

The Effect of Fiber -Protein Levels on Milk Parameters, Linear Body Measurements and Udder Dimensions of West African Dwarf Sheep at First Lambing

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Abstract

A study on the effect of dietary fiber -protein levels on milk parameters and performance of West African Dwarf ewes and their lambs at first lambing was investigated for twelve weeks. The experimental diet includes control (CTRL), low fiber high protein (LFHP), and high fiber low protein (HFLP). Diet significantly ($p < 0.05$) influenced milk fat and fat-protein ratio of the milk, feed intake and milk off take but did not significantly ($p > 0.05$) influenced total solids and protein content. The LFHP diet was the most consumed ($P < 0.05$) compared to other diets and it induced higher percentage of milk offtake, fat and protein content. Lactating ewes on LFHP were significantly superior in weight, body parameters and udder dimensions except wither height and teat length that had significantly higher values in HFLP and CTRL diet respectively. Lambs on LFHP diet were significantly superior in weight and body parameters. No significant difference was detected among diets for heart girth and udder width in lactating ewes and for body length and neck circumference in their lambs. The fat/protein ratio of LFHP and CTRL diets indicated sufficient supply of energy and fiber as compared to diet on HFLP. Feed cost was highest in control diet but lowest for high fiber -low protein diet. Since dietary low fiber high protein improved the milk and body parameters, low fiber high protein (LFHP) diet should be formulated for lactating ewes to enhance the performance of WAD and their lambs at first lambing.

Keywords: Fiber -protein levels; Milk parameters; West African dwarf sheep; Dairy ruminants

Introduction

Level of nutrition, mainly referred to energy level or level of feed intake, is a main factor affecting milk yield and milk composition in dairy ruminants. While there have been some reports on the effect of nutrition on milk, body and udder parameters in temperate breeds of sheep [1,2], not much has been done to estimate the effect of nutrition on milk, body and udder parameter of Nigerian sheep and the performance of their lambs. There is a growing awareness of the need to provide more information on the Nigerian sheep in general and the West African Dwarf sheep in particular as sources of meat and milk. The West African Dwarf sheep is the predominant breed of the humid tropics from South West Africa through Central Africa. This breed is trypanotolerant, hardy and has high quality milk [3]. Therefore, this study was conducted to determine the effect of dietary fiber -protein level on milk parameters and performance of West African Dwarf sheep at first lambing.

Materials and Methods

Experimental animals and their management

Nine lactating (West African Dwarf) ewes at first lambing with initial body weight ranged from 20.33-24.4 kg were randomly distributed into three treatment group of 3 lactating ewes per replicate in a completely randomized design at the sheep unit, Teaching and Research Farms Directorate (TREFAD), of the Federal University of Agriculture Abeokuta, Ogun State, Nigeria. The ewes lambed between October and December. They were housed in 2 open sided pens with a wooden slated floor, raised a little above the ground. The animals were taken to the experimental pen 10 days after parturition. The animals were managed under an intensive system with zero grazing. They were fed with concentrate according to their diet group (Control, Low fiber High protein, High fiber Low protein), chopped grasses (*panicum maximum*) and water was given to the animals *ad libitum* (Table 1). Diets were offered twice daily at 6.00 and 16.00hr. Residuals

Ingredients	Control	Low fibre-High protein	High fibre-Low protein
Maize	10	10	8
Groundnut cake	13	0	0
Palm kernel cake	18	30	45
Rice husk	37	38	0
Wheat/offal	20	20	45
Salt	1	1	1
Bone meal	1	1	1
Total	100	100	100
Calculated analysis			
Metabolisable Energy (MKcal)	1866.1	7912.1	1753.4
Crude Protein%	16.455	16.856	11.25
Fat%	5.199	4.595	4.686
Crude Fibre%	21.69	9.38	22.22
Calcium%	0.6608	0.4003	0.648
Av Phosphorus %	0.2925	0.2497	0.2734
Lysine %	0.77240	0.4205	0.5178
Methionine %	0.3342	0.3024	0.2914

Table 1: Percentage composition of experimental diet.

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were weighed daily and subtracted from the offered amounts to obtain the actual feed consumed. Animals were weighed before feeding. Data pertaining to milk production and composition were compiled during one lactation period of 12 weeks. All lambs had access to the experimental diet of their dams.

