Nig. J. Anim. Prod. 2017, 44(3):342 - 353
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Performance evaluation and haematological biochemical parameters of West African dwarf goats fed pineapple waste (*Ananas comosus*) with or without yeast (*Saccharomyces cerevisiae*) supplementation

[1] Adekanbi, A. O., [2]Onwuka, C. F. I., [2]Oni, A. O., [4]Ojo, V. O. A., [3]Ajayi, F. T., [1]Popoola, M. A.

[1]*Federal college of Animal Health and Production Technology, P.M.B 5029, Moor Plantation, Ibadan, Nigeria.*

[2]*Department of Animal Nutrition, Federal University of Agriculture, Abeokuta, Nigeria.*

[3]*Institute of Agricultural Research and Training, P.M.B 5029, Moor Plantation, Ibadan, Nigeria*

[4]*Department of Pasture and Range Management, Federal University of Agriculture, Abeokuta, Nigeria.*

Abstract

Pineapple waste (PW) is an agro-industrial by-product containing high fibre and can be harnessed by feeding it to ruminant animals to solve their nutritional problems in Nigeria. A study was conducted to assess the nutritive value of Pineapple (PW) as supplementary feed for ruminant animals during the dry season when grasses are either not available or of low quality. Pineapple waste were collected, sundried and then used for the feeding trial at different inclusion levels of 0%, 10%, 20% and 30% with or without yeast supplementation (WOWYS). Twenty four West African dwarf bucks (between 6.5 and 7.5 kg) were assigned to eight dietary treatments with three bucks per treatment and arranged in 2 x 4 factorial layouts in a completely randomized design over a period of 84days. Data were obtained on growth performance and haematological parameters. Results of performance characteristics showed that average concentrate consumed (257.58 g/day), total weight gain (3.23 kg), metabolic weight gain ($2.48W^{0.75}$) and daily weight gain (35.88 g/day) of experimental animals were significantly higher (p? 0.05) in goats fed 10% inclusion level WOWYS. Pineapple waste inclusion levels WOWYS significantly (p? 0.05) influenced white blood cell count (WBC), lymphocytes, monocytes and mean corpuscular haemoglobin concentration across the treatments. The monocytes (3.00%) Neutrophil counts (30.00%) were best and significantly higher (p? 0.05) in goats fed 10% PW inclusion level WOWYS while WBC increased significantly (p? 0.05) across the dietary treatments (9.63 – 11.65 $x10^3/mm^3$) and were within normal levels expected of healthy goats. It is concluded that dietary inclusion of PW with or without yeast supplementation in concentrate diet up to 10% improved the performance characteristics and haematological blood parameters of West African Dwarf goats without any adverse effects.

Keywords: Pineapple wastes, Yeast, Performance and Haematology

Introduction

Ruminant production is an important component of agricultural sector in Nigerian economy. The nation's meat supply is almost exclusively derived from ruminant livestock. The major constraint of increasing small ruminant productivity is the improvement of ruminant nutrition and feed supply (Akangbe and Adeleye, 2002). Ruminant livestock play an important role in the economic development of Nigeria in terms of feeding the steadily growing population and providing the available resources for national development. Goats are classified as an important small ruminant on account of their unique ability to adapt

and maintain themselves in harsh environment. Their small size relative to cattle contributes to their wide distribution and easy management by farmers. They are considered superior to other ruminant species in their utilization of poor quality and high fibre feeds (Oyeyemi and Akusu, 2005). They are mostly kept as sources of meat, milk and skin. Other purposes of keeping goat include household income, festival season and special occasions (Odeyinka and Okunade, 2005). Pineapple waste is an example of such agro-industrial by-product that can be utilized to a good advantage for ruminant nutrition in Nigeria.

Pineapple waste is usually discarded as waste after processing and it is a rich source of energy but low in protein (Fadel *et al.,* 2000). Yeast products such as *Saccharomyces cerevisiae* and *Aspergillus oryzae* appear to be more useful in manipulating rumen metabolism. As a result, the use of *S. cerevisiae* as a microbial feed additive has increased during the past 20 years. However, the response of yeasts is not consistent on the nutrient utilization, rumen fermentation and production which depend on several factors.

