Asian Journal of Research in Animal and Veterinary Sciences

4(4): 1-8, 2019; Article no.AJRAVS.53001

Carcass Characteristics of West African Dwarf (Bucks) Fed Yeast and Lactic Acid Bacteria Fortified Diets

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Authors' contributions

This work was carried out in collaboration between both authors. Author UAI designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author UHU managed the analyses of the study. Authors UAI and UHU managed the literature searches. Both authors read and approved the final manuscript.

Article Information

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Complete Peer review History: http://www.sdiarticle4.com/review-history/53001

Original Research Article

Received 20 September 2019
Accepted 25 November 2019
Published 17 December 2019

ABSTRACT

This study was conducted to determine the carcass characteristics and meat quality of bucks fed diets fortified with yeast and lactic acid bacteria. 30 West African Dwarf (WAD) bucks (8.50±1.59 kg) were allotted to six dietary treatments with five (5) animals per group in a complete randomized design. The treatments were: diet without antibiotics or probiotics (control D1), control + antibiotics (D2), control + 2.50 g yeast (D3), control + 5.00 g yeast (D4), control + 2.50 g yeast + lactobacillus acidophilus (D5) and control + 5.00 g yeast + lactobacillus acidophilus (D6), where D5 and D6 were fortified with *Lactobacillus acidophilus* at 1.00 x 10^{12} cfu/g each. At the end of the feeding trial, three animals per treatment were slaughtered after being starved for 18 hours. There was no significant difference in final body weight and average daily gain which ranged from 10.60 kg to 11.75 kg and 20.79 g/day to 28.29 g/day respectively. There were no significant differences (P>0.05) in physical characteristics except for the rib eye area (REA) which was higher (P≤0.05) in D6 than D1, D4 and D5 (12.33 cm^2 vs 7.67, 9.33 and 9.33 cm^2) respectively. Brisket was influenced (P>0.05) with D3

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(8.33%) lower than D5 (11.35%). Colour, marbling, temperature, water holding capacity (WHC) and pH at O and 1 hr were significantly different (P≤0.05) as a result of treatment effect. The meat cholesterol decreased (P<0.05) with increase in probiotics inclusion. These results showed that inclusion of yeast and *Lactobacillus acidophilus* even up to 5.00 g in the diet of WAD bucks impacted positively on the carcass characteristics and meat quality of bucks without any deleterious effect.

Keywords: West African Dwarf bucks; yeast; Lactobacillus acidophilus; carcass characteristics; meat qualities.

1. INTRODUCTION

Feeding sub-therapeutic levels of antibiotics to livestock has been in practice for a very long time. Antibiotics have been noted to play a vital role as stated by [1] to beneficially alter gut micro flora and affect the metabolism of pathogenic microbes, maintains gut health and enhances production performance. However, despite the numerous benefits there are health concerns on its usage such as the resistance issue in human pathogens [2]. These hazardous effects of antibiotics justified the ban placed on its usage in animal feed by the European Union in 2006 [2]. Thus there is a need to find alternatives to antibiotics in order to bridge the existing gap between improved performance and safety of animal products to consumers.

Alternative feed additives such as dietary acidifiers, essential oils, probiotics and prebiotics have been introduced as potentials replacements for antibiotics. Probiotics is non-pathogenic microbes which occur in nature and the gastrointestinal tract of ruminants, where they exert a positive influence on the host physiology; improve nutrient synthesis and their bio-availability resulting in better growth performance in farm animals [3,4] had reported a positive impact of probiotic supplementation on nutrient intake, weight gain and feed conversion ratio in ruminants. [5,6,7] all reported higher carcass weight in beef steers, goat and heifers in response to probiotics supplementation. In contrast, no changes were seen in weights and proportions of carcass cuts of sheep [8] and goat [9] in response to probiotic supplementation [6] found no effect of probiotics supplementation on the weights of lung, heart and kidney [10] reported no significant difference in marbling score of mutton for sheep fed yeast as a supplement.

