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ORIGINAL ARTICLE

EFFECT OF PROBIOTIC MIX SUPPLEMENTATION ON GROWTH PERFORMANCE AND ECONOMICS OF PRODUCTION OF GROWING YANKASA SHEEP

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Abstract

The experiment was conducted to evaluate the effects of probiotic mixture (Saccharomyces cerevisiae 2 × 10 8 cfu/g + Lactobacillus acidophilus 6 × 10 8 cfu/g) on feed intake, and rumen fermentation parameters of growing Yankasa. Lambs of about 6-8 months of age and an initial average live body weight of 12.3 ± 0.68 kg were used. The lambs were divided into three groups (5 lambs/group) and the experiment lasted for 84 days lasted for 70 day The control group T1 received concentrates feed mixture without probiotic mixture supplementation; group T2 and T3 received 0.2 and 0.3 g/kg mixture supplementation with concentrate respectively. Dry matter and nutrient intake were taken, digestibility trial was conducted at the end of the experiment. Results showed improvement (P<0.05), in dry matter (787.55 - 1067.98 g/d), crude protein (131.69 - 181.12 g/d) and non-fiber carbohydrate (116.61- 252.47 g/d) intakes by probiotic supplementation. Lambs fed T2 and T3 significantly (P < 0.05) improved in the average body weight gain (7.92 kg, 8.7 kg) and average daily gain (100.47 g/d, 138.57 g/d) compared with lambs fed control diet (T1). Feed conversion ratio (7.73) was better (P<0.05) for lambs placed on T1 (14.31) and T2 (10.03) respectively. The best average net profit (₦5,457/animal) was obtained for animals placed on T3 relative to ₦2,609/animal) and ₦4,332/animal) realized from T1 and T2 respectively. The obtained results indicated that probiotic mixture supplementation improved lambs dry matter, growth voluntary dry matter intake, growth performance and economic benefits to farmers. However, diet with 0.3% (T2) probiotic supplementation proved to be superior in enhancing feed intake (1067.98 g/d), daily average daily weight gain (138.57 g/d) and economic benefit (₦20609 – ₦5,457/animal) in growing Yankasa sheep.

Key words: Feed additive, weight changes and cost efficiency, sheep

Introduction

The exponential growth of human population in the world resulted to growing demand for food of plant and animal origin. According to the report of Van Bavel (2013) the number of people in the world is estimated to reach 9 billion by 2050. For this reason, scientists are looking for solutions allowing intensification of food production, with simultaneous reduction of production costs, and in compliance with high standards of quality and safety (for both people and the environment). Many scientists and nutrition specialists believe that animal production can play a role in increasing food production. In the past, antibiotics and other medicinal products had been broadly used, mainly in order to modify the alimentary microbiota and to boost productivity and animal growth. Long-term use of those substances has led to development of drug-resistant microorganisms, posing a threat to consumers' health and exerting a negative effect on the environment. As a result, the European Union ban the use of antibiotic-based growth stimulators (Sarker et al., 2010). Therefore, alternative natural substances such as probiotics ensuring similar effects have been sought. Probiotics are characterized as dietary supplements containing most likely a live microorganism, which exhibit a beneficial effect on the host animal performance and health by stimulating appetite (Nahashon et al., 1994), improving the balance of the intestinal microorganisms and digestion

(Arowolo and He, 2018). Addition of probiotics has been proved to improve feed intake, average daily gain, digestibility with high economic returns in kids in growing lambs (Soren et al., 2013). Probiotic products may contain one or more selected microbial strain. Studies showed that yeast additives such as Saccharomyces cerevisiae led to an increase in the concentration of ruminal bacteria, especially Fibrobacter spp., due to the equilibrium in rumen pH (Beauchemin et al., 2006). Bacterial additives such as lactate producing bacteria (LAB) (Lactobacillus, B ifidobacterium, Enterococcus, Streptococcus, and Bacillus) and lactate utilizing bacteria (LUB) (Megasphaera elsdenii, Selenomonas ruminantium, and Propioni bacterium) are used as microbial additives. This current study was aimed at effect of probiotic mixture supplementation on the feed intake and growth performance and economic benefit of Yankasa lamb.

Methodology

Experimental Site

The study was carried out at Small Ruminant Unit of Teaching and Research Farm, Federal College of Wildlife Management, New Bussa. Nigeria (9° 53 N, 4° 31 E) located in the Guinea Savannah vegetation zone, with a humid tropical climate, mean annual rainfall of about 1,040 mm and mean temperature of 34 °C.