The use of yeast in ruminant animal nutrition has been the subject of numerous studies over the last decade. It has been postulated that its inclusion in the diet of farm animals is beneficial; however, right amount must be added for optimal results to be obtained (Fickers *et al*., 2005).

Haematological studies represent a useful process in the diagnosis of many diseases as well as investigation of the extent of damage in the blood (Onyeyili *et al*., 1991). Haematological studies are important because the blood is the major transport system of the body and evaluations of the haematological profile usually provide vital information on the body's response to injury of all forms, including feed toxicity (Ihedioha *et al.,* 2004). Haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu *et al.,* 2001). This study is designed to evaluate the performance and haematological parameters of West African dwarf goats fed diet containing pineapple waste with or without yeast supplementation.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan in the South- Western Part of Nigeria. The area lies within the rain forest ecological zone, and falls within longitude and latitude 7^0 27'N and $3^0$25'E, respectively at altitude 200-300m above the sea level with an annual rainfall of about 1250 mm. The temperatures and relative humidity ranged from 30-35^{0}C and 76-84% respectively. The experiment was conducted during the dry season.

Collection and processing of the experimental diets

Pineapple waste

Fresh wet pineapple wastes (peelings and the pulp peelings) were collected in polyethylene woven sacks from Lafia Canning Factory of Fumman Agricultural Products Nigeria Ltd., Apata, Ibadan, Nigeria. The collected materials were sundried for ten days on asphalt surface, kept in a jute bag in preparation for feed formulation with other ingredients.

Source of Yeast

Yeast was purchased from STK Industries Limited 8, Offin Canal, Apongbon, Lagos Island, Lagos State, Nigeria(Major distributor for Guangxi Danbaoli yeast Company- Limited, China).

Composition of yeast (Baker's yeast)

The yeast used in the study was the commercially available 'baker's yeast' (*Saccharomyces cerevisiae)*. Baker's yeast contains nitrogen base, biotin, calcium pantothenate, folic acid, inositol, niacin and it is also rich in protein and vitamins.

Experimental animals and their management

A total number of twenty four (24) male West African dwarf goats aged 10- 12 months with an average live weight of 6.5± 2kg were used for this study. The animals were housed intensively in well ventilated individual pens disinfected with morigad solution before their arrival. To ensure good condition of the goats, they were given prophylactic treatments which included intramuscular application of oxytetracycline and vitamin B complex at a dosage of 1ml/10kg body weight of the animal. They were also dewormed with 1ml/10kg body weight of Albendazole® and treated against ectoparasites with 0.5ml/10kg body weight of Ivomec®. The animals were allowed an adaptation period of two weeks during which they were maintained on *Panicum maximum* and maize sievate. Fresh water was also supplied *ad libitum*. After the adaptation period, the animals were divided into eight treatment groups of three animals each, after balancing them for body weight. Each group of animals was randomly assigned to one of the eight different experimental concentrate diets.

Experimental design

The experimental design was completely randomized design in a 2x4 factorial arrangement. The animals were divided randomly into eight groups containing three replicates each, after balancing them for weight. The feeding trial lasted for 84 days. Animals were fed at 5% body weight while clean water was provided *ad-libitum.*

Experimental diets

Eight experimental concentrate diets were formulated to contain varying levels of pineapple waste at 0, 10, 20 and 30% with or without yeast inclusion in replacement for maize bran. Other ingredients in the diets which were constant are bone meal, wheat offal, dried brewers grain, premix and salt (Table 1).