Not much has been reported in literature on carcass characteristics of West African Dwarf goats fed probiotics. Therefore, the objective of this study was to address the effect of yeast alone and in combination (fortification) with *Lactobacillus acidophilus* on carcass characteristics of West African Dwarf Bucks.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at the University of Uyo Teaching and Research Farm, Uyo. Uyo is located between latitude 0502` North and longitude 07º56' East. The feeding trial lasted from July 2014 to December 2014 while the carcass analysis was undertaken in January 2015.

2.2 Experimental Diets and Animals

The concentrate mix (cassava peel, brewers dried grains, palm kernel cake, limestone, salt, premix) was formulated and mixed into six treatments. Concentrate control was fortification formulated and mixed with antibiotic, yeast (2.5 g and 5 g) and mixed probiotic, of yeast and *Lactobacillus acidophilus* at 2.5 g and 5.0 g plus *Panicum maximum* forage.

Thirty West African Dwarf (WAD) bucks were assigned to one of six dietary groups with five bucks per group in a completely randomized design. Bucks were housed in pens with facilities for feeding and watering. Wood shavings were provided as bedding materials. All health treatments were administered as at when due. After the growth performance trial which lasted for 109 days, a total of 18 bucks were fasted for 18 hours for carcass characteristics and meat quality evaluation. Prior to slaughtering, the animals were starved but given water for sixteen hours and then weighed and slaughtered. After skimming, the pH of carcass was taken at O hour, 1 hour and 24 hours post slaughter, using pH metre. Hot carcass weight was taken on the floor of the slab within 20 minutes post mortem using a hanging scale and dressing percentage recorded. Carcass yield was determined using the procedures described by [11]. Carcasses were chilled for 24 hours at 4°C, and then evaluated after splitting along the midline into primal cuts. Empty body weight was calculated as the difference between fasted body weight and gut contents. Chilling loss, cooking loss and water holding capacity were determined as prescribed by [12], and [13]. Meat colour and marbling were done using 7 and 10 point hedonic scales, where 1 represents the lowest.

2.3 Chemical Analysis

Dried meat samples were analyzed for dry matter, crude protein, ether extract and ash according to [14]. Cholesterol in meat was determined by the method of [15] while low density lipoprotein cholesterol and high density lipoprotein cholesterol was as prescribed by [16].

2.4 Statistical Design and Model

Study was conducted in a completely randomized design. All data collected were subjected to analysis of variance using the procedure of [17] while differences between means were determined using Duncan Multiple Range Test. Experimental model is: Yi, = μ + α- +Σi, Yi, = individual observation, μ = general mean of the population, αi = treatment mean, Σij = composite error effect.

3. RESULTS

3.1 Carcass Characteristics of Bucks Fed Experimental Diets

The results of the carcass characteristics of bucks are as shown in Table 1. The results showed that there were no significant differences (P>0.05) in the fasted body weight, slaughter weight, empty body weight, hot carcass weight, dressing percentage, gut contents, left and right carcasses, chilled right carcass and chilled loss percentage which ranged from 9.42 – 10.17 kg, 9.30 – 9.98 kg, 7.82 – 8.37 kg, 4.33 - 4.63 kg, 44.-44 – 47.77%, 1.50 – 1.83 kg, 2.06 – 2.33 kg, 2.13 – 2.37 kg, 2.09 – 2.25 kg and 1.44 – 3.77% respectively. However, the rib eye area (REA) was influenced (P<0.05) by the fortification of probiotics with bucks carcasses of D3 and D6 (11.33 and 12.33 cm^2 respectively) being similar (P>0.05) with those of D2 (10.67 cm^2) but different (P<0.05) from that of D4, D5 and D1 (9.33, 9.33 and 7.67 cm^2 respectively).

The primal cuts of WAD bucks (goats) are presented in Table 2. All the parameters assessed were not significantly different from each other except for brisket which was influenced (P<0.05). The weighted primal cuts for neck, rack, flank, loin, hind shank, fore shank and hind arm/leg ranged between 8.65-10.48%, 8.71 – 11.53%, 2.89-4.35%, 6.18-7.44%, 5.80 – 6.99%, 5.71-6.78% and 22.43-26.22% respectively. The brisket weight was similar (P>0.05) for D5, D4, D1 and D2 (11.35, 10.06, 9.90 and 9.25% respectively while that of D5 was different (P<0.05) from D3 and D6 (8.33 and 9.06%).

