FIBRE FRACTION UTILIZATION AND GROWTH PERFORMANCE OF WEST AFRICAN DWARF BUCKS FED BLACK PEPPER *(PIPER NIGRUM)* SEED MEAL SUPPLEMENTED DIETS

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ABSTRACT
A seventy (70) day study aimed at investigating fibre fraction utilization and growth performance of West African Dwarf bucks fed black pepper supplemented diets was conducted. The study involved twelve (12) West African Dwarf bucks aged 1-1½ years with an average live weight of 5.02±0.23 kg. A basal diet was formulated and supplemented with varying levels of black pepper as A= 0mg, B= 250mg, C= 500mg, and D= 750mg. Parameters investigated were nutrient composition, nutrient intake, and performance characteristics of the bucks Data generated were subjected to statistical analysis and from the result, diet D had the highest crude protein (17.37%). Neutral detergent fibre (NDF) increased with increased black pepper supplementation. Acid detergent lignin (ADL) ranged from 10.69% (diet B) to 13.28% (diet C). NDF and ADL intake were significantly ($p<0.05$) impacted by treatment. The NDF and ADL intake was significantly ($p<0.05$) impacted by treatment, ADF intake ranged from 133g/day (diet A) to 198.75g/day (diet C), ADL intake ranged from 33.71 g/day (diet D) to 60.24g/day (Diet A). Performance characteristics showed that daily weight gain of bucks fed diet D (63.48 g/day) was the highest and bucks fed diet C converted their feed to flesh (4.23) better than other goats however, any of the diets could be fed to enhance performance of the bucks since there was no significant ($p>0.05$) differences among the performance parameters. The study concluded that black pepper as additive could serve as affordable and sustainable way of improving protein quality of diet and fibre utilization by ruminants.
Keywords: Nutrition, Fibre, Utilization, Supplement, Digestibility, Black pepper

INTRODUCTION

Goats, renowned for their adaptability and efficient digestion of fibrous feedstuffs, play a crucial role in livestock production systems across the globe, particularly in resource-limited regions. Their ability to thrive on marginal lands and convert low-quality forages into valuable protein makes them vital contributors to food security and income generation for smallholder farmers (Silanikove, 2010). However, maximizing fibre utilization and enhancing weight gain in goats often poses a challenge due to the inherent limitations of their digestive system and the nutritional deficiencies common in their typical diets (Lu *et al.,* 2008). In recent years, a growing body of research has explored the potential of feed additives and supplements to address these limitations and improve the performance of goats. Among these, black pepper *(Piper nigrum* L.) seeds have emerged as a promising candidate due to their diverse bioactive compounds with reported rumen fermentation-modulating and growth-promoting properties (Kumar *et al.,* 2015). Black pepper (*Piper nigrum*) seeds are rich in essential oils, pungent alkaloids like *piperine*, and phenolic compounds, all of which possess antimicrobial, antioxidant, and rumen digestive enzyme-modulating activities. *Piperine*, in particular, has been shown to stimulate rumen microbial activity, enhance cellulose and hemicellulose degradation, and increase volatile fatty acid production, leading to improved fibre digestibility and nutrient utilization (Cobellis *et al.,* 2016).

Despite these promising individual properties, the efficacy of black pepper seed supplementation in enhancing fibre utilization and weight gain in goats remains unclear. Limited research exists in this area, with inconsistent findings reported across different studies. Some studies have demonstrated significant improvements in feed intake, digestibility, and weight gain in animals fed black pepper-supplemented diets (Kumar *et al.,* 2017), while others have shown no significant effects. This study was therefore aimed at evaluating the fiber fraction utilization and growth performance by West African Dwarf bucks fed black pepper (*piper nigrum*) seed meal supplemented diets.

MATERIALS AND METHODS

Site of experiment, collection of materials and feed formulation

The experiment was carried out at the Small Ruminant Unit of the Teaching and Research Farm, and the Laboratory analysis was carried out at the Nutrition Laboratory of the Department of Animal Production and Health, Federal University of Technology, Akure (FUTA). Black pepper seeds (*Piper nigrum*) was obtained from a local market within Akure, sun-dried for 5 days and then milled into powder.

The sun-dried cassava peels were obtained from cassava processing industry at Igbatoro, Akure. The other non-pulverized ingredients were milled in order to get uniform particle size. The basal diet was formulated from milled cassava-peel (53.20 kg), wheat offal (22.00 kg), palm kernel cake (20.80 kg), urea (1.00 kg), bone meal (1.00 kg), salt (1.00 kg) and premix (1.00 kg). The powdered black pepper seed was added as supplement at rate of 0 (A), 250 (B), 500 (C) and 750 mg (D) to 100 kg of basal diet to make complete experimental diets.