The dams were taken into the experimental pen ten days after parturition to allow the lamb access to colostrums. The dams were hand milked once at 7 am after isolation of lamb for 12 hrs (7 am-7 pm). The milk total solids, fat and protein and fat-protein ratio of the milk were analyzed in the laboratory.

Data on weight of dams and lambs at birth, feed-in-take, teat length, width circumference, height at withers, body length, heart girth, neck length, udder circumference, udder width, distant of teat from ground were collected on weekly bases. Milk samples were analyzed for protein, fat, total solids and ash using standard methods [4]. Milk Protein was analyzed by using titration method [4]. Milk fat was determined by separation method. Milk Total solid was determined by evaporation method.

Statistical analysis

Data generated was analyzed using One-Way analysis of variance as contained in SAS package [5]. Means was separated using Tukey's Studentized Range test.

Result and Discussion

Effect of dietary fiber protein levels on weight of dam, feed intake, milk parameters of WAD ewes at first lambing

The influence of diet on feed intake was significant ($p < 0.05$) (Table 2). Mean milk offtake was significantly ($p < 0.01$) lower (by about 15 and 37 ml) in ewes on HFLP and CTRL as compared to lactating ewes on LFHP diet. The overall average feed intake and milk offtake were

1.09 kg and 197.46 ml respectively. The effect of diet on to the fat and fat/protein ratio content of the milk was found to be highly significant ($p < 0.001$) (Table 2). Average composition of milk parameters of WAD sheep for total solid, fat, protein and fat/protein ratio content were 14.52%, 6.18%, 6.73% and 0.99% respectively. No significant ($p < 0.05$) difference was obtained among diets on total solids and proteins, however, lactating ewes on CTRL diet had higher values of total solids as compared to ewes on LFHP and HFLP diet while lactating ewes on LFHP had higher values of proteins as compared to ewes on CTRL and HFLP (Table 2). The fat/protein ratio for lactating ewes on CTRL and LFHP diet were significantly ($p < 0.001$) higher as compared to ewes on HFLP diet.

Weight of dam, body measurements and udder dimensions were significantly ($p < 0.05$) superior in animals on LFHP diet while wither height which was significantly higher in ewes on HFLP diet. Teat length was significantly ($p < 0.001$) superior in ewes on CTRL diet.

The average linear body measurement and weight of WAD ewes at first lambing were 60.31 cm, 60.47 cm, 18.52 cm, 29.78 cm, 71.35 cm for wither height, body length, neck length, neck circumference and heart girth respectively while the average udder dimensions were 27.93 cm, 15.07 cm, 2.69 cm, 4.41 cm, 10.64 cm and 34.72 cm for udder circumference, udder width, teat length, teat circumference and distance between teat (Table 3).

Effect of dietary fiber -protein levels on lamb's weight and linear body measurement

Table 4 shows the effect of dietary treatments on weight and linear body measurements of lambs. There was a significant ($p < 0.001$) dietary effect on lamb's weight, wither height, heart girth and neck length. Lamb body length and circumference were not significantly affected. Weight and all body parameters were superior in ewes on LFHP. The

Parameters	Control N=36	Low fibre-High protein (n=36)	High fibre-Low protein (n=36)	Overall mean (n=108)	pvalue
Feed intake (kg)	1.02 ± 0.02 ^b	1.04 ± 0.02 ^b	1.09 ± 0.02 ^a	1.05 ± 0.01	P<0.05
Milk off-take (ml)	177.36 ± 7.09 ^b	214.83 ± 5.54 ^a	200.18 ± 8.66 ^a	197.57 ± 45.38	P<0.01
Total solids (%)	14.76 ± 0.37	14.30 ± 0.36	14.52 ± 0.44	14.52 ± 0.22	ns
Fat (%)	7.18 ± 0.68 ^a	7.81 ± 0.55 ^a	3.51 ± 0.17 ^b	6.18 ± 0.35	P<0.001
Protein (%)	6.25 ± 0.34	7.23 ± 0.33	6.71 ± 0.22	6.73 ± 0.18	ns
Fat/protein (%)	1.27 ± 0.17 ^a	1.15 ± 0.09 ^a	0.52 ± 0.02 ^b	0.99 ± 0.07	P<0.001

Table 2: Effect of dietary fibre-protein levels on weight, feed intake and milk parameters of WAD ewes at first lambing.

