ADAN J. Agric. 2020, 1 (1): 173-179

ISSN 2736-0385

Milk yield and composition of West African dwarf (wad) goats fed palm kernel cake supplement for conventional concentrate

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Abstract

The effect of replacement of conventional Concentrate (CC) supplement with Palm Kernel Cake (PKC) on the milk composition and yield of West African Dwarf (WAD) dams fed Pennisetum purpureum silage (grass) basal ration was investigated. Twenty five lactating WAD dams of average weight of 13kg ± 0.2 were randomly assigned into five dietary treatments in a Completely Randomized Design (CRD) layout. Each treatment group consists of five replicates of lactating dam. Dams were individually housed and offered silage freely with 400g of one of the five supplement treatments (T) per day (viz: C/PKC: T1 – T5); T1: 100/0; T2: 75/25; T3: 50/50; T4: 25/75 and T5: 0/100). The replacement of CC by PKC had significant ($p<0.05$) effect on the average milk yield, percentage (%) fat, protein, specific gravity, ash and fat corrected milk (FCM) but showed no significant ($p>0.05$) effect on the total solid (TS%) of the milk of the treatments. Based on this result it can be concluded that the proportionate combinations of CC and PKC as supplement to Pennisetum purpureum (grass) silage rations of WAD goats during lactation will improve the milk yield and the composition without adverse effect. However, at 50% replacement of CC by PKC (50/50) the milk yield is enhanced while the fat and protein components were improved at 100% replacement of CC by PKC.

Key words: *Conventional Concentrate; Palm Kernel Cake; Supplement; Milk yield; Milk composition, WAD goats*

Introduction

Goat milk which is rarely utilized for human consumption due to social belief (Emrobowansan, *et. al*., 2019, Belewu, 2001, Butswat *et. al*., 2002) was found to be a fundamental food in the diets of many cultures (Silanikove *et al.*, 2010. Goat milk with grains, meats, vegetables, fruits and dairy products were reported to be nutrient rich foods that supplies many nutrients and proved relatively good to health (Drewnowski and Fulgoni, 2008). Goat milk contains small fat globules (Jenness, 1980; Chandan *et al.*, 1992) and both cow milk and goat milk protein percentage wereas reported to be similar (Park *et al.*, 2010) and Heanlein (2004; 2007). Belewu (2001) reported goat milk to be useful in the treatment of dyspepsia, peptic ulcer, pyloric stenosis, liver dysfunction jaundice and biliary disorder. As noted, there is growing awareness on the importance of goat as source of milk for man (Malau-Aduli *et.al*., 2004). Referencing the above facts, the dietary value of goat milk produced through PKC supplementation is worth studying to encourage its production and consumption among the local populace since the goat is owned by nearly all the household units unlike cow which is more expensive. In Nigeria, the WAD goats are managed extensively by subsistence and rural farmers

and Safiyu *et. al.,* (2017) reported that milk production of this breed is well documented. Therefore, this study was conducted to investigate Palm Kernel Cake as potential supplement for conventional concentrate in lactating WAD goats to enhance milk yield and composition, using *Pennisetum purpureum* silage as basal diet.

Materials and Methods

Experimental animals and milking procedure

Twenty five lactating WAD does were randomly divided to five groups from the first week of lactation in a Completely Randomized Design (CRD) layout. Each does with its nursing kid were individually confined and kept under intensive conditions at Ruminant unit of Teaching and Research farm of Landmark University, Omu-Aran. Each group were assigned randomly to one of the five experimental diets comprised silage and 400g of one of the five experimental supplement per day (FC/PKC: 100/0; 75/25; 50/50; 25 /75 and 0/100). The silage was supplied free choice which allowed maximum voluntary intake of the silage with measured quantity of CC or PKC (400grams/day). The diets were offered as a meal ration per day in the morning (10.00hr). Does in control group received supplement that contained no PKC (T1) alongside silage, while does in groups two to five received supplement that have the proportions of CC replaced with PKC. The animal pens were of the same dimension (3 x 1.5m^2) with similar designed flooring and free water facility. Fresh clean water and mineral salt lick were provided freely.

Milking procedure

The kids were allowed to suckle the dams for 3 days before the commencement of milking and evaluation. Against each collection day, the kids were separated from the dam over-night between 18:00hours in evening and 10:00hours of the following morning (6pm-10am). Hand milking method was adopted. This was undertaken by gentle press of the udder teat of the lactating dam before morning feeding. The quantity of the milk obtained from each dam within 3 minutes of hand milking was quantified for each dam in each of the three (3) randomly selected days in the weeks for collection before feeding. Measuring cylinder was used to measure the volume and milking took place once in a day. Prior to daily collection of the milk, milk parlors, utensils, measuring cylinder were cleaned and sterilized. The udders of the goat does were cleaned with warm water before milking high level of hygiene was observed throughout the milk collection period.

