



## INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY

### Evaluation of Different Levels of Ginger as Feed Additives on Growth Performance of Pregnant Red Sokoto Does and their Kids

\*<sup>1</sup>Ibrahim, U.M., <sup>2</sup>Abdu, S.B., and <sup>2</sup>Musa, A.

<sup>1</sup>National Animal Production Research Institute, Shika-Zaria, Nigeria

<sup>2</sup>Department of Animal Science, Ahmadu Bello University Zaria, Nigeria

\*Corresponding Author's Email and Mobile No.: [umibrahim@abu.edu.ng](mailto:umibrahim@abu.edu.ng); +2348030572879

Received on: April, 2023

Revised and Accepted on: May, 2023

Published on: July, 2023

#### ABSTRACT

Twenty-eight (28) Red Sokoto does (RSD) weighing on the average 17.86 kg were assigned to four different diets treatment (1,2,3 and 4). Ginger was added in different levels with treatments 2, 3 and 4 containing 250 g, 500 g and 750 g respectively in a completely randomized design. Treatment 1 was the control with 0 g ginger. The animals were fed at 4% body weight. Feed intakes, weight gain and cost implication were measured and recorded. Results showed that Red Sokoto Does (RSD) fed diet containing 0 g and 750 g levels of ginger inclusion had a significantly ( $P<0.05$ ) higher total feed intake (137.71 kg and 137.70 kg) respectively than other levels. Animals fed (750 g) ginger inclusion level recorded a significantly ( $P<0.05$ ) higher weight gain (10.78 kg). Feed conversion ratio was best (12.81) in the treatment fed 750 g ginger inclusion level with similar values ( $P>0.05$ ) across the treatments. Kids from RSD fed 500 g ginger inclusion level recorded a significantly ( $P<0.05$ ) higher weight at birth, final weight, total weight gain and daily weight gain (2.40 kg, 9.60 kg, 7.20 kg and 120.00 g) respectively. The kids were monitored from kidding to weaning stage (three months after kidding). Feeding diet containing 750 g ginger to pregnant RSD reduced the cost of feeding/kg gain by 31% compared to the control. The study revealed that levels of ginger inclusion improved weight gain of both RSD and their kids and saved feeding cost per kg weight gain of RSD.

**Keywords:** Red Sokoto does, Pregnant, Growth Performance, Kids, Ginger. Diet.

#### 1.0 INTRODUCTION

The Red Sokoto, a cloven-footed animal is the most important goat breed in Nigeria, accounting for about 70% of the estimated 73.8 million goats in Nigeria (NASS, 2011). A relatively small sized animal with easily seen forehead; black mucosal lining; both gender have small to average horns; ears are small and horizontal, infrequent toggles; beard of abundant hair in males which is usually absent in the females; their forehead mostly covered with hair that is usually lengthy, rough and black in males compared to females; males bear a bright mane that extends to the shoulders; neck is small, slim and very flexible; their coat color is mostly red; males are always darker than the females and may have a dark stripe; back end hair normally dark; well known for high quality skin (Juan *et al.*, 2021).

The main center of distribution in Nigeria is the northern parts (Sokoto and Kano States). However,

subtypes with color variations are found to the west and east of this region and are owned mainly by the Hausa-speaking agricultural tribes (FDLPCS, 2020). Their compact nature is an indication of crossing that has occurred with Dwarf/forest goats in its area of distribution even before selection. Another reason is the high fecundity of the animals which tends to buttress a hypothesis that such a blending had happened (Juan *et al.*, 2021).