Table 1: Ingredient composition (%) of the concentrate diets

Ingredients	With yeast				Without yeast			
	0%	10%	20%	30%	0%	10%	20%	30%
Maize bran	50.00	40.00	30.00	20.00	50.00	40.00	30.00	20.00
Pineapple waste	0.00	10.00	20.00	30.00	0.00	10.00	20.00	30.00
Bone meal	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Wheat offal	24.50	24.50	24.50	24.50	24.50	24.50	24.50	24.50
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Dried brewers grain	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Yeast	–	1	1	1	-	-	-	-
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Determined Analysis								
Dry matter	89.84	90.03	89.89	89.91	90.08	89.91	89.50	
Crude protein	16.21	15.28	14.92	15.17	15.39	13.78	13.89	
Crude fibre	11.37	14.67	15.59	15.73	14.58	17.58	17.24	
Ether extract	3.74	3.61	3.57	3.55	3.63	3.68	3.65	
Ash	7.59	7.14	6.88	7.21	7.26	6.54	6.75	
Nitrogen free extract	50.93	49.33	48.93	48.25	49.22	51.61	48.42	
Neutral detergent fibre	41.69	42.93	49.87	48.95	43.27	51.87	52.33	
Acid detergent fibre	27.08	31.79	38.79	39.05	28.79	40.08	41.06	
Acid detergent lignin	9.79	10.78	11.06	10.76	11.95	11.79	11.87	
Hemicellulose	14.61	11.14	11.08	9.90	14.48	11.79	11.27	
Cellulose	17.29	21.01	27.73	28.29	16.84	8.29	29.19	

(-) indicates diets without yeast supplementation
(+) indicates diets with yeast supplementation at the rate of 1g per kg of feed

Feed intake and live weight changes

The growth of the animals in response to the experimental treatments was monitored by - taking their pre-experimental body weights, followed by weighing on a weekly basis prior to feeding. Feeds offered daily per animal were recorded and refusals were weighed and recorded to compute feed intake on daily basis. Feed conversion ratio (FCR) was also calculated.

Collection of blood samples

5mls of blood sample was collected from three randomly selected goats per treatment via jugular vein puncture using hypodermic syringes before feeding into a labelled sample bottle containing anticoagulant and the sample was rocked gently to ensure easy mixing of the blood with the anticoagulant.

Chemical analysis

Aliquot of daily feed samples (Concentrate and *Panicum maximum)* were collected, oven-dried, ground and sieved through a 2-mm sieve and stored in airtight containers for proximate (AOAC, 2007) and fibre (Van Soest *et al.,* 1991) analyses. Cellulose was taken as the difference between ADF and lignin while hemicellulose was also taken as the difference between NDF and ADF.

Statistical analysis

The data obtained from the study were subjected to analysis of variance SAS (2002). Means for treatments showing significant differences in the Analysis of variance were compared using the Duncan multiple range test, (Duncan, 1955).

Results and discussion

Chemical composition of Pineapple Waste (PW) and Panicum maximum (PM)

Table 2 shows the chemical composition of pineapple waste and *Panicum maximum* used in the experiment. The crude protein value for pineapple wastes recorded (11.78%) was contrary with the report of Okoruwa and Njidda (2012). These researchers reported a crude protein of (4.66 %). The high crude protein of pineapple wastes obtained in this study could be as a result of high fermentation. The crude fibre and dry matter percentage reported here were similar with the report of Okoruwa and Njida (2012). However, the value obtained for ash and nitrogen free extract (3.68% and 50.63%) were lower than the values (7.00% and 61.13%) respectively as reported by the same authors. The variations observed might be due to the differences in geographical location, age of the plant and time of harvesting. The crude protein value of *Panicum maximum* confirmed the report of Agishi (1985) that tropical pasture grasses are frequently low in protein and cannot support high levels of ruminant production. The higher crude protein content of Pineapple waste to that of *Panicum maximum* could be expected as most Agro-industrial by-product wastes contain higher nitrogen contents than grasses. Thus, this suggests that Pineapple wastes could as well serve as protein supplement to poor quality grasses.