Animal procurement and management

Twelve (12) West African Dwarf (WAD) bucks aged 1 -1½ years with an average live weight of 5.03 kg were selected from the flock of goat's unit of the Teaching and Research Farm, FUTA. The bucks were placed on prophylactic treatment against bacterial infections using oxytetracycline LA® at a dose of 0.5ml per 5 kg body weight per buck, and also against ecto and endo-parasite using Ivermectin. The bucks were randomly allocated to 4 groups of three bucks per treatment. The bucks were fed the 500 g each of the basal diet supplemented with varying levels (0 – 750 mg) of black pepper and fresh water *ad libitum* in the morning at 8.00 am during the 70 days. The feed intake was determined by subtracting the daily left over from the feed given each day. During the last 14 days of experimental period, the bucks were transferred to metabolism cages for total collection of faeces and urine and 10% of faecal and urine samples were stored in refrigerator until they were required for chemical analysis. The parameters assessed were dry matter, protein, fibre fractions intakes, weight gain and feed conversion ratio.

Laboratory analysis and statistical analysis

At the end of experimental period, the separate samples of diets, faeces and urine were bulked, mixed thoroughly and sub-samples were analyzed for chemical composition according to the AOAC (2002) procedures. Data generated were subjected to one-way analysis of variance (ANOVA) using SPSS 26 and where significant differences were found, the means were compared using Duncan Multiple range test.

RESULTS AND DISCUSSION

The chemical composition of the experimental diets containing black pepper is presented in Table 1. The dry matter values observed in this study is different from the values reported by Fajemisin *et al*. (2019) when nutrients potentials of *Dioclea reflexa* and *Monodora myristica* seeds was evaluated as feedstuff for West African Dwarf goats' production. The obtained crude protein contents of the diets were more than the 8% crude protein requirement by ruminant animal for optimum microbial activities in the rumen (Norton, 2003). However, crude protein values of diets B, C and D increased with supplementation rate of black pepper seed although, the CP of diets B and C were lower compared to diet A. The increased addition levels of black pepper resulted in increased dietary crude fiber of the diets, this observation might be due to texture and particle sizes of the black pepper.

The Table 2 shows the results of the nutrients intake of the WAD bucks fed the experimental diets. The nitrogen free extract, neutral detergent fibre, acid detergent lignin and hemicellulose intake values were significantly ($p<0.05$) influenced by the treatments. Bucks fed diet A had the highest dry matter intake (314,03 g/day). The high dry matter intake might be attributed to the protein quality, acceptability and palatability of the diet hence, sources of energy and nitrogen enhance rumen microbial activity (Omotoso and Fajemisin, 2020). The crude protein intake in this study was lower than the values reported by Adeduntan *et al*., (2020) when goats were fed diets that contained *Tometosa nilotica* seed meal.

The crude fiber (89.6 g/day) intake of bucks fed diet A was higher compared to crude fibre consumption of bucks fed others diets, this observation might be attributed to increased peppery aroma and taste of the diets B, C and D. The fibre fractions intake of bucks fed experimental diets were higher than the values reported by Saka *et al.,* (2020) when WAD goats were fed graded level of

alkaline treated malted sorghum sprout.

The Table 3 shows the results of the weight gain and feed conversion to flesh by the experimental bucks, there was no significant (P>0.05) differences observed among the parameters assessed. The average weight gain of the bucks fed diet A (58.63 g/day) was the least compared to the weight gain of the other bucks however, the highest weight gain (65.48 g/day) was obtained in bucks fed diet C. Since there were no significant (p>0.05) differences among the values of dry matter intake and weight gain of the bucks, it implied that any of the diets could be fed to the bucks to enhance their growth performance. The result of feed gain/ratio revealed that the feed conversion to flesh varied from 4,23 (diet D) to 5,34 (diet A). It was observed that bucks fed diet D converted their diet to flesh better than the other bucks. The observed feed gain/ratio in the bucks fed diet D might be attributed to the crude protein quality and intake that might enhanced the growth performance of the bucks and rumen microbial protein required by the bucks to convert their diet to flesh (Lu *et al.*, 2008).

CONCLUSION

This study revealed that black pepper seed with crude protein content above recommended protein for maintenance of ruminant serves as a very important additive in goat's diet, as it impressively aids the effective utilization of fibre fractions; hence, enhancing energy intake. Bucks fed diet D (supplemented with 750mg black pepper), were more efficient at converting feed into flesh compared to bucks fed other diets. Therefore, the use of black pepper as additive at 750mg/100kg could serve as affordable and sustainable way of improving protein quality in the nutrition of ruminants, particularly bucks.

REFERENCES

A.O.A.C. (2002). Association of Official Analytical Chemists, Official methods of Analysis. 15th Edition. Washington D.C. U.S.A

Adeduntan M. O, Omotoso O. B and Fajemisin A. N. (2020). Blood profiling and growth response of goats fed diets containing *tomentosa nilotica* seed meal. https://doi.org/10.2478/azibna-2020-0011

Cobellis, G., Trabalza-Marinucci, M., and Yu, Z. (2016). Critical evaluation of essential oils as rumen modifiers in ruminant nutrition: A review. Science of the Total Environment, 545, 556-568. https://doi.org/10.1016/j.scitotenv.2015.12.103

Fajemisin, A, N., Alade, C. T., Ibhaze, G. A., Omotoso, O. B. and Alokan, J. A. (2019). Nutrient potential evaluation of Dioclea reflexa and Monodora myristica seeds as feedstuff for West African Dwarf goat's production. Proceedings of the 10th Annual FUTA Agric conference held at School of Agriculture and Agricultural Technology (SAAT), The Federal University of Technology, Akure, Nigeria. 8 - 12th July, 2019.

