GLOBAL JOURNAL OF BIOLOGY, AGRICULTURE & HEALTH SCIENCES
(Published By: Global Institute for Research & Education)
www.gifre.org

UTILIZATION OF RICE STRAW ENSILED WITH SOYBEAN MEAL AND GARLIC OIL BY YANKASA RAMS IN SEMI ARID REGION OF NIGERIA

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ABSTRACT

An experiment was conducted to evaluate the effect of feeding garlic oil on some performance characteristics of growing Yankasa rams. Sixteen (16) rams with an average weight of 19kg were selected and divided randomly into 4 groups with 4 animals per group. All rams in the different groups were fed similar ensiled diet of Rice straw (RS) and Soybean meal (SB).The first group (A ,control) was fed the ensiled diet alone while group 2,3,and 4(B,C and D) were supplemented with 1, 2 and 3 litres of garlic oil inclusion respectively. At the end of 12weeks, digestibility trial was carried out using 12rams (3 rams each) for 3weeks.Results indicated that daily Dry matter intake was significantly (P<0.05) higher for treatment B (1156.81g) than those fed A,C and D. Similarly, Organic matter intake was significantly (P<0.05) higher for rams on treatment B (1063.31g) than those on other treatments. Average daily gain was significantly (P<0.05) higher for rams on treatment B (77.50 g) compared to others. Digestibility of all nutrients were significantly (P<0.05) higher for rams on treatment B. Cost of feed /kg gain was also best for rams on treatment B which had the lowest cost(N/kg) (1088.30).It can be concluded that using garlic oil as feed additives at the rate of 1litre, 2litres and 3litres ration improve utilization of nutrients, growth rate and feed intake in terms of aroma, colour and palatability. The group fed supplemented diet with 1litre garlic oil showed the best performance with an average daily gain of 77.50g/d, Feed-gain ratio of 15.76 and increase in feed intake of 1221.94(g). Base on these findings, it can be concluded that inclusion of garlic oil up to 1 litre in the diet of growing Yankasa rams had the best result interms growth performance and digestibility.

INTRODUCTION

For the past few decades, a number of chemical feed additives such as antibiotics, ionophores, methane inhibitors and defaunating agents have been tried in ruminant nutrition to modulate rumen fermentation in order to enhance growth, milk yield, feed intake and efficiency (Cowan, 1999). But, most of these supplements are not used routinely because of toxicity problems posed to the host animals and rumen microbial adaptation to these additives. Most importantly, a great awareness from public health aspects on residues of these chemicals in milk and meat and bacterial resistance to antibiotics as a result of increased use in the food chains prohibits their use as feed additives (Barton, 2000). These supplements have been criticized by consumers' organizations on the grounds of product safety and quality.

Consumers' demands have stimulated the search for natural alternatives to chemical feed additives. As plants are part of herbivore diets; those that contain bioactive compounds such as Essential Oils (EO), saponins and tannins with antimicrobial properties could be explored for feeding animals to improve feed utilization and health (Cowan, 1999). Therefore, recent research has been focused on exploiting plant bioactives as natural feed additives to improve rumen fermentation such as enhancing protein metabolism, decreasing methane production (Wallace *et al*., 2002; Patra and Saxena, 2010) reducing nutritional stress such as bloat and improving animal health and productivity (Patra, 2007). A number of recent reviews discussed the effects of EO on rumen fermentation (Calsamiglia *et al*., 2007; Benchaar *et al*., 2008) rumen micro-organisms (Hart *et al*., 2008) and ruminant performance (Benchaar *et al*., 2008).

Garlic oil is a mixture of a large number of different molecules that are found in the plant or occur as a result of changes during oil extraction and processing. Garlic oil is known for its wide variety of therapeutic properties (antiparasitic, insecticidal, anticancer, antioxidant, inmunomodulatory, anti-inflammatory, hypoglycaemic), and its antimicrobial activity against a wide spectrum of gram-positive and gram-negative bacteria is often seen as its most prominent activity and has been thoroughly studied (Reuter *et al*., 1996), its potential effect on modifying rumen microbial fermentation has not been researched until recently.