Table 2: Chemical composition of pineapple waste and *Panicum maximum*

Parameters (%)	Pineapple waste	*Panicum maximum*
Dry matter	90.14	90.87
Crude protein	11.78	8.67
Crude fibre	21.79	31.28
Ether extract	2.26	2.46
Ash	3.68	9.87
Nitrogen free extract	50.63	38.59
Neutral detergent fibre	59.88	61.38
Acid detergent fibre	43.15	46.79
Acid detergent lignin	13.87	9.67
Hemicellulose	16.73	14.59
Cellulose	29.28	37.12

Hemicellulose =%NDF-%ADF, Cellulose=%ADF-%ADL

Performance characteristics of West African dwarf goats fed pineapple wastes with or without yeast supplementation

Table 3 shows the effect of inclusion levels of pineapple waste with or without yeast supplementation on performance characteristics of West African dwarf goat. The weight gain ranged from (2.84 -3.23 %)), metabolic weight gain ranged from (2.17 -2.48 %), daily weight gain ranged from (31.56 -35.88 %), cost per kg of feed ranged from (22.44 -34.24 %), cost per feed consumed per goat ranged from (4.91 -7.08 %) and cost per weight gain ranged from (267.82 – 434.79 %) respectively were significantly (P? 0.05) influenced by the levels of inclusion. Goats on 10% inclusion level had the highest weight gain (3.37kg) and the least feed conversion ratio of 11.65 compared to the control but not significantly different from other treatments .. Goats on 10% inclusion level had the lowest (N4.91) cost of feed consumed per goat.. The same trend was recorded in the values obtained for cost of feed per kg and cost per weight gain respectively.

Table 4 shows the interaction effect of inclusion levels of pineapple wastes with or without yeast supplementation of West African dwarf goat. There were significant (P? 0.05) differences in the interaction effect of total feed intake, average feed intake, cost per kg feed, cost of feed consumed per goat and cost per weight gain respectively as the inclusion levels increases. The cost of feed consumed per goat increases as the levels of inclusion increases, but the highest price of N6.78 per goat was recorded by goat fed 30% inclusion level while the least price of N4.82 was recorded by goats fed 10% pineapple waste. Variation in weight gain and average daily intake were observed across the treatments, the variation may be due to differences in the age and breed of animals. Some of the animals gained weight, which indicated that intake of energy and protein were little above maintenance requirement. The performance result was consistent with the report of Kawas *et al*. (2007) who found out that yeast supplementation did not affect growth performance in finishing lambs but in contrast, Haddad and Goussous (2004) observed improved weight gain after supplementing yeast to finishing sheep diet. The reasons behind the different responses to yeast supplementation between the various studies are still under investigation. It is, however, evident that yeast can have a beneficial effect on performance under circumstances such as basal diet, the amount of yeast supplemented, type of forage, health status of the animals and feeding strategy.

However, the improved weight gains and growth rate of the animals on 10% inclusion of pineapple waste with yeast supplementation could be related to the crude protein (CP) components of the feed. Therefore, the higher growth rates and lower feed conversion ratio-obtained in this study indicated better goat performance in terms of weight gain with the high level of pineapple waste as supplement. A lower value of feed conversion ratio (FCR) is an indication of better performance and feed conversion to flesh (Devendra *et al.* (1982). The result obtained from this experiment agrees with the observation of Devendra *et al.* (1982) that body weight change is a reflection of nutritive status of the animal.

Table 3: Effect of levels of pineapple waste with or without yeast supplementation on performance characteristics by West African dwarf goats