Kumar, R., Balachandran, C., Tewari, A., and Tewari, L. M. (2017). Effect of black pepper on performance, oxidative stability, blood parameters and gut morphology in broilers exposed to nitrite in drinking water. Animal Feed Science and Technology, 345, 76–82. https://doi.org/10.1016/j.anifeedsci.2015.05.009

Kumar, S., Sehgal, J.P., Puniya A.K. and Kumar R. (2015) Growth performance and fibre utilization of Murrah male buffalo claves fed wheat straw based complete feed blocks incorporated with superior anaerobic fungal zoospores (*Neocallimastix sp.* GR-1). *Indian Journal of Animal Science,* 85(3):275-281

Lu, C. D., Kawas, J. R., and Mahgoub, O. G. (2008). Fibre digestion and utilization in goats. Small Ruminant Research, 74(1-3), 45-52. https://doi.org/10.1016/j.smallrumres.2007.03.015

Norton, B.W. (2003). The nutritive values of trees legumes as dietary supplement for ruminants.

Omotoso, O. B., and Fajemisin, A. N. (2020). Replacement value of white mulberry forage for elephant grass on nutrients digestibility, weight gain and blood profile of sheep. Archiva Zootechnica, 23(2), 23–35. Supplements. *Journal of Animal Production Research*, 1-6.

Saka, A. A., Adekunjo, R. K., Odukoya, S. O., Jinadu, K. B., and Awodele, O. A. (2020). Intake, digestibility and nitrogen utilization of West African dwarf goats fed diets containing graded levels of alkaline treated malted sorghum sprout. *Nigerian Journal of Animal Production*, 47(3), 281-290.

Silanikove, N. (2000). The physiological basis of adaptation in goats to harsh environments. Small Ruminant Research, 35(3), 181-193. https://doi.org/10.1016/S0921-4488(99)00096-6

Table 1. Chemical composition of experimental diets

Parameters	**Diets**					
	A	**B**	**C**	**D**	**SEM**	**P-Value**
Dry matter	89.38	89.16	89.02	88.28	0.21	0.38
Crude protein	16.77	16.32	16.34	17.37	0.26	0.52
Crude fibre	25.54	27.20	26.24	27.33	0.25	0.00
Ash	6.03	5.04	8.54	11.59	0.81	0.00
Ether extract	14.56	14.65	13.87	11.79	0.35	0.00
Nitrogen free extract	37.10	36.78	34.98	31.91	0.76	0.03
Nuetral detergent fibre	37.99	50.02	59.22	61.79	2.84	0.00
Acid detergent fibre	30.96	33.87	31.59	32.00	0.59	0.37
Acid detergent lignin	10.80	10.69	13.28	11.12	0.33	0.00
Hemicellulose	7.03	16.15	27.63	29.78	2.87	0.00
Cellulose	20.15	23.18	18.31	20.89	0.69	0.06

Table 2. Nutrients intake of WAD goat fed basal diet supplemented with Black pepper meal

Parameters (g/day)	A	B	C	D	SEM	P-value
Dry matter	314.03	270.91	298.31	269.41	14.26	0.69
Crude protein	58.86	49.70	54.98	52.94	2.81	0.76
Crude fibre	89.6	82.63	88.05	83.52	4.06	0.94
Ash	21.82^{ab}	15.34^{b}	28.80^{ab}	35.32^{a}	2.88	0.05
Ether extract	51.09	44.54	44.49	36.00	2.60	0.23
Nitrogen free extract	129.48	111.58	116.78	97.39	5.70	0.27
Nuetral detergent fibre	133.28^{b}	151.96^{ab}	198.75^{a}	188.27^{ab}	11.16	0.11
Acid detergent fibre	108.45	103.32	104.71	97.46	4.52	0.89
Acid detergent lignin	60.24^{a}	58.48^{a}	49.45^{a}	33.71^{b}	3.74	0.01
Hemicellulose	24.83^{b}	48.63^{b}	94.04^{a}	90.81^{a}	9.85	0.00
Cellulose	70.54	70.84	64.59	64.83	3.25	0.88

abc=Means on the same row with difference superscripts are significantly varied (P<0.05)

Table 3. Growth performance of WAD goats fed basal diets supplemented with Black pepper

Parameters	A	B	C	D	SEM	P-value
Initial weight (kg)	5.00	4.90	5.13	5.07	0.23	0.99
Final weight (kg)	8.28	8.20	8.80	8.62	0.28	0.90
Weight gain (kg)	3.28	3.30	3.67	3.55	0.07	0.14
Daily weight gain (g/day)	58.63	58.93	65.48	63.39	1.27	0.14
Feed gain/ratio	5.34	4.58	4.57	4.23	0.22	0.40

abc=Means on the same row with difference superscripts are significantly varied (P<0.05)