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Growth Performance and Carcass Characteristics of Ram Lambs Fed Concentrate Mixture Containing Varying Levels of Cashew Nut Kernel Meal

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ABSTRACT

A study was conducted to evaluate the effect of feeding concentrate mixture containing varying levels of cashew nut kernel meal (CNKM) on growth performance and carcass characteristics in ram lambs. In a completely randomized design, 18 ram lambs were divided into 3 equal groups of six each. They were allotted in to three dietary treatments (T_1 to T_3) comprising of green fodder *viz.,* Super Napier and concentrate mixture (20% CP) containing CNKM at 0, 10 and 20%, respectively. The body weight gain and average daily gain increased ($P<0.05$) linearly with increasing level of CNKM in concentrate mixtures from T_1 to T_3, while the feed cost per kg weight gain decreased by ₹ 1.46 in T_2 and ₹ 19.81 in T_3 as compared to control. Carcass studies in ram lambs fed concentrate mixtures had no effect ($P>0.05$) on various carcass parameters expressed as percentage of hot carcass weight. No significant differences were observed in the proportion of whole sale cuts (% carcass weight) and yield of visceral organs (% of pre slaughter weight) among the different treatments. It is concluded that CNKM can be included up to 20 % in the concentrate mixture for improved body weight gain, feed efficiency and economical meat production in ram lambs.

HIGHLIGHTS

- Cashew nut kernel meal (CNKM) significantly improved weight gain, average daily gain, feed conversion efficiency in ram lambs.
- CNKM affected the yield of quality carcass parameters economically in ram lambs.

Keywords: Carcass characteristics, cashew nut kernel meal, growth performance, ram lambs

Small ruminants have an important role in the sustainability of village communities in the developing countries, where they rely on forages available in common property resources. Raising of sheep and goats for backyard farming or for commercial scale is cheaper and easier to manage compared to large ruminants and other livestock animals. The wicked scenario of fodder availability and escalated cost of concentrate ingredients had led to the exploration of new feed resources which do not compete with the human food chain is a continuous activity (Waje *et al*., 2010). Agro-industrial by-products could be an alternative as cheap and sustainable feed resources for ruminants. Cashew nut industry produces annually large amounts of biomass available as potential animal feed such as cashew apple waste (CAW), cashew nut shell (CNS), cashew nut shell liquid (CNSL), cashew nut testa (CNT) and cashew nut meal/cashew nut kernel meal (CNM/CNKM). Most commonly followed methods of cashew nut processing are roasting and steam cooking. Freshly harvested nuts were sun dried in yards for 2-3 days and then these nuts were subjected to roasting/steam cooking to liberate the oil in nuts which is cashew nut shell liquid (CNSL). Roasted nuts were then decorticated to remove shell and the obtained kernels were dried and peeled for easy removal of testa.

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The kernels are then graded by hand/sieve using CEPC (Cashew Export and Promotion Council) specifications. The processing of raw cashew nut carried out in many of the producing countries revealed that 60-65% are of commercial value and 35-40% of the processed nuts are often discarded either as broken or scorched kernels (Agbede *et al.,* 2006). The best kernels were exported and used for human consumption, while the discarded kernels were subjected to cold process method to extract oil. The discarded nut is said to contain a significant quantity of high protein material, which is particularly used for feeding of animals (Sogunle *et al*., 2009). In cashew nut industry, large quantities of cashew nut meal is produced after extraction of cashew oil, which can be used in animal feeding. The discarded nut or rejected cashew nut kernel meal (CNKM) obtained after oil extraction contains 87.00-95.40% DM, 21.20-38.12% CP, 0.72-3.43% CF, 15.10-58.00% EE, 3.73-5.45% TA and 20.34-34.50% NFE as reported by several authors (Oddoye *et al*., 2013; Akande *et al*., 2015 and Usman *et al.,* 2016). Cashew nut meal has more recently assumed greater importance due to the fact that its use has been extended for feeding of animals. It is a valuable and potential by-product that can be utilized as an alternative energy and protein source for growing ruminants and the data on utilization of CNKM is scanty. Hence, the present work has been taken up to study the effect of feeding concentrate mixture containing varying levels of cashew nut kernel meal on growth performance, carcass characteristics and economics in ram lambs.