The weight for the head, skin, internal organs and physical composition of the half carcass are presented in Table 3. Similar to earlier results the weights for the head, skin, internal organs and gastrointestinal tract were not influenced by the treatments. The physical composition of the half carcass was also not affected by the treatments except for the parameter on meat to fat ratio. The meat to fat (ratio) of meat from D5 and D6 (12.64 and 5.86%) were higher (P<0.05) than those from D2 and D3 (10.66 and 10.59%) but similar with those from D1 and D4 (11.13 and 10.94%).

Table 4 reveals the physical qualities of WAP goat (Buck) meat fed probiotic, fortified diets. The chilling loss (%); cooking loss (%) and pH at 24 hours were not affected (P>0.05) by the treatments and ranged between 5.99 – 13.57%, 33.27 – 41.07% and 6.00 – 6.12 respectively. Colour, marbling, temperature, water holding capacity (WHC) and pH at O and 1 hour were altered (P<0.05) as a result of treatment effect. The colour of the meat samples for D1 and D2 were similar (P>0.05) with those of D4 and D5 but different (P<0.05) from those of D3 and D6. Marbling seemed to reduce with increase in probiotic fortification with D6 (6.00) being the least (P<0.05) while D1 recorded with highest (7.33). The WHC ranged from 54.00% (D6) to 77.00% (D1) and followed the same trend as observed in marbling.

The chemical composition of meat samples from WAD goats fed probiotics are presented in Table 5. The ether extract decreased with increase inclusion of probiotics. Meat samples from D1 and D2 were similar (P>0.05) with that of D3 while being different (P<0.05) from those of D4, D5 and D6. The cholesterol content was highest in D4 and the lowest was seen in D6. Increase in probiotics inclusion led to increase in high density lipoproterin (HDL) concentration and decrease in LDL.

Table 1. Carcass characteristics of bucks fed probiotic fortified diets

	D1	D2	D3	D4	D5	D6	SEM
Fasted bwt (kg)	9.87	9.77	9.42	9.87	10.17	9.67	0.79
Slaughter wt (kg)	9.30	9.50	9.32	9.65	9.98	9.33	0.78
EBW (kg)	8.04	7.93	7.82	8.37	8.43	7.91	0.64
HCW (kg)	4.47	4.36	4.33	4.56	4.52	4.63	0.39
Dressing (%)	45.23	44.63	46.40	46.21	44.44	47.77	1.62
REA cm^2	7.67^{c}	10.67^{ab}	11.33^{a}	9.33^{bc}	9.33^{bc}	12.33^{a}	0.53
Left carcass	2.20	2.06	2.07	2.17	2.20	2.33	0.19
Right carcass	2.16	2.13	2.13	2.30	2.23	2.37	0.20
Chilled right carcass	2.13	2.09	2.10	2.21	2.15	2.25	0.20
Chilling loss%	1.44	3.77	1.56	3.37	3.32	2.17	1.68

a,b,c means on the same row bearing different superscripts differ (P<0.05) significantly; D1 = control D2 = control + antibiotic, D3 = yeast 12.5g (d), D4 = yeast 15.0g (d), D5 = yeast + LAB 2.5g (d), D6 = yeast + LAB 5.0g (d); BWT/WT = Body weight/weight, EBW = Empty body weight, HCW = Hot carcass weight, REA = Rib eye area

