NUTRIENT INTAKE AND FERMENTATION PARAMETERS OF WEST AFRICAN DWARF GOATS FED DIETS CONTAINING VARYING LEVELS OF *Momordica charantia* POWDER

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ABSTRACT
Twenty (20) West African dwarf (WAD) goats were subjected to four (4) dietary treatments containing Momordica charantia leaf powder (MCLP) at varying inclusion levels (0, 10, 20 and 30 g/kg DM) to assess its effect on nutrient intake and fermentation parameters. Megathrysus maximus was fed as a basal diet and concentrate diet as supplement in a ratio of 60:40. The experiment was laid out in a completely randomized design and it lasted for 90 days. Results showed that MCLP inclusion increased (P<0.05) total dry matter (DM), crude protein (CP), crude fibre (CF) and acid detergent fibre (ADF) intakes. There were no significant (P>0.05) differences in pH, total volatile fatty acids and ammonia nitrogen at 0hour across all treatments except for ammonia nitrogen concentration at 4hours. It was therefore concluded that for increased nutrient intake, MCLP can be included in the diet of WAD goats up to 30g/kg DM.

Keywords: *Nutrient intake, Fermentation, Phytochemical compounds, Momordica charantia,*

DESCRIPTION OF PROBLEM

The adverse effects of using synthetic substances in animal production, has increased the interest of ruminant nutritionists towards the use of medicinal plants to enhance nutritional efficiency and performance of livestock. These medicinal plants are referred to as phytogenic feed additives, phytobiotics and phytochemical compounds. They offer significant nutraceutical and nutritional benefits for animal health and nutrition (1). These plant-based products contain secondary metabolites such as polyphenols, quinines, flavonoids, alkaloids, saponins, tannins and polypeptides and they exhibit key bioactive properties essential for increasing livestock productivity by improving feed efficiency and animal performance (2). In some African countries, *Momordica charantia* is widely cultivated (3) and commercially grown for its nutritional value (4). It is a vegetable plants that is discarded because of its bitter taste, even though it has higher nutritional value (5). The leaves of *Momordica charantia* contain secondary metabolites, including alkaloids, saponins, tannins, glycosides, and cardiac glycosides, which may add to its therapeutic benefits (6). Proximate analysis reveals that the leaf and fruit of *Momordica charantia* are good sources of protein, carbohydrates, essential minerals, crude fat and vitamins (7). One of the key bioactive compounds in *Momordica charantia* leaf are polysaccharides (8) and saponins, which have been shown to have the ability to modulate rumen fermentation in a number of ways, including increasing the concentration of total volatile fatty acids (tVFAs), speed up the breakdown of feed substrates, decreasing the production of methane, and lowering the rumen's acetate to propionate ratio (A/P) and ammonia concentration (9). However, there is paucity of information on the effects of *Momordica charantia* leaf powder on nutrient intake and fermentation parameters of West African dwarf goats. This study therefore aims at determining the effect of diets containing *Momordica charantia* leaf powder on nutrient intake and fermentation of West African dwarf goats.

MATERIALS AND METHODS

Experimental site

The study was carried out at the Small Ruminant Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture Abeokuta, Ogun State, Nigeria. Ogun State is in the rainforest zone of South West Nigeria. The area has an annual mean temperature of 34.7°C, a relative humidity of 82% and an annual mean rainfall of 1,037 mm.

It is about 70 m above sea level and lies on latitude 7°5'-7°8'N and longitude 3°11.2'E.

Processing of test materials and formulation of diets

The leaves of *Momordica charantia* were harvested during dry season within Abeokuta, Ogun State, air-dried and ground to pass through 1mm sieve. This was used to formulate four (4) experimental diets which contain *Momordica charantia* leaf powder at 0, 10, 20 and 30 g/kg DM (Table 1). The experimental diets; (*Megathrysus maximus* and concentrate supplement) were offered to the animals at 5% of their body weight in a ratio of 60:40 respectively.

Table 1: Gross composition of experimental concentrate diets (%)

	Inclusion of *Momordica charantia* leaf powder (g/kg)			
Ingredients	0	10	20	30
Maize	15.00	15.00	15.00	15.00
Soyabean meal	12.00	12.00	12.00	12.00
Palm kernel cake	30.00	30.00	30.00	30.00
Wheat offal	25.00	25.00	25.00	25.00
Rice bran	15.00	15.00	15.00	15.00
Bone meal	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50
Salt	1.00	1.00	1.00	1.00
Total	**100.00**	**100.00**	**100.00**	**100.00**
MCLP	-	+	++	+++

MCLP – *Momordica charantia* leaf powder, 0 g/kg (-), 10 g/kg (+), 20 g/kg (++), 30 g/kg (+++)

Experimental animals and management

Twenty (20) West African dwarf (WAD) goats with average body weight 8.5± 1.17kg were used for the experiment. Pens were cleaned and disinfected with Izal solution prior to the arrival of the animals. The goats were kept in the quarantine section for two weeks for proper prophylactic treatment which consisted of intramuscular application of oxytetracycline LA and vitamin B complex at the dosage of 1 mL/10 kg body weight of the animal. They were thereafter divided into four (4) treatment groups of five (5) animals each on weight equalization basis and housed in individual pens. The treatments consisted of *Megathyrsus maximus* and concentrate diet (ratio 60:40) with varying levels of *Momordica charantia* leaf powder (0, 10, 20 and 30g/kg diet). Water was supplied *ad libitum* to the goats. Feed offered to each animal and the leftover were weighed daily. Feed intake and dry matter intake (DMI) were determined as follows:

Feed intake (g) = Feed offered – Feed leftover

DMI = % Dry matter x feed intake

Determination of rumen fermentation parameters

On the last day of the study, about 100 mL of rumen fluid was collected from three animals per treatment before feeding (collection 0th hour) and after feeding (collection at the 4th hour) using suction tube. The collected fluid was filtered through a four-layer cheese cloth and immediately measured for pH using the pH meter. It was then divided into two parts of 30ml each, for rumen ammonia nitrogen and total volatile fatty acids concentration determination. Total volatile fatty acids concentration was determined by titration method following the procedure of (10). Ammonia nitrogen concentration was determined using the micro-Kjeldahl method (11).