MATERIALS AND METHODS

The growth trial was carried out at Krishi Vigyan Kendra, Lam, Guntur, while chemical analysis was done at Department of Animal Nutrition, NTR College of Veterinary Science, Gannavaram. Cashew nut kernel meal was procured from M/s Index International, Virudhunagar, Tamil Nadu. Feed ingredients like maize, deoiled rice bran, gingelly cake, soybean meal, mineral mixture and salt were procured from the local market. Super Napier was supplied from the fields of Krishi Vigyan Kendra, Lam, Guntur. The ingredient and chemical composition of experimental concentrate mixtures fed to ram lambs is furnished in Table 1.

Growth Trial

Eighteen ram lambs (9-11 kg) of about 3-4 months age were randomly divided into three equal groups of six each, housed in individual pens with provision for individual feeding. Fresh, clean drinking water was provided to the animals throughout the day. All the lambs were dewormed with Ivermectin @ 1 mL/50 kg body weight before and at the middle of the growth trial. All ram lambs were offered respective diets (T_1 to T_3) daily two times *i.e.* 9.00 am and 2.00 pm (1% of BW) and super napier was made available all through the day in *ad libitum*, during growth trial of 90 days. Feed samples were analyzed for proximate composition as per AOAC, (2007), fibre fractions (Van Soest *et al*., 1991) and calcium and phosphorus Talapatra *et al.* (1940).

Carcass studies

Two representative animals from each group were slaughtered at the end of growth trial and evaluated for various carcass parameters. The animals were slaughtered by 'Halal' method after overnight fasting with free access to water. The live weights before slaughter were recorded. The stripping, legging, dressing and evisceration were performed by adopting the standard procedure described by Gerrand (1964). Carcass and non-carcass components were separated and weighed immediately after slaughter. Weight of the ingesta was computed as the difference between full and empty digestive tract. The empty body weight was computed as the difference between pre-slaughter weight and weight of the ingesta. The carcass was then divided into 5 wholesale cuts *i.e.* leg, loin, rack, shoulder and neck and fore shank and brisket as suggested by the National Livestock and Meat Board of United States of America (Brandly *et al.,* 1968). The proportion of the respective cuts was calculated on the basis of hot carcass weight.

Statistical analysis

The data collected during growth trial was subjected to one way analysis and for carcass traits from means (Snedecor and Cochran, 2004).

RESULTS AND DISCUSSION

The CP content of super napier green fodder was 12 per cent and is in line with the findings of Aruna (2017) and Devika (2019). Similarly, the CF, NDF and ADF content of the fodder in the present study (Table 1) is similar to the values (Eshwer, 2018). The CP and EE content of CNKM in the present study was 25.56 and 12.60 per cent, respectively. The lower and higher values of CP and EE in various cashew nut by-products as given by several authors (Oddoye *et al.,* 2011; Bezerra *et al*., 2015; Usman *et al*., 2016 and Ahaotu *et al.*, 2018) compared to the given values in CNKM might be attributed to variety of cashew, collection method and maturity of fruits and nuts, employment of different oil extraction methods etc. The concentrate mixtures, T_1, T_2 and T_3 were iso-nitrogenous (Table 1). Increased levels of inclusion of CNKM from 0 to 20% in the concentrate mixtures resulted in increased OM, EE and decreased TA, CF and NFE content as compared to the control (T_1). Further, the study indicated that the levels of NDF, ADF, cellulose and ADL increased with increasing levels of CNKM in the concentrate mixtures (T_1 to T_3).

The data on the growth performance and economics of ram lambs fed concentrate mixtures containing 0 to 20% CNKM were presented in Table 2. The body weight gain and ADG were highest ($P<0.05$) in T_3 compared to other treatments but the differences between T_1 and T_2 were not statistically significant. Improved body weight gain might be attributed favourable energy to protein ratio in treatment diets that led to the efficient utilization of nutrients. Similar findings were observed by several authors (Okoruwa and Igene (2015) in goats; Ahaouta *et al.* (2018) in rabbits) fed various cashew by-products. In contrast, Okolo *et al*. (2012) reported decreased ($P<0.05$) total weight gain and daily weight gain with increased levels of cashew nut shell in goats. Similarly, decreased ($P<0.05$) total weight gain and ADG compared to control were also reported earlier (Ocheja *et al*., 2014 in west African dwarf goats fed cashew nut shell and Aubert *et al.,* 2016 in pigs fed cashew nuts). Further, several authors (Liwaway *et al.,* 2013, Oddoye

Table 1: Ingredient and chemical composition (% DM basis) of experimental diets fed to ram lambs