Parameters	Control N=36	Low fibre-High protein (n=36)	High fibre-Low protein (n=36)	Overall mean (n=108)	pvalue
Weight of dam (cm)	23.74 ± 0.77 ^b	26.93 ± 0.32 ^a	24.08 ± 0.61 ^b	24.84 ± 0.37	P<0.001
Linear Body Measurements					
Wither height (cm)	60.86 ± 0.52 ^a	58.44 ± 0.90 ^b	61.64 ± 0.77 ^a	60.31 ± 0.45	P<0.01
Body length (cm)	57.64 ± 0.79 ^b	62.89 ± 0.54 ^a	61.06 ± 0.94 ^a	60.47 ± 0.49	P<0.001
Neck length (cm)	17.39 ± 0.43 ^{ab}	20.97 ± 1.78 ^a	17.22 ± 0.53 ^b	18.52 ± 0.65	P<0.05
Neck circumference (cm)	28.60 ± 0.13 ^b	31.22 ± 0.41 ^a	29.39 ± 0.36 ^b	29.78 ± 2.58	P<0.001
Heart girth (cm)	71.17 ± 0.22	71.50 ± 0.75	71.39 ± 0.73	71.38 ± 0.35	ns
Udder dimensions					
Udder circumference (cm)	27.78 ± 0.29 ^b	31.36 ± 0.60 ^a	24.72 ± 0.38 ^c	27.93 ± 0.37	P<0.001
Udder width (cm)	14.80 ± 0.22	15.28 ± 0.38	15.07 ± 0.70	15.07 ± 0.27	ns
Teat length (cm)	2.92 ± 0.05 ^a	2.61 ± 0.08 ^b	2.56 ± 0.08 ^b	2.69 ± 0.04	P<0.01
Teat circumference (cm)	3.82 ± 0.10 ^b	4.67 ± 0.20 ^a	3.82 ± 0.20 ^b	4.41 ± 0.11	P<0.001
Distance between teats (cm)	10.58 ± 0.13 ^b	11.11 ± 0.15 ^a	10.25 ± 0.18 ^b	10.64 ± 0.01	P<0.001
Distance of teat from ground (cm)	31.97 ± 0.34 ^b	35.89 ± 0.44 ^a	36.31 ± 0.68 ^a	34.72 ± 0.35	P<0.001

Table 3: Effect of dietary fibre-protein levels on linear body measurements and udder dimensions of WAD ewes at first lambing.

Parameters	Control	Low fibre-High protein	High fibre-Low protein	Overall mean (n=108)	pvalue
Weight of lamb (kg)	5.65 ± 0.34 ^{ab}	6.25 ± 0.44 ^a	4.71 ± 0.23 ^b	5.50 ± 0.21	P<0.001
Lamb wither height (cm)	45.03 ± 0.62 ^b	49.06 ± 0.57 ^a	44.36 ± 1.13 ^b	46.15 ± 0.51	P<0.001
Lamb body length (cm)	38.43 ± 0.57	38.83 ± 0.73	37.18 ± 0.49	38.15 ± 0.35	ns
Lamb heart girth (cm)	49.90 ± 1.57 ^{ab}	50.65 ± 1.43 ^a	44.71 ± 1.21 ^b	48.42 ± 0.85	P<0.01
Lamb neck length (cm)	12.92 ± 0.50 ^{ab}	14.78 ± 0.39 ^a	12.01 ± 0.57 ^b	13.24 ± 0.30	P<0.001
Lamb neck circumference (cm)	21.69 ± 0.48	23.24 ± 0.36	21.67 ± 0.54	22.20 ± 0.28	ns

Table 4: Effect of dietary fibre-protein levels on weight and linear body measurement of lambs.

mean lamb's weight, wither height, body length, heart girth, neck length and neck circumference were 5.50 kg, 46.15 cm, 38.15 cm, 48.42 cm, 13.24 cm and 22.20 cm respectively.

Discussion

Ewes fed high fiber diets spent more time eating as compared to ewes on CTRL and HFLP diet. The increased feed intake of the birds on HFLP diet is expected because of the high fiber which tends to increase the total fiber content of the diets thereby diluting other nutrients. For the ewes to meet their energy requirements to maintain rapid growth and development, they consumed more feed. Abdel-Rahman and Mehaia [6] reported feed intake of 1.95kg/day for lactating Nadja ewes in Saudi Arabia.