Experimental Animals' Management and Design

Fifteen growing intact Yankasa rams (12.3 ± 0.68 kg; LW) was procured from local markets, quarantined for 14 days during which they were treated against internal and external parasites using antibiotics. The lambs were housed in individual rammed floor with bedding materials. The experiment was conducted in a completely randomized design with four treatments and five replications. The sheep were balanced for their initial BW. Each animal within each of the treatments was randomly assigned to one of the three dietary treatments to study the effect of feeding of threshed sorghum top based complete feed without or with supplementation of probiotic. A complete feed was prepared containing threshed sorghum tops 50 parts and concentrate mixture 50 parts on DM basis to meet the nutrient requirement of animals as per ICAR (2013). The parts of concentrate mixture contained TST = 50.0%, maize = 8.0%, wheat bran = 10.0%, cowpea husk = 8.0%, groundnut cake = 18.0%, urea = 1.0%, Dicalcium phosphate = 1.0%, premix = 1.0% and salt 1.0% (Table 1). Probiotic (Saccharomyces cerevisiae 2 × 10 10 cfu/g + Lactobacillus acidophilus 6 × 10 9 cfu/g) in equal ratio was incorporated in complete threshed sorghum tops based complete feed at 1, 2 and 3 % of DM respectively, for efficient utilization in ruminant system, while complete feed without probiotics served as control. The experiment lasted for 84 days (63-day feeding trial and 21- day adjustment period). Feeding was done twice daily, at 08:00 and 16:00 h, and water was made available ad libitum. Feed intake was calculated as Feed intake (g/d) = Feed offered – feed refusal.

Digestibility Trial

At the end of the growth experiment, the growing sheep from each group was transferred individually into metabolic crates to determine apparent digestibility. Lambs were allowed a period of 7 days to adapt to the crates followed by a collection period of 7 days when feed intakes and orts was recorded and sampled. Daily faecal samples of each animal was collected, weighed, and recorded, and then 10% aliquots each was kept prior to chemical analysis. At the end of the experiment, samples from each sheep were pooled and a subsampled for faeces analysis obtained. Feed samples and faeces were taken separately, thoroughly mixed together, sub-sampled, milled through a 1-mm sieve in a hammer mill and preserved for proximate composition determination.

Chemical Analyses

The dry matter (DM), crude protein (CP), ether extracts (EE) and ash contents of diets and faeces were analyzed according to the AOAC (2000). The neutral detergent fibre (NDF), acid detergent fibre (ADF) and lignin were according to Van Soest et al. (1991). Non-fibre carbohydrate (NFC) was estimated using the equations of Sniffen et al. (1992).

Statistical Analysis

Data collected was subjected to a one-way ANOVA using version 9.1 of SAS software (SAS Institute, 2003). Significant difference between individual means was separated by Duncan's procedure.

Results and Discussion

Chemical composition

Similar amount of DM was recorded in all the nutrients except for neutral detergent fibre (NDF) ware obtained in the feed components of the treatment diets (Table 1). Higher NDF content was recorded in T3 than T2 and T1. The diets tested were formulated to meet the nutrient requirement of growing sheep. The supplementary concentrates were formulated to contained CP (17.0 % DM) recommended for growing sheep (MLA, 2007) with NDF content far below the 65 % DM threshold level at which cell wall inhibits feed intake, digestibility and animal performance.

Table 1: Chemical composition of experimental diets (% DM)

	Level of probiotic supplementation (%)			
Nutrient	T1(0.00)	T2 (0.2)	T3 (0.3)	SEM
Dry matter	92.38	92.12	92.00	0.37
Organic matter	92.16	90.83	97.51	5.34
Crude protein	16.87	17.44	17.63	0.18
Ether extract	4.67	3.30	3.23	1.43
Nofibre carbohydrate	14.98	14.96	12.91	2.06
Neutral detergent fibre	41.00[c]	44.45[b]	58.31[a]	3.44
Acid detergent fibre	31.19	30.40	23.40	5.76

[abc] Means in the same row with different superscripts differ significantly (P<0.05)

The NFC content of the concentrates was adequate to stimulate NH3–N utilization in the rumen (Tylutki et al., 2008). The optimal concentration of NFC is important in ruminant diets to avoid acidosis and other metabolic problems. Supplementation generally did not significant effect on the chemical composition of the experimental diets because the probiotic mixture used is nonnutritive feed additive and therefore did not add any nutrient to the diets as level of inclusion increases. There was a significant difference ($P < 0.05$) between T1 and T2, while T2 and T3 were similar in terms of total DM (Table 2).