Feeding rice straw alone does not provide enough nutrients to ruminants to maintain high production levels due to the low nutritive value of this highly lignified material. The high level of lignification and silicification, the slow and limited ruminal degradation of the carbohydrates and the low content of nitrogen are the main deficiencies of rice straw, affecting its value as feed for ruminants (Van Soest, 2006).

Soya bean contains a high quality protein which is comparable to animal protein and it is described as the best protein source in the vegetable kingdom (Okagbare and Akpodiete, 2006). Soya bean has a number of antinutritional lipoxygenase enzyme, lectins, phytic acid, goitrogen, uraese and genistein (McDonald *et al*., 1995) and cotton, gossypol (Church and Pond, 1988). Most of these antinutritional factors are heat liable (Church and Pond, 1988; Okagbare and Akpodiete, 2006) and would have been destroyed during processing. The complex processes of rumination and the microbial population of the rumen could cope with any residue from such antinutritional factor.

The study was therefore aimed at determining the growth performance, nutrient digestibility of Yankasa rams fed rice straw ensiled with soybean meal and garlic oil.

MATERIALS AND METHODS

Experimental Location

The experiment was conducted at the Teaching and Research Farm, Bayero University, Kano which is located at the new site campus of the University, demarcated by the lines of longitude 9^0 30 and 12^0 30 north and latitudes 9^0 30 and 8^0 42 east. It has a daily mean temperature of 30 to 33^0 C in the months of March – May. Lowest temperature is 10^0 C between the month of September and February (K-SEEDS, 2004).The area is characterized by tropical wet and dry climate; a dry season (Oct - April) and wet season (May- Sept.) with annual rain fall ranging between 787 – 960 mm (KNARDA, 2011).

Collection and Preparation of Experimental Samples

Rice straw was purchased from selling points identified within and around Kano State. The straw was chopped into smaller sizes of 2-3cm (Ogunlolu *et al*., 2010). Soybean was obtained from Yankaba market in Kano while Garlic oil was obtained from Kurmi market in Kano. Other feed ingredients for the experiment, which include maize, wheat offal, soybean meal,salt and cowpea husk were obtained from Yankaba and Dawanau markets, respectively in Kano metropolis.

Ensiling Procedures

The rice straw used for silage was chopped to make compaction easy. Chopped rice straw was ensiled with soybean meal and garlic oil in proportions as presented in Table 1.Garlic oil was mixed with 50 litres of water and sprinkled on each treatment (every 100kg of rice straw and soybean mixtures) (Table 1) The samples were ensiled for 21days. Masking tape was used to label each container of 200 litres after filling with weighed materials (Rice straw, soybean and garlic oil). At the expiration of each ensiling period, samples from each container was taken for physical observations and chemical analysis.

Table 1: Proportion (Kg) of Rice Straw Ensiled with Soybean Meal and Garlic oil

A	30	70	__
B	30	70	1Litre
C	30	70	2Litres
D	30	70	3Litres

Experimental Concentrate Preparation and Formulation

A concentrate diet with 16.21% CP was formulated (Table 2) and offered as supplement.300g was offered to each of the sixteen (16) experimental animals.

Table 2: Gross Composition of Concentrate Diet for growing Yankasa ram

Ingredients	Inclusion level (%)
Maize	19
Wheat offal	30
Soybean meal	20
Cowpea husk	30
Salt	1
Total	**100**
Calculated CP (%)	**16.21 %**
Calculated energy (kcal/kg)	**2381.8**
Cost of feed (N/kg)	**76.20**

Experimental Animals and their Management

A total of sixteen (16) Yankasa ram lambs of 15-20kg each was purchased from different markets in Kano State for the experiment. The animals were treated for internal and external parasites using Ivomec – super 200 ug/kg body weight before the start of the experiment. The experimental animals were managed intensively and group fed at 4% of their body weight on dry matter basis (Coffey *et al*., 2004) and water was provided *ad libitum* before the commencement of the experiment. Daily records of feed intake were taken throughout the period of the experiment by weighing feed offered and left over the following day in the morning. The animals were weighed prior to commencement of the experiment and subsequently at weekly intervals between 8.00am and 9.00am before being offered feed in the morning. The feeding trial lasted for 84days (12 weeks).