Ginger possesses a few anti nutritional factors like the alkaloids, saponin, tannins and glycosides that are well known for their functions in stimulating digestive system as well as reducing fever (Trivic, 2020). Saponins are mainly produced by plants, some lower marine animals and some rhizo bacteria (Guanzhen *et al.*, 2021). They may inactivate protozoa, a condition resulting to higher bacterial count because of lower predation of bacteria by protozoa. This condition leads to slower turnover of protein in the rumen (Ibrahim *et al.*, 2022). The

slower protein turnover leads to a high flow of bacterial nitrogen. This condition leads to increase in productive performance (Zuniga *et al.*, 2022). Tannins are known to enhance rumen undegradable protein, a condition that protects the animals against bloat which eventually leads to improvement in productive performance (Besharati *et al.*, 2022). Hence, the aim of this study was to determine the influence of ginger on performance of pregnant RSD and pre-weaning growth rate of their kids.

## 2.0 MATERIALS AND METHODS

### 2.1 Study Area

The study was carried out at the National Animal Production Research Institute (NAPRI), Ahmadu Bello University (ABU), Shika, Zaria, Nigeria. Shika is located on latitude 11° 12'N and longitude 7° 33'E at an altitude of 640 meters above sea level (GPS, 2019).

### 2.2 Feed Preparation

A 14% crude protein content was intended for feeds. The nearby Samaru market was visited to obtain dry ginger, which was then powdered. Different dosages were used, with treatments 2, 3, and 4 containing 250 g, 500 g and 750 g, respectively. Treatment 1 served as the empty ginger control.

#### 2.2.1 Analysis for Anti-nutritional Substances

Ginger was analyzed for anti-nutritional factors (tannin, saponin, oxalates, alkaloids, flavonoids and phenols) using the procedures of AOAC (2005).

#### 2.2.2 Experimental Treatment, Design and Feeding Procedure

The experimental animals were randomly allotted to four (4) treatment groups with seven animals per group. Completely randomized design (CRD) was used with number of animals representing replication and varying inclusion levels of ginger representing treatments. They were given diet containing 14% crude protein (Table 1) from conception to parturition. Concentrate was given to the animals at 1.5% of body weight while *D. smutsii* was offered at 2.5% body weight. Concentrate was offered in the morning immediately after cleaning the pens and weighing

the feeds left over. The does were weighed fortnightly and a record of differences in the weight was taken from the variations between current and previous week. The fortnightly changes in weights were used to adjust the quantity of feed offered in order to maintain the percent of body weight.

#### 2.2.3 Experimental Animals and their Management

Twenty-eight (28) RSD of between 10 and 12 months of age, with average weight of 17.86 kg were obtained from the Goat Unit of the Small Ruminant Research Programme (SRRP) in NAPRI. The animals were transferred to the Experimental Unit of the same Programme. They were allowed to adapt to their new environment for two weeks before commencement of the study. They were orally dewormed with albendazole (2.5% solution) as prophylaxis against gastrointestinal parasites before starting the experiment. Estrus was synchronized using Estrumate® injection (synthetic prostaglandin) and does were bred in order to achieve uniform conception and for easy management. Four (4) healthy breeding RSB from the Goat Unit of Small Ruminant Research Programme were introduced to the does, with one buck per treatment. At kidding time, the does and kids were weighed. The kids were subsequently weighed fortnightly up to the time of weaning (three months after kidding) in order to monitor body weight changes.

#### 2.3 Cost Implication of Feeding Red Sokoto Does

The cost implication of feeding RSD was determined taking into cognizance the market price of the different feed ingredients used during the research period.

#### 2.4 Chemical Analysis

Feed samples were analyzed for Dry Matter (DM), Ether Extract (EE), Crude Fiber (CF), Crude Protein (CP) and Ash as outlined by Association of Analytical Chemists (AOAC, 2007). Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) were determined according to Van Soest *et al.* (1991).

#### 2.5 Statistical Analysis

Mean values difference in body weight were analyzed for repeated measure analysis using Proc

Mixed Procedure of SAS (2005). Significant differences between treatment means were determined using Duncan's Multiple Range Test of SAS (2005).

### 3.0 RESULTS

#### 3.1 Chemical Composition of the different diets Fed to Pregnant Red Sokoto Does (%)

It indicated a higher DM in the ginger while ash and CP were higher in the concentrate feed (Table 1). CF was higher in *D. smutsii* hay.

