid profile of Zandi lambs

Item	Treatment			SEM
	Control	Low Yeast	High Yeast	
SFA (%)	46.12	45.95	45.37	2.475
UFA (%)	53.88	54.05	54.63	2.921
MUFA (%)	44.93	45.03	45.23	2.714
PUFA (%)	8.95	9.02	9.40	0.981
UFA/ SFA ratio	1.16	1.17	1.20	0.359
PUFA/ MUFA ratio	0.19	0.20	0.21	0.032
Omega 3 (%)	1.49	1.56	1.71	0.295
Omega 6 (%)	5.65	5.73	6.09	0.841
Omega 6/ Omega 3 ratio	3.79	3.67	3.56	0.629

SFA, saturated fatty acids; UFA, unsaturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; SEM: standard error of the means

Table 4: Effect of different levels of yeast supplement on carcass traits of Zandi lambs

Item	Treatment			SEM
	Control	Low Yeast	High Yeast	
Slaughter weight (kg)	45.70	45.56	44.73	1.574
Empty body weight (kg)	39.10	40.23	39.41	1.570
Hot carcass weight (kg)	22.64	23.29	22.42	0.929
Carcass/SW ratio (%)	49.40	51.16	50.05	0.685
Carcass/EBW ratio (%)	57.87	57.95	56.84	0.435
Carcass length (cm)	71.00[a]	68.66[b]	69.33[ba]	0.471

SW, slaughter weight; EBW, empty body weight. SEM: standard error of the means
a ,b Means within a row with different superscripts are significantly different (P<0.05).

Table 5: Effect of different levels of yeast supplement on carcass parts of Zandi lambs

Item	Treatment			SEM
	Control	Low Yeast	High Yeast	
Muscle and bone (%)				
Leg & rear shank	20.44	20.97	19.36	0.561
Shoulder & front shank	16.83	16.48	17.72	0.288
Loin & rack & ribs	37.97	37.36	39.07	0.526
Breast	3.37	3.37	3.55	0.157
Neck	5.99	6.75	6.12	0.290
Total Muscle and bone	84.63	84.94	85.84	0.407
Fat (%)				
Fat tail	15.37	15.05	14.15	0.407
Tallow	1.99	2.53	4.26	0.373
Total Fat[1]	17.36	17.58	18.41	0.409

[1]Total Fat = fat tail and tallow SEM: standard error of the means

Table 6: Effect of different levels of yeast supplement on non-carcass parts of zandi lambs

Item	Treatment			SEM
	Control	Low Yeast	High Yeast	
Head (%)	6.54[a]	5.91[b]	6.11[ba]	0.122
Foot (%)	2.57	2.28	2.28	0.084
Pelt (%)	13.61	13.64	12.74	0.316
ESF (%)	3.21	3.06	3.30	0.114
EI (%)	3.48	3.49	4.02	0.172
Heart (%)	0.46	0.41	0.43	0.013
Liver (%)	1.66	1.58	1.67	0.069
Lungs & trachea (%)	1.60	1.45	1.48	0.037
Kidney (%)	0.29	0.28	0.27	0.009
Spleen (%)	0.20	0.16	0.18	0.012
Testis (%)	1.20	1.11	0.86	0.072

ESF, empty stomach and fore-stomachs; EI, empty intestine. SEM: standard error of the means a ,b Means within a row with different superscripts are significantly different (P<0.05).

Carcass traits and parts

Results of different levels of live yeast on carcass traits, carcass parts and non-carcass parts of zandi lambs are presented in Table 4, 5 and 6 respectively. Overall no significant effects were recorded on the carcass traits (P>0.05), apart from carcass length which the highest one was for CD group and the lowest one was for LY group (P<0.05). Empty body weight, hot carcass weight, carcass/slaughter weight ratio and carcass/empty body weight ratio, nearly were similar in all groups. In agreement with our results, Mandour et al., 2009 and ding et al., 2008 did not find any improvement in carcass traits after yeast addition to diets. On the other hand according to Mahyuddin and Winugroho, 2010 and Milewski, 2009, yeast has a positive impact on carcass traits.

No significant differences were detected in percentage of muscle, bone and fat between groups (P> 0.05). The highest level of total muscle, bone and fat was for HY group and the lowest one was for CD group (P>0.05). The lowest amount of tallow was for CD group and the highest ones for HY group (P-Value: 0.055). Also, no significant difference was found between the groups in terms of non-carcass parts (P>0.05), except head which the highest one was for CD group and the lowest one was for LY group (P<0.05). In agreement with our results, Mandour et al., 2009 and Mahyuddin and Winugroho, 2010, came to the same conclusion with this research after yeast addition to diets. These minor significant differences may be due to animals genetic and strains differences or even different cutting method of carcass parts.

Conclusions

In the present study, Saccharomyces Cerevisiae SC47 in the form of live yeast had no specific effect on meat quality and carcass traits of Iranian Zandi lambs, and could not make a difference in the nutritional value. The differences in the type and amount of food consumed, type of probiotic, or how to use it can be the reason of difference between results of this study and results of other researchers. So, more studies are necessary to clarify effects of live yeast supplementation on fattening lambs.

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