Experimental Design and Treatments

A Randomized Complete Block Design was used for the experiment. The Sixteen (16) experimental animals were divided into four treatments (groups) of four animals each, so that each animal serves as a replicate (Four (4) replicates per treatment). The initial weight of the animals in each treatment was balanced. The experimental animals were housed in individual pens measuring 2m x 1m. The pens were cleaned and disinfected. Water and salt lick were provided *ad libitum.*

Digestibility Trial

At the end of the feeding trial, a digestibility trial was conducted using three (3) animals from each treatment. The animals were fed the same experimental diet used in the feeding trial. The digestibility trial lasted for 3 weeks (2 weeks for adaptation and one week for faecal sample collection). Faecal collection bags were used for faecal sample collection and was fitted during the last 7 days after adaptability. During the collection period, daily feed intake and total faecal output from each animal was recorded. After thorough mixing, 5% of the faecal sample was taken and oven dried at 80^0C for dry matter determination and then stored for subsequent analyses.

Chemical analysis and Physical Characteristics Evaluation

Thoroughly mixed representative samples of rice straw, experimental diets (A to D), soybean meal, concentrate diet and faeces were analyzed for crude protein, crude fibre, ether extract and ash according to AOAC (2005). NDF (neutral detergent fibre (NDF) and acid detergent fibre (ADF) where also analysed according to the procedures of Van Soest *et al.* (1991). The physical characteristics of the ensiled material were determined for its aroma and colour by three independent scorers on a subjective scale of 1 to 4 (Table 3). Thereafter, pH of the ensiled materials was taken using a digital pH meter following a standard procedure (AOAC 2005). This was done by filling a 150ml beaker with ensiled material and added sufficient water. Then content poured in a blender and blended. The blended material was then sieved using a cheese cloth and the pH was determined from the substance. The concentration of ammonia in the ensiled silage was determined according to the method of Varga and Prigge (1982).

Table 3: Description of colour and aroma rating used as indices of silage quality

Rating	Colour	Aroma
1	Dark or deep brown	Putrid or rancid
2	Light brown	Pleasant
3	Pale yellow	Sweet
4	Yellowish green	Very sweet

(Source: Muhammed *et al.*, 2009)

STATISTICAL ANALYSIS

The data generated were subjected to analysis of variance (ANOVA) in a randomized complete block design using SAS package (1988). Where the significant differences between the means were detected Duncan's Multiple Range Test, (DMRT) was used for mean separation (Obi, 1990).

RESULTS

Physical Characteristics of Ensiled diets

Table 4 shows the result of physical characteristics of the ensiled diets. Diet A was dark brown with a putrid aroma, diet B was pale yellow with a sweet aroma and diet C and D were light brown with a pleasant smell.

Table 4: Physical Characteristics of Ensiled diets

Parameter	Colour	Aroma
A	Dark or deep brown	Putrid or rancid
B	Pale Yellow	Sweet
C	Light brown	Pleasant
D	Light brown	Pleasant

Ammonia and pH of Ensiled diet

Results of ammonia and pH of the ensiled diet fed Yankasa rams is presented in Table 5.There was significant differences ($P<0.05$) between the ensiled diet which ranged between 0.33 to 0.97 % with ensiled diet A having the highest significant difference and ensiled diet D had the lowest significant difference. For the pH, it ranged from 4.30 to 5.10 and ensiled diet A had the lowest significant difference ($P<0.05$) while C had the highest.