	Factor			Levels of inclusions of pineapple waste				
Parameters	**With Y S**	**Without Y S**	**SEM**	**0%**	**10%**	**20%**	**30%**	**SEM**
Initial weight (kg)	7.41	8.41	0.32	7.68	8.25	7.92	7.78	0.44
Initial metabolic wt ($W^{0.75}_{kg}$)	4.49^{b}	4.92^{a}	0.11	4.61	4.86	4.71	4.65	0.19
Final weight (kg)	10.53	11.50	0.31	10.52	11.48	11.04	11.00	0.48
Final metabolic wt ($W^{0.75}_{kg}$)	5.58	5.80	0.21	5.42	5.52	6.05	5.78	0.27
Weight gain (kg)	3.12	3.09	0.11	2.84^{b}	3.23^{a}	3.12^{ab}	3.22^{ab}	0.13
Metabolic wt gain ($W^{0.75}_{kg}$)	2.34	2.36	0.06	2.17^{b}	2.48^{a}	2.34^{ab}	2.40^{ab}	0.07
Daily weight gain (g)	34.66	34.33	1.33	31.56^{b}	35.88^{a}	34.66^{ab}	35.78^{ab}	1.62
Concentrate consumed (g/day)	196.50^{b}	257.58^{a}	11.05	206.90	219.24	238.24	243.80	19.95
Grass consumed (g/day)	286.02	271.79	9.25	260.48	292.66	297.39	283.10	12.83
Total feed intake (g/day)	482.52	529.38	16.59	467.37	511.91	517.63	526.90	22.62
Average daily intake (g/day)	433.88	475.58	14.85	419.89	461.00	465.51	472.54	20.24
Feed conversion ratio	11.99	12.83	0.38	12.70	11.65	12.78	12.51	0.53
Cost per kg of feed (₦)	26.29	26.29	1.41	34.24^{a}	22.44^{d}	25.24^{b}	23.24^{c}	1.53
Cost of feed consumed /wt gain/goat (₦)	5.10^{b}	6.69^{a}	0.37	7.08^{a}	4.91^{b}	5.92^{ab}	5.66^{ab}	0.51
Cost per weight gain (₦)	317.50	340.68	21.63	434.79^{a}	267.82^{c}	322.83^{b}	290.92^{bc}	14.56

^{a,b,c} means in the same row with different superscripts are significantly (p₦0.05) different

YS = Yeast Supplementation SEM = Standard Error of Mean

Table 4: Interaction effect of levels of Pineapple waste with or without Yeast supplementation on performance characteristics of West African Dwarf goats

	With Yeast supplementation				Without Yeast supplementation			
Parameters	0%	10%	20%	30%	10%	20%	30%	SEM
Initial weight (kg)	7.30	7.83	7.50	7.00	8.67	8.33	8.57	0.22
Initial metabolic wt ($W^{0.75}_{kg}$)	4.44	4.68	4.53	4.30	5.03	4.90	5.00	0.09
Final weight (kg)	10.13	11.23	10.53	10.20	11.73	11.58	11.80	0.24
Final metabolic wt ($W^{0.75}_{kg}$)	5.67	5.62	5.84	5.19	5.41	6.26	6.36	0.15
Weight gain (kg)	2.83	3.40	3.03	3.20	3.33	3.22	3.23	0.08
Metabolic wt gain ($W^{0.75}_{kg}$)	2.17	2.50	2.28	2.39	2.17	2.40	2.41	0.04
Daily weight gain (g)	31.44	37.77	35.69	37.64	39.22	37.85	38.04	0.95
Concentrate consumed (g/day)	173.41	214.51	202.22	195.87	223.97	274.26	291.73	10.16
Grass consumed (g/day)	287.69^{ab}	297.39^{a}	284.52^{ab}	274.47^{ab}	287.94^{ab}	274.26^{ab}	291.73^{a}	6.59
Total feed intake (g/day)	461.11	511.91	486.74	470.34	511.91	548.52	583.45	12.53
Average daily intake (g/day)	414.26	460.87	437.52	422.88	461.13	493.50	522.19	11.20
Feed conversion ratio	12.66	11.54	12.49	11.29	11.77	13.07	13.74	0.27
Cost per kg of feed (₦)	34.24^{a}	22.44^{d}	25.24^{b}	23.24^{b}	22.44^{d}	25.24^{b}	23.24^{c}	0.98
Cost of feed consumed per goat (₦)	5.93^{b}	4.82^{b}	5.10^{b}	4.55^{b}	5.02^{b}	6.74^{ab}	6.78^{ab}	0.31
Cost per weight gain (₦)	433.36^{a}	259.03^{b}	315.16^{b}	262.45^{b}	276.60^{b}	330.51^{b}	319.39^{b}	15.21