The milk offtake was generally low. The poor performance is not a new phenomenon as it has been reported elsewhere [7,8]. For instance, the East Friesland and Scottish Black ewes in the temperate produced about 2.4 litres/ day [9]. The main reason seems to be that most of the indigenous sheep in the tropics are for meat while the sheep in the temperate environment have been highly selected for milk production. Also, less favourable environment, inadequate nutrition due to variation in the quality of feedstuffs, as feed ingredients available in the natural environment of the exotic breeds could be of better quality. The low milk yield could also be due to genetic factors and previous handling due to the fact that the West African Dwarf had never been subjected to milking process except suckling. However, the West African Dwarf in the tropics in a previous study produced 122 ml [10] under semi-intensive and extensive management system respectively. Milk offtake was slightly lower than the result obtained in this study. The high milk offtake obtained in this study as compared to the report obtained in previous studies was mainly because the lactating ewes in this present study were raised under the intensive system of management.

The high milk offtake in ewes on LFHP diet could be as a result of the protein concentration in the LFHP diet. This result was found to be consistent with the report by Robinson et al. [11], which states that an increase in dietary protein concentration without a change in energy intake will increase the milk yield if ewe has not reached her potential yield. The average protein content is slightly lower than 5.8 g/l obtained by Sakult and Boylan, [12] in temperate and 5.52%, 6.07%, and 5.43% reported in tropical breeds of sheep [3,13]. Body weight, all the body traits and composition observed in this study were higher than values obtained by Kominakis et al. [2] except for protein content. Generally, the milk composition is comparable to that obtained in the temperate breeds. A low milk yield has been associated with high milk content in lactating ewes in the tropics [14].

The fat/protein ratio and does not indicate fiber surplus and deficiency. However, the fat/protein ratio observed in animals in animals on HFLP diet indicated fiber deficiency and energy surplus. Malau-Aduli and Anlade [13] reported that protein and SNF (Solid-non-fat) percentages were significantly increased by reducing fiber content whereas fat and TS (Total Solids) percentages significantly increased

by increasing crude fiber in the diet but in our report, increased crude fiber decreased fat content significantly. Banik et al. [15] suggested that a milk fat/protein ratio of 1.1-1.5 could be taken as optimal and the greater than 1.5 could indicate energy deficiency and fiber surplus in ration while the milk fat/protein ratio less than 1.1 indicates fiber deficiency and energy surplus. The mean fat-protein ratio obtained in this study was comparable to that reported by Alphonsus et al. [16] in Friesian x Bunaji cows.

The total solids value reported in this study was in consonance with 16.3% obtained by Jenness [17] and 15.61% obtained by Andreas [18] but the milk fat content was higher than 5.3% reported by Jenness [17] and similar to 6.04% obtained by Andreas [18]. The low fiber and high fiber diet tend to produce significantly higher milk fat. This is consistent with the findings of Bocquier and Caja [19]. The result was due to high inclusion of dietary protein as suggested by Bocquier and Caja [19] which state that dietary protein has positive correlation with milk fat content.

The average weight and wither height of about 25 kg and 60 cm respectively were higher than that reported on West African Dwarf sheep in a previous study [20]. However another study working with Yankasa, Yankasa x WAD crosses and Frizarta dairy sheep, reported a higher weight and wither height [2,8] than in the current study. Variations with other studies might be contributed by genetics, climatic conditions and management practices. The significantly higher wither height in ewes on HFLP diet implies that lactating ewes on this diet are generally taller, hence they cannot be used as meat animal. Generally, the mean body length, heart girth, udder circumference, udder width, teat length, teat circumference, distance between teat and distance of teat from ground were lower than that reported elsewhere [2,8,20-22].

Effect of dietary fiber protein levels on lamb's weight and linear body measurements

Lambs of dams on low fiber high protein had the highest value of weight and linear body measurements. The lambs on high-fiber low-protein level of inclusion however recorded the least value of weight. These values were comparable with those values reported by Adewumi and Olorunisomo [3].

Conclusion

Based on the result obtained from this research, it can be concluded that the lactating ewes on LFHP diet were significantly superior in milk and body parameters.

Recommendation

It is then recommended from this experiment that high quality milk offtake can be harvested with high dietary protein level in the diet of lactating ewe at first parity.

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