**Table 1: Chemical Composition of the Concentrate Feeds, *D. smutsii* hay and Ginger Fed to Pregnant Red Sokoto Does**

Nutrients (%)	Inclusion levels of ginger (g/100 kg diet)				<i>D. smutsii</i>	Ginger
	0	250	500	750		
Dry Matter	91.40	91.60	91.90	92.10	90.04	96.09
Organic Matter	81.60	81.78	82.06	82.24	87.39	88.72
Ash	9.80	9.82	9.84	9.86	2.65	7.37
Ether Extract	3.58	3.59	3.61	3.62	0.54	5.90
Crude Fiber	17.91	17.94	17.97	18.00	30.05	12.28
Crude Protein	13.90	13.90	14.00	14.00	5.36	11.36
Nitrogen Free Extract	54.81	54.75	54.58	54.52	61.40	63.09
Neutral Detergent Fiber	36.94	36.99	37.03	37.07	63.81	16.99
Acid Detergent Fiber	19.30	19.32	19.34	19.36	33.94	8.83

#### 3.2 Phytochemical Constituents of Ginger

Results of Phytochemical constituents (Table 2) indicated a higher oxalate content followed by flavonoid, phenol, alkaloid and saponin in that order. Tannin was the lowest constituent in the sample material.

**Table 2: Phytochemical Constituents of Ginger**

Constituents	Composition (mg/100g ginger)
Tannin	0.26
Saponin	0.80
Oxalate	4.56
Alkaloid	1.20
Flavonoid	2.40
Phenol	1.52

#### 3.3 Performance of Pregnant Red Sokoto Does Fed Varying Levels of Ginger

All the parameters for feed intake showed significant ( $P < 0.05$ ) differences across the treatments (Table 3). The result of concentrate intake showed that does fed diet containing 0 and 750g/kg ginger had similar intakes (89.79 and 86.03kg, respectively), while animals fed 250 and 500 g/100kg ginger had similar concentrate intake (73.79 and 73.22kg, respectively). Final body weights were not significantly ( $P > 0.05$ ) affected across the dietary treatments. The result of feed conversion ratio (FCR), although not significantly ( $P > 0.05$ ) different indicated that does in the treatment containing 750g/100 kg ginger had the lowest (best) FCR.

**Table 3: Performance of Pregnant Red Sokoto Does Fed Diet Containing Varying Inclusion Levels of Ginger**

Parameter	Inclusion levels of ginger (g/100 kg diet)				SEM
	0	250	500	750	
Total concentrate intake (kg)	89.79 <sup>a</sup>	73.79 <sup>b</sup>	73.22 <sup>b</sup>	86.03 <sup>a</sup>	5.09*
Daily concentrate intake (g/day)	598.60 <sup>a</sup>	491.93 <sup>b</sup>	488.13 <sup>b</sup>	573.53 <sup>a</sup>	25.50*
Total hay intake (kg)	47.92 <sup>ab</sup>	44.31 <sup>b</sup>	43.75 <sup>b</sup>	51.68 <sup>a</sup>	2.93*
Daily hay intake (g/day)	319.47 <sup>ab</sup>	295.40 <sup>b</sup>	291.67 <sup>b</sup>	344.53 <sup>a</sup>	19.5*
Total feed intake (kg)	137.71 <sup>a</sup>	118.10 <sup>b</sup>	116.97 <sup>b</sup>	137.70 <sup>a</sup>	7.59*
Daily feed intake (g)	918.0 <sup>a</sup>	787.3 <sup>b</sup>	779.8 <sup>b</sup>	918.0 <sup>a</sup>	50.58*
Initial weight (kg)	16.14	16.29	16.57	16.14	0.87 <sup>NS</sup>
Final weight (kg)	24.79	25.50	24.25	26.92	1.47 <sup>NS</sup>
Total weight gain (kg)	8.64 <sup>ab</sup>	9.21 <sup>ab</sup>	7.68 <sup>b</sup>	10.78 <sup>a</sup>	1.37*
Daily weight gain (g)	57.62 <sup>a</sup>	61.40 <sup>ab</sup>	51.20 <sup>b</sup>	71.87 <sup>a</sup>	9.16*