Nutrient	Super Napier	CNKM	T_1	T_2	T_3
Ingredient composition					
Maize			35	31	28
Deoiled rice bran			35	33	30
Gingelly cake			9	9	9
Soybean meal			18	14	10
Mineral mixture			2	2	2
Salt			1	1	1
Cost/kg feed (₹)			23.56	23.18	22.82
Chemical Composition (% DM basis except for DM)					
Dry matter	24.00	92.00	90.60	91.10	91.60
Organic matter	89.00	91.00	87.00	87.05	87.08
Total ash	11.00	9.00	13.00	12.95	12.92
Crude protein	12.00	25.56	20.08	20.07	20.05
Ether extract	2.10	12.60	1.80	2.50	3.40
Crude fibre	42.00	4.30	14.90	14.50	13.90
Nitrogen Free Extract	32.90	48.54	50.22	50.02	49.73
NDF	80.12	52.33	40.00	43.90	44.80
ADF	49.50	31.44	15.00	18.00	21.10
Hemi cellulose	30.62	20.89	25.90	25.00	23.70
Cellulose	38.20	23.65	8.50	9.15	9.20
Acid detergent lignin	4.80	5.96	2.99	2.75	3.50
Silica	3.20	2.12	2.75	1.98	1.88
Calcium	0.65	0.36	1.13	1.09	1.06
Phosphorus	0.18	0.46	0.52	0.38	0.54

et al., 2013 and Bezerra *et al.,* 2015) reported no effect (P>0.05) in body weight gain and ADG among the dietary treatments fed various cashew by-products.

The present study indicated that the feed conversion ratio (FCR) improved (P<0.05) with increased level of inclusion of CNKM with T_3 performing the best, but the differences between T_1 and T_2 and T_2 and T_3 were comparable (Table 2). In line with the present study, improved (P<0.05) FCR was observed in rabbits fed cashew nut waste (Usman *et al.,* 2016) and cashew apple (Ahaotu *et al*., 2018) compared to control. In contrast, Okolo *et al.* (2012) reported poor FCR (P<0.05) among the treatment diets in goats fed cashew nut shell, while, non-significant differences in FCR were observed in hogs fed cashew apple among the different treatments (Liwaway *et al*., 2013). Increased level of inclusion of CNKM from 0 to 20% resulted in decreased (P<0.05) cost of feed/kg gain by ₹ 1.46 and ₹ 19.81 in T_2 and T_3, respectively, as compared to control (Table 2). Similar results were reported by several authors (Jaji *et al.,* 2011 in chicks and Ahaotu *et al.,* 2018 in rabbits) fed various cashew by-products. However, no difference was observed in cost of feed/kg gain in swine fed dried cashew apple compared to other treatments (Liwaway *et al*. (2013).

Data on carcass parameters in ram lambs fed concentrate containing varying levels of CNKM was presented in Table 3. Various carcass parameters in ram lambs fed CNKM did not differ among the treatment groups,

Table 2: Effect on growth performance and economics of ram lambs fed different levels of cashew nut kernel meal containing diets

Particulars [NS]	T_1	T_2	T_3	SEM	P-Value
Initial BW (kg)	14.01 ± 0.92	14.05 ± 1.43	14.43 ± 0.34	0.546	0.949
Average BW (kg)	20.88 ± 1.10	20.98 ± 1.38	22.57 ± 0.81	0.635	0.506
Weight gain (kg)*	6.87^a ± 0.25	6.93^a ± 0.18	8.14^b ± 0.51	0.232	0.030
ADG(g/d)*	76.38^a ± 2.71	81.99^a ± 1.71	90.44^b ± 5.68	2.426	0.048
DMI (g/d)	772.87 ± 4.53	779.11 ± 20.98	789.81 ± 16.97	8.734	0.750
FCR (g feed/ g gain)*	10.11^a ± 0.32	9.50^{ab} ± 0.39	8.73^b ± 0.46	0.238	0.072
Cost of feed/kg gain (₹)*	123.67^a ± 0.52	122.21^a ± 0.22	103.86^b ± 0.88		

[NS]Non-significant; Each value is an average of six replicates, *P<0.05.