^{a,b,c} means in the same row with different superscripts are significantly (p₦0.05) different
YS = Yeast Supplementation; SEM = Standard Error of Mean

Table 5: Effect of levels of pineapple waste with or without yeast supplementation on (Initial) haematological parameters on West African dwarf goats

	Factor							
Parameters	**With Y S**	**Without Y S**	**SEM**	**0%**	**10%**	**20%**	**30%**	**SEM**
PCV (%)	25.63	27.88	1.07	24.50 ^{b}	24.75 ^{b}	28.25^{ab}	29.50^{a}	1.22
Hb (g/dl)	7.90	8.80	0.40	7.60^{b}	7.68^{b}	8.80^{ab}	9.33^{a}	0.44
RBC (x 10^3/mm^3)	10.48	10.60	0.22	11.01^{a}	10.19^{b}	11.24^{a}	9.72^{b}	0.18
MCV (fl)	24.57	26.48	1.26	22.21^{b}	24.34^{b}	25.20^{b}	30.35^{a}	1.15
MCHC (g/dl)	30.38	31.59	0.56	33.33 ^{b}	33.35 ^{ab}	33.34 ^{b}	33.42 ^{a}	0.73
MCH (pg)	7.56	8.38	0.46	6.90^{b}	7.53^{b}	7.85^{b}	9.59^{a}	0.41
WBC (x 10^3/mm^3)	8.54	9.38	0.60	9.06^{ab}	7.95^{b}	10.64^{a}	8.20^{b}	0.77
Neutrophil (%)	29.50	29.63	1.36	31.25^{a}	30.25^{a}	32.50^{a}	24.25^{b}	1.43
Lymphocyte (%)	65.88	65.75	1.33	64.25^{b}	65.25^{b}	62.75^{b}	71.00^{a}	1.39
Monocyte (%)	2.50	2.38	0.28	1.50^{b}	2.75^{a}	2.50	3.00^{a}	0.31
Eosinophil (%)	2.25	2.25	0.31	3.00	1.75	2.50	1.75	0.27

$^{a, b, c}$ **means in the same row with different superscripts are significantly (p₦0.05) different**

PCV Packed cell volume, Hb Haemoglobin, RBC Red blood cell, MCV Mean corpuscular volume, MCHV Mean corpuscular haemoglobin concentration, MCH Mean corpuscular haemoglobin, WBC White blood cell.

SEM = Standard Error of Mean

YS= Yeast supplementation

Table 6: Interaction effect of levels of Pineapple waste with or without Yeast supplementation on (Final) haematologi cal parameters on West African dwarf goats

Parameters	With yeast supplementation				Without yeast supplementation			SEM
	0%	10%	20%	30%	10%	20%	30%	
PCV (%)	24.50^{ab}	21.00^{b}	27.00^{a}	30.00^{a}	28.50^{a}	29.50^{a}	29.00^{a}	0.70
Hb (g/dl)	7.50^{ab}	6.10^{b}	8.55^{a}	9.45^{a}	9.25^{a}	9.05^{a}	9.20^{a}	0.30
RBC (x 10^3/mm^3)	10.92^{ab}	10.49^{bc}	10.94^{ab}	9.56^{d}	9.89^{a}	11.53^{a}	9.87^{cd}	0.15
MCV (f l)	22.42^{cd}	19.70^{d}	24.80^{bc}	31.36^{a}	28.98^{ab}	25.80^{bc}	29.35^{ab}	0.90
MCHC (g/dl)	30.65^{ab}	27.63^{b}	31.80^{a}	31.43^{a}	32.41^{a}	30.66^{ab}	31.73^{a}	0.45
MCH (Pg))	6.87^{cd}	5.65^{d}	7.84^{bc}	9.87^{a}	9.41^{ab}	7.86^{bc}	9.31^{ab}	0.33
WBC (x 10^3/mm^3)	8.20^{ab}	9.03^{ab}	9.63^{ab}	7.33^{b}	6.88^{b}	11.65^{a}	9.08^{ab}	0.43
Neutrophil (%)	23.50^{ab}	30.00^{a}	27.50^{c}	27.00^{c}	30.50^{bc}	37.50^{a}	21.50^{d}	1.00
Lymphocyte (%)	62.50^{c}	65.00^{bc}	68.00^{b}	68.00^{b}	65.00	57.50^{d}	74.00^{a}	0.98
Monocyte (%)	1.00^{b}	3.00^{a}	2.50^{ab}	3.50^{a}	2.50^{ab}	2.50^{ab}	2.50^{ab}	0.19
Eosinophil (%)	3.00	2.00	2.50	1.50	1.50	2.50	2.00	0.21