Feed conversion ratio (feed/gain) 15.93 12.82 15.23 12.81 5.23<sup>NS</sup>

<sup>ab</sup>Mean within the same row with different superscripts are significantly different (P<0.05) \*significant at 0.05; SEM=Standard error of means and NS= not significant

### 3.4 Performance of Red Sokoto Kids Fed Varying Levels of Ginger

Results indicated that all the parameters (Weight at kidding, final weight, weight gain and daily weight gain) measured to be significantly different (P<0.05) across the treatments (Table 4). Kids from the does fed diet containing 500g/100kg recorded significantly (P<0.05) higher weight at kidding (2.40 kg), followed by those fed 750g/100kg diet (1.97 kg). Final weight and average daily weight gain followed similar pattern.

**Table 4: Weight Gain of Red Sokoto Kids Fed Diet Containing Varying Inclusion Levels of Ginger**

Parameter	Inclusion levels of ginger (g/100 kg diet)				SEM
	0	250	500	750	
Weight at birth (kg)	1.71 <sup>c</sup>	1.78 <sup>c</sup>	2.40 <sup>a</sup>	1.97 <sup>b</sup>	0.09*
Final weight (kg)	3.41 <sup>c</sup>	6.06 <sup>b</sup>	9.60 <sup>a</sup>	6.67 <sup>b</sup>	0.73*
Weight gain (kg)	1.70 <sup>c</sup>	4.28 <sup>b</sup>	7.20 <sup>a</sup>	4.70 <sup>b</sup>	0.69*
Daily weight gain (g)	28.33 <sup>c</sup>	71.33 <sup>b</sup>	120.00 <sup>a</sup>	78.33 <sup>b</sup>	11.48*

abcMean within the same row with different superscripts are significantly different (P<0.05); \*significant at 0.05; SEM=Standard error of means.

### 3.5 Cost Implication of Feeding Ginger to Red Sokoto Does

Animals that were fed ginger at 250 g had the least cost (₦1,123.87) of feed per kg gain when compared to the animals in other treatment groups (Treatments 1, 3 and 4) (Table 5).

**Table 5: Cost Implication of Feeding Varying Levels of Ginger to Red Sokoto Does**

Parameters	Inclusion levels of ginger (g/100 kg diet)			
	0	250	500	750
Cost of concentrate/kg (₦)	46.43	48.03	49.64	51.25
Cost of <i>D. smutsii</i> /kg (₦)	45.91	45.80	45.89	45.87
Total cost of feed/kg (₦)	92.34	93.83	95.53	97.12
Total feed consumed (kg)	137.71	118.10	116.97	137.70
Cost of feeding (₦/doe)	12,716.14	11,081.32	11,174.14	13,373.42
Weight gain (kg)	8.64	9.21	7.68	10.78
Cost of feed/kg gain (₦/kg)	1,471.78	1,123.87	1,231.99	1,162.91
Value of gain (₦)	4,320.00	4,930.00	4,535.00	5,750.00
Cost over gain (₦)	0.34	0.23	0.27	0.20

₦ = Naira

## 4.0 DISCUSSION

### 4.1 Performance of Red Sokoto Does Fed Varying Levels of Ginger

Total consumption of feeds by the animals was higher in the groups fed 0 g and 750 g ginger. The overall feed intake decreased in the groups fed 250 g and 500 g ginger. The lower feed intake could be related to the polyphenol compound of ginger. The negative impacts of phenol compounds have been related to their negative effect on intake as well as availability of some nutrients. However, there was a significant increase in feed intake by does fed the higher ginger inclusion (750g ginger). Ginger helps