Table 3: Effect on carcass characteristics and wholesale cuts (% carcass weight) of ram lambs fed diets containing different levels of cashew nut kernel meal

Parameter [NS]	T_1	T_2	T_3	SEM	P-Value
Carcass Parameters					
Pre slaughter weight (Kg)	23.18 ± 0.48	23.55 ± 1.29	23.59 ± 0.99	0.493	0.948
Empty Body weight (Kg)	20.56 ± 0.45	20.72 ± 0.99	20.76 ± 1.20	0.469	0.986
Hot Carcass weight (Kg)	11.37 ± 0.07	11.62 ± 0.60	11.83 ± 0.41	0.220	0.748
Dressing Percentage (%)					
(On live weight)	49.07 ± 0.73	49.34 ± 0.16	50.19 ± 0.36	0.293	0.299
(On empty weight)*	49.35^a ± 0.88	50.19^b ± 0.16	55.35^b ± 0.36	0.979	0.001
Fore saddle (%)	51.88 ± 1.00	51.96 ± 1.07	53.06 ± 0.09	0.466	0.582
Hind saddle (%)	46.69 ± 1.85	46.78 ± 0.60	47.88 ± 0.02	0.595	0.719
Wholesale cuts (% carcass weight)					
Brisket & Fore shank	13.55 ± **1.00**	14.06 ± 0.97	14.08 ± 1.12	0.523	0.921
Shoulder & Neck	24.54 ±0.56	25.02 ± 2.11	25.20 ± 1.21	0.726	0.946
Rack	15.33 ± 0.72	15.67 ± 0.64	16.05 ± 0.80	0.376	0.789
Loin	10.13 ± 0.84	10.19 ± 0.23	10.29 ± 0.92	0.367	0.987
Leg	35.13 ± 1.20	35.22 ± 0.42	35.64 ± 0.49	0.401	0.891

[NS]Non-significant; Each value is an average of two replicates, *P<0.05.

Table 4: Yield of visceral organs (% of pre slaughter weight) of ram lambs fed concentrate mixtures containing different levels of cashew nut kernel meal

Parameter (%)[NS]	T_1	T_2	T_3	SEM	P-Value
Pluck	3.49 ± 0.02	3.50 ± 0.01	3.51 ± 0.00	0.009	0.741
Liver	1.68 ± 0.11	1.74 ± 0.22	1.90 ± 0.27	0.112	0.752
Kidney	0.38 ±0.03	0.41 ± 0.01	0.45 ± 0.01	0.016	0.178
Heart	0.59 ± 0.05	0.61 ± 0.04	0.71 ± 0.01	0.027	0.144
Testes	1.11 ± 0.02	1.13 ± 0.01	1.16 ± 0.01	0.010	0.121
GIT (Full)	24.15 ± 0.19	24.21 ± 0.40	24.76 ± 0.35	0.191	0.404
GIT (Empty)	7.11 ± 0.04	7.13 ± 0.01	7.15 ± 0.01	0.014	0.586
Intestines	4.27 ± 0.01	4.32 ± 0.05	4.58 ± 0.20	0.078	0.248
Spleen	0.31 ± 0.01	0.34 ± 0.01	0.37 ± 0.01	0.005	0.732
Lungs with trachea	2.15 ± 0.10	2.35 ± 0.32	2.39 ± 0.33	0.142	0.808
Skin	12.31 ± 0.08	12.35 ± 0.26	12.53 ± 0.20	0.104	0.711
Head	9.13 ± 0.21	10.29 ± 0.79	10.31 ± 0.83	0.389	0.420
Blood	4.32 ± 0.01	4.33 ± 0.01	4.35± 0.01	0.005	0.000
Limbs	6.18 ± 0.16	5.27 ± 0.70	5.43 ± 0.67	0.317	0.519

[NS]Non-significant.

however, a numerical increase was observed in T_3 compared to control which might be due to increased body weight gains. In contrast, Ocheja *et al*. (2016) reported no difference in dressing percentage in goats fed cashew nut shell. Whole sale cuts (% of carcass weight) in ram lambs fed CNKM reported a numerical increase compared to control with non-significant differences (Table 3). Similar findings were observed in goats fed cashew nut shell (Ocheja *et al.*, 2016). The increase in the weights of primal cuts in lambs fed 20% CNKM might be due to the best utilization of diet for muscle build up and hence quality meat production (Omojola and Attah, 2006). Similarly, the inclusion of CNKM from 10 to 20% in the concentrate mixtures had no effect (P>0.05) on yield of visceral organs in ram lambs as compared to the control (Table 4). In line with the present study, Ocheja *et al.* (2019) reported non-significant (P>0.05) differences in the weight of full gut, empty gut, hooves and blood in goats fed cashew nut shell, while Aubert *et al.* (2016) reported increased (P<0.05) proportions of visceral organs in swine fed cashew.

CONCLUSION

Inclusion of CNKM from 10 to 20 per cent in the concentrate mixture resulted in better growth performance, dressing percentage, wholesale cuts and decreased feed cost/kg gain in ram lambs. Hence, it is concluded, that CNKM can be incorporated up to 20% in the diet of growing ram lambs for economical meat production without any adverse effects on the health of animals.

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