Table 2. Primal cuts of WAD bucks fed probiotics fortified diets

	D1	D2	D3	D4	D5	D6	SEM
Neck	10.14	10.43	8.65	10.48	10.39	10.47	0.65
Rack	10.70	11.53	8.71	10.56	10.19	8.72	1.12
Brisket	9.90^{ab}	9.25^{ab}	8.33^{b}	10.06^{ab}	11.35^{a}	9.06^{b}	0.64
Flank	4.22	4.21	4.28	3.89	4.35	4.15	0.24
Loin	7.44	7.09	7.22	6.18	6.58	6.43	0.72
Hind shank	6.99	6.99	6.81	6.23	6.67	5.80	0.45
Fore shank	6.68	6.78	6.14	6.19	6.27	5.71	0.37
Hind arm/leg	23.81	23.63	22.43	26.22	25.13	23.87	1.21
Fore arm/leg	17.19	16.81	16.70	19.02	17.43	17.32	1.16

a,b.c means on the same row bearing different superscripts differ (P<0.05) significantly; D1 = control D2 = control + antibiotic, D3 = yeast 12.5g (d), D4 = yeast 15.0g (d), D5 = yeast + LAB 2.5g (d), D6 = yeast + LAB 5g (d); 1 = primal cuts in half carcass (%)

Table 3. Body parts, internal organs and physical composition of WAD bucks

	D1	D2	D3	D4	D5	D6	SEM
Head	10.03	10.49	9.89	10.14	9.90	9.79	0.25
Skin	8.86	9.47	9.67	10.01	9.98	10.11	0.54
Internal organ[1]	4.58	4.54	4.56	4.48	4.74	4.55	0.13
Gastro intestinal tract[2]	9.69	9.64	8.76	8.94	9.27	8.29	0.35
Physical composition							
Meat	70.36	70.49	70.74	71.29	71.00	71.86	0.81
Bone	23.13	22.71	22.57	21.76	22.76	22.48	0.91
Fat	6.37	6.67	6.70	6.53	5.67	5.60	0.32
Meat: bone	3.04	3.10	3.14	3.31	4.14	3.14	0.18
Meat: fat	11.13^{ab}	10.66^{b}	10.59^{b}	10.94^{ab}	12.64^{a}	12.86^{a}	0.59

a,b,c means on the same row bearing different superscripts differ (P<0.05) significantly; 1 = includes kidney, liver, lungs, heart, spleen, trachea and bile; 2 = comprises oesophagus, empties of small intestine, large intestine, rumen, reticulum, omasum and abomasums; D1 = control D2 = control + antibiotic, D3 = yeast 12.5g (d), D4 = yeast 15.0g (d), D5 = yeast + LAB 2.5g (d), D6 = yeast + LAB 5g (d)

Table 4. Physical qualities of WAD goat meat

	D1	D2	D3	D4	D5	D6	SEM
Colour 1	6.33^{a}	6.67^{a}	5.67^{b}	6.00^{ab}	6.00^{ab}	5.67^{b}	0.27
Marbling 2	7.33^{a}	6.67^{abc}	7.00^{ab}	6.33^{bc}	6.33^{bc}	6.00^{c}	0.27
WHC%	77.00^{a}	75.50^{a}	69.00^{ab}	58.50^{ab}	58.00^{ab}	54.00^{ab}	6.99
Chill loss%	8.12	8.89	9.92	11.89	13.57	5.99	3.66
Cooking loss%	36.71	33.27	36.54	36.76	36.96	41.07	3.24
pH O loss	6.38^{b}	6.36^{b}	6.63^{a}	6.64^{a}	6.54^{ab}	6.49^{ab}	0.07
pH 1 loss	6.24^{ab}	6.30^{ab}	6.33^{a}	6.20^{ab}	6.30^{ab}	616^{b}	0.05
pH 24 hour	6.09	6.07	6.02	6.06	6.07	6.06	0.03

a,b,c means on the same row bearing different superscripts differ (P<0.05) significantly; D1 = control D2 = control + antibiotic, D3 = yeast 12.5g (d), D4 = yeast 15.0g (d), D5 = yeast + LAB 2.5g (d), D6 = yeast + LAB 5g (d); 1 = seven point scale used, 2 = ten point scale used, WHC = Water holding capacity