speed up digestion process and empty stomach more quickly. Ibrahim *et al.* (2022), reported a decreased feed intake in Red Sokoto Bucks fed 500 g ginger. Such phenomenon could be attributed to hot nature of ginger. A better feed conversion ratio (12.81) was observed in animals fed diet containing 750g ginger which is an indication that the animals in that group had a better feed utilization. The non-significant difference in final weight gain also showed the efficiency of the animals in utilizing the feeds even with increased levels of the ginger. Does fed 750 g ginger inclusion recorded higher weight gain. Daily weight gain was significantly affected

by ginger inclusion across the treatments with the treatment group fed 750 g ginger recording higher value. This is an indication that the animals in that group were able to withstand the highest ginger inclusion level in this study and also responded well.

#### 4.2 Growth Performance of Red Sokoto Kids Fed Varying Levels of Ginger

Daily weight gain (120g) of kids was higher in the treatment fed 500 g ginger compared to other groups. The same phenomenon was reflected on total weight gain, final weight gain and weight at kidding. The reason could be that; the kids got enough milk hence gain more weight. This could be attributed to the phyto chemical substances present in the ginger. Ginger was reported to help increase the absorption of essential nutrients (protein, energy, vitamins and minerals), thus improving the growth of animals (Ibrahim *et al.*, 2023). Ginger may also increase feed digestion by reducing the time of feed passage through the digestive tract (Nemati *et al.*, 2021). It may also result in increase or improve feed intake due to its ability to increase stability of feed and beneficially influence the gastrointestinal ecosystem through inhibition of the growth of pathogenic microorganisms (Mao *et al.*, 2019). In general, kids from groups with ginger supplementations (250, 500 and 750 g ginger) performed better than those in the control group (0g ginger). Nweze, (2020), supplemented young ruminants with *scent and neem leaf-extracts*. Supplemented group had higher weight gain than unsupplemented ones.

#### 4.3 Cost Implication of Red Sokoto Does Fed Diets Containing Varying Inclusion Levels of Ginger

Feeding cost per kg gain in RS does was higher for animals fed diet containing 0g ginger. Addition of ginger as an additive in the diets of RSD saved cost in animals fed 250 g ginger when compared to other treatments (0, 250 and 500 g ginger inclusion), respectively. This agrees with the findings of Adegun and Aye (2022), who fed *Moringa oleifera* to West African Dwarf (WAD) rams. He found that all the treatment groups with *M. oleifera* recorded lower feeding cost compared to the control. The significance of feed, either purchased or produced on the farm cannot be over emphasized as it

constitutes a large part of the expenses (60-65 %) incurred in sheep and goat production (Camillus *et al.*, 2023).

#### 5.0 CONCLUSION

It was concluded that levels of ginger inclusion improved performance of both RSD and their kids and saved feeding cost per kg weight gain of RSD.

#### REFERENCES

- Adegun, M. K. and Aye, P. A. (2022). Growth performance and economic analysis of West African Dwarf rams fed *Moringa oleifera* and Cotton Seed Cake as protein supplements to *Panicum maximum*. *American Journal of Food and Nutrition*, 3(2): 58 – 63. DOI: 10.3923/ajava.2022.118.125.
- AOAC (Association of Official Analytical Chemists) (2005). Official Methods of Analysis. *Association of Official Analytical Chemist*, Washington DC, 15(1): 931-946.
- AOAC (Association of Official Analytical Chemists) (2007). Official Methods of Analysis. 19th Edition. Washington DC.
- Besharati, M., Maggiolino, A., Palangi, V., Kaya, A., Jabbar, M., Eseceli, H., De Palo, P. and Lorenzo, J. M. (2022). Tannin in Ruminant Nutrition: Review. *Molecules*, 27(23):8273. DOI: 10.3390/molecules27238273.
- Camillus, A. W., Emmanuel, A., Richmond, Debrah, Emmanuel, D., Susana, C. and Frank, A. P. (2023). Profitability and choice of commercially preferred feed and farmers' own preferred feed among poultry producers in Ghana. *Journal of Agriculture and Food Research*, 12, DOI: 10.1016/j.jafr.2023.100611.
- FDLPCS, (2020). Federal Department of Livestock and Pest Control Disease. National Livestock Volume Synthesis. Resource Inventory and Management Limited. Jersey, JE48UD, UK.
- GPS (Global Positioning System) (2019). Guanzhen, W., Junlong, W., Muhammad, F. N., Mohamed, A. E. and Chunpeng, W. (2021). Biological Activities and Chemistry of Triterpene Saponins from Medicago species: An Update Review, Evidence-Based Complementary and Alternative Medicine, vol. 2021, Article ID 6617916, 11 pages, 2021. DOI: 10.1155/2021/6617916.