Throughout the 16 weeks of lactation study, samples of milk collected from each dam were pooled together to estimate weekly milk yield of each of the experimental animals. A portion of the milk (50ml) from each dam was stored at -4^{0}C and used to determine the composition of the milk by methods of AOAC, 2005. The results were analyzed; using General Linear Model Procedure (GLM) of SAS (1995). Duncan's Multiple Range Test (Duncan, 1955) was used to compare the significant across treatments.

Table 1 : Average daily milk yield (ml/day) of lactating goat does fed *Pennisetum purpureum* silage supplemented with Palm kernel cake as replacer of Formulated concentrate

	Week of lactation																
Conc./ PKC	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Average Milk Yield**
100/0	53.60^{c}	76.00^{b}	93.00^{b}	96.00^{c}	105.00^{c}	116.00^{c}	146.00^{b}	140.00^{b}	85.00^{c}	70.00^{c}	56.00^{c}	39.00^{c}	28.00^{d}	24.00^{c}	22.00^{c}	19.40^{c}	74.54^{b}
75/25	83.00^{b}	92.00^{a}	105.00^{a}	118.00^{b}	140.00^{b}	140.00^{b}	140.00^{b}	133.00^{b}	130.00^{b}	104.00^{b}	90.00^{b}	85.00^{b}	60.00^{b}	55.00^{b}	45.00^{b}	35.00^{b}	97.18^{b}
50/50	104.00^{a}	92.00^{a}	87.00^{c}	155.00^{a}	160.00^{a}	163.00^{a}	172.00^{a}	188.00^{a}	190.00^{a}	192.00^{a}	145.00^{a}	97.00^{a}	90.00^{a}	63.00^{a}	57.00^{a}	50.00^{a}	125.31^{a}
25/75	53.00^{c}	72.00^{b}	90.00^{b}	92.00^{c}	95.00^{c}	100.00^{d}	10.20^{c}	85.00^{c}	83.00^{c}	70.00^{c}	56.00^{c}	43.20^{c}	36.00^{c}	20.00^{c}	16.60^{d}	13.20^{d}	58.45^{c}
0/100	60.00^{c}	70.00^{b}	80.00^{c}	80.00^{d}	76.00^{d}	63.20^{e}	57.00^{d}	55.00^{d}	56.00^{d}	52.00^{d}	42.00^{d}	24.00^{d}	22.00^{e}	20.00^{c}	14.80^{d}	10.00^{d}	48.88^{c}
SEM±	1.91	1.41	1.38	1.35	1.78	1.72	2.32	1.91	1.59	1.89	0.92	1.20	0.84	0.64	0.68	0.61	0.65

*Means within column with different superscripts are significantly different ($p<0.05$)

Results

The milk yield of the dam during the sixteen weeks of lactation of the dam fed grass silage and experimental supplement are presented in Table 1. The average milk yield (125.31ml) obtained from group fed diet T3 as significantly ($p<0.05$) different among the treatment groups while the average yield from groups fed T1 and T2 were similar ($p>0.05$), and likewise the values obtained from groups T4 and T5 displayed marginal ($p>0.05$) difference. The highest average milk yield (125.31ml) was obtained from treatment T3 (50:50) and least value (48.88ml) was recorded from treatment group T5 (0:100). The milk yield of dams fed different C:PKC combinations peaked at different weeks and gradually reduced as the weeks of lactation progressed. Each supplement mixture showed a peculiar milk yield pattern. The proportionate replacement of CC by PKC showed significant ($p<0.05$) different of the percentage (%) fat, protein, specific gravity (SG), total solid (TS), ash, fat corrected milk (FCM) and not solid fat (SNF) component of the milk but had no significant ($p>0.05$) on the total acidity (TA%) in Table 2

Table 2: Composition of the milk of WAD goat does fed *Pennisetum purpureum* silage supplemented with Palm kernel cake as replacer of Conventional concentrate

	Conventional concentrate - PKC ratio					
Parameters	**100/0**	**75/25**	**50/50**	**25/75**	**0/100**	**SEM±**
Fat %	1.12^{c}	1.06^{c}	1.65^{b}	0.77^{c}	2.17^{a}	0.039
Protein%	4.09^{c}	6.50^{b}	5.31^{bc}	6.06^{b}	8.27^{a}	0.113
SG g/ml	1.06^{ab}	1.04^{b}	1.06^{ab}	1.07^{a}	1.05^{ab}	0.002
T. S %	7.06^{b}	8.27^{ab}	9.18^{a}	7.90^{ab}	7.56^{ab}	0.143
T. A %	0.37^{a}	0.37^{a}	0.29^{a}	0.29^{a}	0.22^{a}	0.015
Ash%	1.08^{c}	1.05^{c}	1.35^{b}	0.91^{c}	1.61^{a}	0.020
FCM (3.5%)	22.50^{c}	21.50^{c}	32.40^{b}	16.04^{c}	42.01^{a}	0.722
SNF %	5.94^{ab}	7.21^{ab}	7.53^{a}	7.13^{ab}	5.39^{b}	0.150

*Means on the same row with different superscripts are significantly different ($p<0.05$)
SG- Specific gravity; T.S- Total solids; T.A- Total acidity; FCM- Fat corrected milk; SNF- Solids-non-fat.