$^{a, b, c}$ means in the same row with different superscripts are significantly (p? 0.05) different

PCV packed c ell volume, Hb haemoglobin, RBC red blood cell, MCV mean corpuscular volume, MCHV mean corpuscular haemoglobin concentration, MCH mean corpuscular haemoglobin, WBC white blood cell.

SEM = Standard Error of Mean

Effect of levels of pineapple wastes with or without yeast supplementation on (Initial) Haematological parameters of West African dwarf goats

Table 5 shows the main effect of levels of pineapple wastes with or without yeast supplementation on haematological parameters of West African dwarf goats. Among the parameters measured packed cell volume, haemoglobin concentration, red blood cells, mean corpuscular volume, mean corpuscular haemoglobin, white blood cells, Neutrophil, lymphocyte, and monocyte were significantly (P? 0.05) influenced by the levels of pineapple wastes except mean corpuscular haemoglobin concentration, eosinophil and platelet were not significantly (P? 0.05) influenced by the levels of inclusion. Packed cell volume and haemoglobin concentration increased as the levels of pineapple wastes increases.

Table 6 shows the interaction effect of levels of pineapple wastes with or without yeast supplementation on haematological final of West African dwarf goats. There were significant (P? 0.05) differences among all the treatments except eosinophil and platelet. The PCV of goats fed with or without yeast supplementation increases as the levels of pineapple waste increases. The same trend was observed in other parameters except eosinophil.

Haematology indices are an index and a reflection of the effects of dietary treatments on the animals in terms of type of diet, quality and amounts of the feed ingested and were available for the animals to meet its physiological, biochemical and metabolic necessities. All the haematological parameters were significantly (P? 0.05) influenced by levels of pineapple waste with or without yeast supplementation.

Mean packed cell volume values obtained in this study were within the range of 21 – 30% reported by Opara *et al.* (2010). In contrast to this, Taiwo and Ogunsanmi (2003) reported higher values of 36.9% and 35.5% for clinically healthy West African Dwarf goats. The haemoglobin range in this study fell within the range of 7 – 15 g/dl reported by Daramola *et al*.(2005) but higher than the values of 5 – 6g/dl obtained by Belewu and Ogunsola (2010) for goats fed fungi-treated *Jatropha curcas* kernel cake rations. The red blood cell counts reported in this study were within the range of 9.2 – 13.5g/dl as reported by Tambuwal *et al.* (2002). The reduced red blood counts recorded for goats at 10% inclusion level at the start of the experiment present a likely susceptibility to anaemia related disease conditions by these goats. The white blood cell counts fell within the normal range as reported by Daramola *et al.* (2005). The values obtained for neutrophils and lymphocytes at the end of the experiment fell within the normal range as reported by Daramola *et al.* (2005). These values are suggestive of a well developed immune system in the West African dwarf goats with such number of immune cells to proffer good health (Daramola *et al.,* 2005).

Conclusion

Based on the results of this study, it can be concluded that a dietary inclusion of 10% pineapple waste with or without yeast supplementation improved the performance of West African dwarf goats (WAD) in terms of feed conversion ratio and had no deleterious effects on the haematological parameters. Thus, pineapple waste can be utilised to a good advantage for goats in replacement for grass during dry season.

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Received: 7th February, 2017
Accepted: 21st June, 2017