- Ibrahim, U. M., Lakpini, C. A. M., Abdu, S. B. and Musa, A. (2022). Evaluation of ginger (*Zingiber officinale*) as feed additive on the performance and cost benefit of Red Sokoto bucks fed *Digitaria smutsii* basal diet. *Animal Research International*, 19(2): 4523 – 4529.
- Ibrahim, U. M., Abdu, S. B., Musa, A. and Lakpini, C. A. M. (2023). Studies on The Milk Yield and Composition of Lactating Red Sokoto Does Fed Ginger (*Zingiber Officinale*) As Feed Additive. *FUDMA Journal of Sciences (FJS)*, 7(2): pp 172 - 175. DOI: 10.33003/fjs-2023-0702-1725
- Juan, J. V., Serkan, A. and Jennifer, W. M. (2021). Non – fiber Carbohydrates in Forages and Their Influence on Beef Production Systems. *Agroecology and Ecosystem Services*, 5: DOI: 10.3389/fsufs.2021.566338.
- Mao, Q. Q., Xu, X. Y., Cao, S. Y., Gan, R. Y., Corke, H., Beta, T. and Li, H. B. (2019). Bioactive Compounds and Bioactivities of Ginger (*Zingiber officinale* Roscoe). *Foods*, 8(6):185. DOI: 10.3390/foods8060185.
- NASS, (2011). National Bureau of Statistics/Federal Ministry of Agriculture Sample Survey, 20/10/2011.
- Nemati, Z., Moradi, Z., Alirezalu, K., Besharati, M. and Raposo, A. (2021). Impact of Ginger Root Powder Dietary Supplement on Productive Performance, Egg Quality, Antioxidant Status and Blood Parameters in Laying Japanese Quails. *International Journal of Environmental Research Public Health*, 18(6):2995. DOI: 10.3390/ijerph18062995.
- Nweze B. O. (2020). Effect of scent leaf-extract (*ocimum grafissimum*) and neem leaf-extract (*Azadirachta Indica*) fed as antimicrobial feed additive on finishing broilers. *Nigerian Journal of Animal Science*, 22 (1): 262-269.
- SAS (2005). Institute Incorporated SAS/STAT user's guide. 6.03 Edition, Cary NC U.S.A.
- Trivic, N. (2020). Available Agricultural Area by Utilization Categories and Ownership Structure of Holdings in the Republic of Serbia. *Natural Resources*, 11, 365-385. DOI: 10.4236/nr.2020.118021.
- Van Soest, P. J., Robertson, J. B. and Lewis, B. A. (1991). Methods for dietary fiber, neutral detergent fiber and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science*, 74: 3583 – 3597.
- Zuniga, S. A., Barrios, G. H. B., Anderson, R. C., Hume, M. E., Ruiz, A. M., Bautista, M. Y., Sanchez, G. N. A., Vazquez, V. J., Infante, R. F. and Salinas, C J. (2022). Antimicrobial and Digestive Effects of *Yucca schidigera* Extracts Related to Production and Environment Implications of Ruminant and Non-Ruminant Animals: A Review. *Agriculture*, 12(8):1198. DOI: 10.3390/agriculture12081198.