Table 5. Chemical composition of meat samples from WAD goats fed probiotics

	D1	D2	D3	D4	D5	D6	SEM
Ether extract (%)	12.23^{a}	12.57^{a}	11.35^{ab}	10.02^{b}	7.98^{c}	6.30^{d}	0.33
Cholesterol (mg/100g)	70.74^{a}	69.69^{ab}	71.62^{a}	72.26^{a}	67.34^{b}	65.14^{b}	1.03
HDL (mg/100g)	11.00^{e}	11.34^{e}	12.49^{d}	13.66^{c}	14.52^{b}	16.65^{a}	0.19
LDL (mg/100g)	58.57^{a}	41.06^{c}	55.16^{b}	55.92^{b}	36.92^{d}	33.71^{e}	0.66

a,b,c means; D1 = control D2 = control + antibiotic, D3 = yeast 12.5g (d), D4 = yeast 15.0g (d), D5 = yeast + LAB 2.5g (d), D6 = yeast + LAB 5g (d); HDL = high density lipoprotein, LDL = low-density lipoprotein

4. DISCUSSION

4.1 Carcass Characteristics of Bucks Fed Experimental Diets

In agreement with the results of this study, no influence of probiotics (yeast) on carcass characteristics of goat (dressing percentage, hot carcass weight, empty body weight, rib eye area, offals, fat and internal organs) were reported by [18]. Similar findings were reported by [19] in growing malpura lambs supplemented with yeast based diet. However, [20] reported a higher dressing yield in Awassi lambs fed diets supplemented with probiotics. This inconsistency might be attributed to species, dose of probiotics and diet composition. Another possibility might be that probiotics inhibit detrimental microbes in the rumen thereby improving fibre digestibility and in turn gain in weights. This was observed in REA.

Several authors [18,9,8] had reported that the proportion of different cuts such as leg, loin, rack, neck and shoulder were not affected by probiotic supplementation in sheep and goats. These findings are similar to the results of the present study.

The yield of the directed bone in this study was comparable to that obtained/reported by [18] of a range of 25% to 28% [21] had earlier reported that supplementation of probiotic reduced meat: bone ratio in Saudi Arabia sheep. The meat to fat ratio might have increased significantly from those on D5 and D6 as a result of more efficient utilization of nutrients and also altering lean and lowering of fatiness in the meat samples [22].

Meat colour is an important apparent meat quality indicator [23]. High score (colour) may likely be caused by its high fat content or feed type. The meat of grass-fed animals is darker than that of animals fed on concentrates solely [24]. In contrast to the result of this study, [10] reported no significant difference in marbling score of lamb meat fed yeast. Also, they noted that yeast supplementation increased marbling score over sodium biocarbonate. The values reported here for WHC were higher than that of [25] who reported an average value of 30.50%, while close to those reported by [26] of an average value of 68.77% for goat meat. A higher proportion of bound water results in the higher WHC content.

Al-Owaimer et al. [27] reported a chilling loss range of 3.20 – 6.70% for Ardhi goats weighing

10 -35 kg which was lower than the values reported in this study except for D6 (5.99%). Cooking loss reported in this study was higher than those of [26] who recorded an average of 27.90%. The probiotic fortified meats (D3 – D6) cooking loss showed that they possessed a low WHC with high numerical values. The pH reported in this study was close to that reported by [28] of a range of 5.88 – 6.03.

The ether extract reported here fell within the range for mammalian tissues as reported by [29] of 5 - 34 % fat (ether extract). The reduction in fat can be attributed to the hypocholesterolemic effect of probiotics [30]. Consistent with the result on body fat in this present study, [31,32] observed lower body fat when probiotic was fed to buffaloes and goats. The lowered body fat content of treated goat meats may be associated with the decreased cholesterol and LDL as found by [33] in buffalo calves and the subsequent increase in HDL content/ concentrations.

5. CONCLUSION AND RECOMMENDATION

Probiotic fortification of diets showed no effect on physical characteristics of WAD goat carcasses. However, the meatiness (rib eye area), brisket and meat: fat ratio was affected. Meat from probiotic fortified diets had leaner meats due to its lowered fat content and this affected the colour, marbling and its water holding capacity. The hypocholesterolemic effect of probiotics was evident in the reduction of cholesterol, ether extract and low density lipoprotein and the increase in high density lipoprotein. There is need for further research on the use of synbiotics in goat diets.

ACKNOWLEDGEMENTS

I wish to acknowledge the assistance of Mr. Uwem Ama who helped in the entire protocol.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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