CHEMICAL ANALYSES

Oven dried feed samples were analyzed for their proximate compositions: crude protein, crude fibre, ether extract and ash (11). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) were determined by the methods of Van Soest *et al.* (12). Phytochemical screening of *Momordica charantia* leaf powder was according to (11).

STATISTICAL ANALYSIS

The General Linear Model (GLM) techniques of SPSS (13) were used to analyzed the data from this study in a Completely randomized design.

RESULTS AND DISCUSSION

Tannin, total phenol, flavonoids, glycosides, alkaloids, and saponins were all found in the phytochemical constituents of *Momordica charantia* leaf powder. This corroborates with the findings of (5), who observed these secondary metabolites in *Momordica charantia* through phytochemical screening and its inclusion in this study is within tolerable levels for animals. Presented in Table 3 is the nutrient intake of goats fed the experimental diets. *Momordica charantia* inclusion increased ($P<0.05$) total dry matter, CP, CF and ADF intakes. This may be due to saponin content in *Momordica charantia* which may have reduced rumen frothiness and improved comfort during feeding. (14) also reported increased nutrient intake when varying levels of *Vernonia amygdalina* was included in the diets of West African dwarf goats. According to (15) feed intake is a function of availability, palatability, fibre digestion and digesta flow rate. The diets had no significant ($P>0.05$) effect across all treatments except for ammonia nitrogen (NH_3-N) concentration at 4hours post feeding (Table 4). Ruminal pH, NH_3-N, and volatile fatty acids (VFAs), are significant indicators of ruminal fermentation and the firmness of the rumen environment (16). The non-significant effect of MCLP on the pH and total VFAs implies that inclusion of MCLP in diets did not disrupt the activity within the rumen. However, the reduction in NH_3-N concentration may be due to the phytochemical composition of MCLP which could have suppressed the activity of proteolytic bacteria and protozoa that degrade dietary protein extensively and hence improve the nutrient utilization efficiency of the animals.

Table 2: Phytochemical composition of *Momordica charantia* leaf powder

Parameters	*Momordica charantia* leaf powder
Tannin (mg/100g)	178.823
Total Phenol (mg/100g)	152.861
Flavonoid (mg/100g)	1567.318
Glycoside (mg/100g)	0.987
Alkaloid (%)	6.950
Saponin (%)	1.547

Table 3: Nutrient intake of West African dwarf goats fed experimental diets (g/day)

	Levels of inclusion of *Momordica charantia* leaf powder (g/kg)					
	MCLP0	MCLP10	MCLP20	MCLP30	SEM	P- value
Total Dry matter Intake	340.39^b	447.43^a	445.87^a	447.48^a	13.57	0.004
Total Crude protein Intake	48.23^b	59.37^a	59.09^a	59.69^a	1.60	0.002
Total Ether extract Intake	7.20^b	8.91^a	8.88^a	8.93^a	0.25	0.003
Total Crude fibre Intake	108.33^b	142.82^a	148.12^a	155.27^a	4.99	< 0.001
Total Ash Intake	48.66^b	60.84^a	60.77^a	60.63^a	1.79	0.006
Total NDF Intake	239.05^b	297.60^a	296.99^a	297.28^a	8.56	0.004
Total ADF Intake	111.33^b	139.69^a	139.64^a	138.91^a	4.20	0.007
Total ADL Intake	52.48^b	64.95^a	72.00^a	75.22^a	2.42	<0.001

abc:Means in the same row with different superscripts are significantly ($p < 0.05$) different, MCLP: Momordica charantia leaf powder, SEM: Standard error of mean, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin.

Table 4: Rumen fermentation parameters of West African dwarf goats fed diets containing varying levels of *Momordica charantia* leaf powder

	Levels of inclusion of *Momordica charantia* leaf powder (g/kg)					
	MCLP0	MCLP10	MCLP20	MCLP30	SEM	p-value
pH (0hr)	6.03	6.31	6.03	6.25	0.054	0.131
pH (4hrs)	6.55	6.68	6.50	6.43	0.054	0.482
TVFA (0hr) (mM)	57.15	53.70	52.05	53.01	1.181	0.507
TVFA (4hrs) (mM)	60.96	62.94	66.51	57.48	1.398	0.122
NH_3N (0hr) (mg/dl)	41.68	38.27	47.63	37.42	1.84	0.170
NH_3N (4hrs) (mg/dl)	46.13^a	39.12^b	34.02^b	37.42^b	3.294	0.003

^{a,b}: Means in the same row with different superscripts are significantly ($p < 0.05$) different. SEM: Standard error of mean, MCLP: Momordica charantia leaf powder, TVFA: Total volatile fatty acids, NH_3N: Ammonia nitrogen concentration.

CONCLUSION AND APPLICATION

Addition of up to 30 g/kg DM *Momordica charantia* leaf powder in the diet of West African dwarf (WAD) goats improved nutrient intake and reduced rumen ammonia nitrogen concentration. It could therefore be recommended in the diet of WAD goats.

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