Nutrient Intake

Table 2: Nutrient Intake of Growing Yankasa Rams Fed Concentrate Supplemented With Probiotic Mix (G/Day)

	Level of probiotic supplementation (%)			
Nutrient (g/d)	T1(0.0)	T2 (0.2)	T3(0.3)	SEM
Dry matter	787.55^{c}	924.15^{ab}	1067.98^{a}	120.00
Dry matter (% BW)	4.32	4.83	4.91	0.58
Organic matter	773.70^{b}	841.81^{bc}	1049.30^{a}	61.26
Crude protein	131.69^{c}	154.12^{b}	181.12^{a}	2.44
Ether extract	28.22	30.56	34.57	6.35
Non fibre carbohydrate	116.61^{b}	137.48^{b}	252.47^{a}	43.00
Neutral detergent fibre	430.22^{a}	596.74^{b}	633.46^{a}	67.92
Acid detergent fibre	324.42	357.44	373.44	33.01

^{abc} **Means in the same row with different superscripts differ significantly (P<0.05)**

The intakes of OMI (773.70 – 1049.30 g/d), CP (131.69 – 181.12 g/d), NFC (116.61 – 252.47 g/d) and NDF (430.22 – 633.46 g/d) increased (P < 0.05) as level of probiotic mixture increased and it was highest in animals placed on T3 diet. However, a non-significant difference (P > 0.05) was observed in dry matter intake (4.32 - 4.91% BW), EE (28.22 - 34.57 g/d) and ADF intakes (324.42 – 357.44 g/d) among treatments. Feed intake in terms of dry matter intake (547 g/d) was affected by the probiotic supplementation and consistent with results of Lesmeister et al. (2004). This may be due to the increased digestibility of the NDF and the DM in their experiment, and also, may be correlated with rumen development (Lesmeister et al., 2004). The progressive increases in nutrient intakes may be a response to progressive decline in fibre fractions (ADF and ADF) and probably induced by level of probiotic supplementation, in consonance with earlier reports.

Table 3: Growth Performance of Experimental Animals

	Level of probiotic mix (%)			
Parameter	T1(0.0)	T2 (0.2)	T3(0.3)	SEM
Dry matter intake (g/d)	787.55^{b}	927.48^{b}	1067.00^{a}	91.50
Initial weight	16.08	16.04	16.03	0.05
Final weight	21.60^{b}	23.01^{b}	27.72^{a}	0.96
Average weight gain (kg)	6.62^{b}	7.92^{b}	8.7^{a}	0.90
Average daily weight gain (g/day)	78.81^{b}	100.47^{b}	138.57^{a}	12.86
Dry matter intake (% BW)	4.22	4.75	5.12	0.55
Feed conversion ration	14.31^{a}	10.03^{b}	7.73^{c}	0.84

^{abc} **Means in the same row with different superscripts differ significantly (P<0.05)**

Dry matter intake (DMI), average LBW, daily weight gain (ADG), DMI (%BW) and feed conversion (FC) of rams fed experimental diets are illustrated in Table 5. Rams placed on T_2 and T_3 recorded the highest values (P<0.05) of DMI (927.48 - 1067.00 g/d), ADG (78.81- 138.57 g/d) and better FC (7.73) respectively compared with control diet (T_1). Also, DMI (%BW) did not show any diet effects (Table 4).

Positive effects of inclusion of probiotic supplementation on growth performance are expected to be accompanied by improvements in feed intake (Ataşoğlu et al., 2010). In the present results, addition of probiotic supplementation improved the lambs performances by enhancing BW

(4.22 - 5.12%) gain, TWG (6.62 – 8.7 kg) and reducing FCR (7.73 - 14.31) in the growing period by a tendency to increase DM intake from 787.55 g/d to 1067.00 g/d. . The levels of the supplemented probiotic used in the present study were similar to those levels used by Salem et al., (2017) who reported that lambs receiving 0.5 and 1 g probiotic/kg feed have significantly ($p<0.05$) greater body weight gain (14.18 kg) compared to the control group (12.07 kg). Other studies reported that improvement in growth performance with probiotic supplementation may be due to a higher feed consumption and better feed efficiency (Antunovic et al., 2006), and improving DM intake, digestibility of fibre fractions and crude protein, and reduced incidence of diarrhoea due to increase number of beneficial microorganisms in the rumen (Kochewad et al., 2009). Another possible reason for improved growth performance with addition of probiotic may be that, during the post-weaning period, lambs are transferring from milk diet provided by the ewe to forage or grain based diet which stimulates rumen development. Ataşoğlu et al. (2010) reported that changes in the intake capacity of young lambs for solid feeds can affect growth performance particularly in the post-weaning period.