Discussion

The increase in milk yield observed during early lactation and the decrease in the yield towards the end of lactation in this study are in agreement with the report of Akpa *et al.* (2002) and Adewumi (2002) who reported an increase in early lactation within 2-5weeks post-partum and thereafter a decline towards the end of lactation in Red Sokoto goats, Yankasa and WAD ewes. The increase in milk yield in early lactation in this study can be linked to the efficiency of secretory cells (Capuco *et al.*, 2001), however the influence of PKC as it replaced CC was apparent in the milk yield across the treatment. The yield from the group of animals fed equal portions of CC and PKC (50:50) showed higher yield from the beginning to the end of the trial period while yield from the group that received 0/100 (sole PKC) gave lowest value. The low value from those animals received sole PKC as supplement to silage can be linked to the energy and high fibre content of PKC used compared to other supplement containing CC as reported by Lu, 1991 that the chemical composition and physical form of structural carbohydrate or insoluble dietary fibre has been reported to influence the productive

performance in goat. However, the yield obtained across the treatment groups were higher than 50g/d reported for West African Dwarf goats (Gall, 1996) but lower to 500g/d from Red Sokoto goats (Devendra and Burns, 1983). Although, the yield is far below the daily production rates of temperate breed of goats (Sannen, Alpine, Toggenburg, and Nordic) which produce between 596 and 700kg per lactation. The difference in milk gross chemical composition between dams fed supplement that contained different proportions of PKC in the FC-PKC mixture supplements can to a large extent due to the replacement effect of FC by PKC the experimental dams had free access to the grass-silage on *ad-libitum* choice. In this study, the milk fat content obtained across the treatment was lower compared to 5.8% reported by Hart *et al.* (1996) and 5.03% reported by Nivea *et.al.,* (2015) who fed graded levels of Aspergillus treated rise husk to goats. The difference may due to the quality and the particle size as reported by LU, 1987. The milk protein contents of the milk in all treatments that contained PKC at varying replacement levels were higher than 4.8% reported by Hart *et al.* (1996). The values from both groups of animals that received sole CC, sole PKC and those that received FC-PKC supplement mix were higher than 3.5% reported (Jennes, 1980) for cow. The protein content obtained in was higher than values reported for goats elsewhere (Jennes, 1980). The total solid (T.S.) and solid-not-fat (SNF) values reported in this study were lower than values reported by Hart *et al*. (1996). The T.S of 7.06-9.18% obtained fall between 7.38-10.15% reported by Nivea *et.al.,* (2015), this indicates PKC as verified replacer of the concentrate. The similarity in total acidity across the treatments may be a confirmation of the efficacy of PKC in improving the composition of milk and beneficial effect of PKC replacement of CC as the composition obtained in this study are comparable with literature. The high milk fat content observed in the milk of dams that offered sole PKC supplement among the groups may be due to energy balance of the supplement and the mobilization of body fat for milk fat synthesis (Chilliard *et al,*. 2003). The high fat content and total solid obtained from group fed combinations of CC and PKC may also due to breed effect that may have enhanced effective utilization of the ration as reported by Morand-Fehr, *et. al.* (2007) and Santini *et. al.* (1991) that fat content in milk was higher when the dietary concentrate proportion increased in goat that had similar energy rate. The high values of the milk fat content and fat corrected milk in this study could be further attributed to the report of Lu *et al.* (1991) and Santini *et al.* (1992) that high fibre and diet particle length results in longer mastication time which may limit the voluntary intake and the resulting salivation can influence the production of acetate, a precursor of milk fat (Sanz Sampelayo *et al.,* 2007). The high milk protein content from the animals fed combinations of CC and PKC compared to group fed CC only (0%PKC) may also be due to optimal utilization of concentrate combinations for protein synthesis.

Conclusion and Recommendations

The experimental animals responded positively to the treatment diets with reference to milk yield and composition throughout the collection period. The 50:50 conventional concentrate-palm kernel cake ratio is recommended for milk yield (Quantity) while total replacement of conventional concentrate by palm kernel cake is recommended for improvement of fat and protein content (Quality). This indicates that the replacement of CC by PKC is economically beneficial in milk by WAD goats.

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