In the present study, FCR (14.31 – 7.73) was improved by probiotic supplementation during growing period, and this may be due to improved feed intake and nutrients digestibility. Improved FCR with probiotic supplementation has been reported with lambs (Haddad et al., 2005). A recent study by El-Katcha et al. (2016) reported that growing lambs receiving Pediococcus spp (Bacteria probiotic) supplementation in drinking water had a higher final BW and weight gain, and better feed conversion efficiency compared to control group. On the other hand, probiotic supplementation had no effect on DM intake, live weight gain, or FCR of steers lambs (Titi et al., 2008). Differences in the results of these experiments may be due to the differences in the animal models used, growth stage, environment, administration/supplementation timelines and level, viable yeast cell number, or composition of animal diets (Whitley et al., 2009).

Economics of Production of Yankasa Sheep Fed with Diets Supplemented With Probiotic Mix

The result of economics of production of Yankasa sheep fed with diets supplemented with probiotic mix Table 6. The average cost of feed consumed increased from (₦313.14) in T1 to (₦ 464.94) in T3 as supplementation level increased. Average total cost of production of ram increased from ₦ 11,391.47 in T1 to ₦ 11,542.77 in T3 with increase in probiotic level. Average total weight gain (6.62-8.77 kg), average selling price and average net profit increased from average of ₦14,000 to ₦17,000.00 and ₦5,735.00 to ₦8,735.50 respectively with increased level of probiotic mix supplementation.

Table 4: Economics of Production of Yankasa Sheep Fed with Diets Supplemented With Probiotic Mix

Parameters	Level of probiotic mix (%)		
	T3 (0.0%)	T3 (0.2%)	T3 (0.3%)
Purchased price (₦/animal) [a]	8,265.00	8,263.50	8,264.50
Average cost of feed (₦/kg/animal) [b]	5.68	6.05	6.42
Total feed consumed (kg/animal) [c]	55.13	64.69	72.42
Total cost of feed consumed (kg/₦/animal) [d]	313.14	391.37	464.94
Average cost of labour (₦/animal) [e]	2,500	2,500	2,500

Medication and transportation/animal [f]	313.33	313.33	313.33
Total cost of production (₦/animal) [g]	11,391.47	11.468.20	11,542.77
Total weight gain (kg/animal) [h]	6.62	7.92	8.77
Selling price (₦/animal) [i]	14,000	15,800	17,000
Net profit (₦/animal) [j]	2,609	4,332	5,457

₦=Naira, Purchase price = a, Average cost of feed (₦/kg/animal) = b, Total feed consumed (kg/animal) =c, Total cost of feed consumed (kg/₦/animal) = d = bxc, Average cost of labour (₦/animal) =e, Medication and transportation/animal =f, Total cost of production (₦/animal) = g = a + d + e + f, Total weight gain (kg/animal) = h, Selling price (₦/animal) = i, Net profit (₦/animal) = j = g - i

Average cost of feed consumed and total cost of production increased with the level of probiotic supplementation; this is as result of higher cost of probiotic mixture as level of supplementation increases. However, at the long run higher level of probiotic mixture supplementation produced higher amount of average weight gain compared with control diet with T3 having the highest amount as supplementation increases. This observation is in tandem with previous works (Haddad and Goussous 2005). Probiotic supplementation has been reported to improve growth performance in sheep (Antunovic et al., 2006). Selling price and net profit increased with increased level of probiotic supplementation with T3 maintaining its superiority on T1 and T2. This increase is due to higher weight gain induced at the long run by higher level of probiotic supplementation. Also probiotic supplementation at 0.3% and 0.35% levels replacements resulted in net profit which were ₦4,332 and ₦5457 respectively compared with control diet ₦2609 without probiotic supplementation (T1). However, higher net profit, benefits of T3 indicate that this diet was economically superior and of better quality

Conclusion

The study shows that probiotic mixture supplementation can be used up to 0.3% in a practical low cost sheep ration without any adverse effect on feed consumption and growth performance of buckling growing Yankasa sheep. However, 0.3% supplementation level shown better feed intake and growth performance of growing Yankasa sheep.

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