Table 5; Ammonia and pH of Ensiled diets

Parameters	Ammonia (%)	pH
A	0.97^{a}	4.30^{b}
B	0.62^{b}	4.70^{ab}
C	0.54^{c}	5.10^{a}
D	0.33^{d}	4.90^{a}

a, b, c, d= means with different superscripts across a row are significantly ($P<0.05$) different

Proximate composition of experimental Diets

Chemical composition of the experimental diets is presented in Table 6. The Dry matter ranged from 93 to 96.76%.The Organic matter ranged from 86.2 to 94.4% with the ensiled diet B having the least value and ensiled diet A had the highest value. The ash content ranged 3.4 to 7.73%. Crude protein content ranged from 3.96 to 39.33 %. The Crude fibre content ranged from 6.00 to 32.28% with rice straw having the highest value. Result for Ether extract ranged 2.04 to 8.15%. Nitrogen free extract ranged from 45.93 to 57.60%.The NDF (Neutral detergent fibre) ranged 36.37 to 56.07%. Result for ADF (Acid detergent fibre) ranged 23.70 to 42.63%.

Table 6: Chemical Composition of Experimental Diet (%)

Parameters	Diet A	Diet B	Diet C	Diet D	Rice straw	Soybean meal	Concentrate
Dry matter	93.00	94.00	94.50	95.00	96.10	96.95	96.76
Organic matter	94.40	86.20	91.10	88.60	87.48	90.25	89.56
Ash	5.60	7.73	3.40	6.20	8.60	6.70	7.2
Crude Protein	15.40	14.70	13.40	12.20	3.96	39.33	17.9
Crude Fibre	24.40	24.40	24.60	24.40	32.28	6.00	13.2
Ether Extract	2.35	4.77	7.60	8.15	4.21	2.04	4.10
NFE	52.25	48.33	51.60	49.45	50.95	45.93	57.60
NDF	50.20	52.50	56.07	52.53	47.40	36.37	55.63
ADF	40.47	42.63	35.60	42.10	37.20	23.70	40.63

NDF- Neutral Detergent Fibre; ADF-Acid Detergent Fibre; NFE-Nitrogen Free Extract

Performance characteristics of Yankasa rams fed rice straw, soybean meal and Garlic oil

Results of the performance of Yankasa rams fed rice straw, soybean meal and garlic oil is presented in Table 7. All parameters evaluated revealed significant (P<0.05) difference across all treatments except for Initial weight and feed: gain ratio which had no significant (P>0.05) difference for all the treatments.

Animals on Treatment B had significantly (P<0.05) higher final weight while those placed on control diet (Treatment A) had the least. There were significant (P<0.05) difference among treatment for live weight. The Average daily gain (ADG) ranged from 62.50 to 77.50 g. Animals on treatment B had the highest gain while there was no significant (P>0.05) differences between the control, those fed 2 litres (treatment C) and 3litres garlic oil (treatment D) with treatment A having the least ADG. The feed: gain ratio ranged from 13.19 to 15.76 with no significant (P>0.05) differences among all treatments and treatment B had the highest while treatment D had the least. The animals on treatment B had the highest feed intake while animals on treatment D had the least with no significant (P>0.05) difference among treatment A, C and D animals and it ranged from 808.39 to 1221.94 g.

The Dry matter intake (DMI) ranged from 773.25 to 1156.81 g with animals on treatment B having the highest intake while no significant (P>0.05) differences among animals on treatment A, C and D and treatment D having the least intake. The Organic matter intake ranged from 719.11 to 1063.31 g with animals on treatment B having the highest and animals on treatment D had the least while there was no significant difference (P>0.05) among treatment A, C and D.

The Ether extract (EE) intake ranged from 24.70 to 60.24 g with animals on treatment A having the least and Treatment C had the highest. There was no significant (P>0.05) differences between treatment B and C also between B and D but there was significant (P<0.05) difference between treatment A and B, A and C, C and D also A and D. The Ash intake was highest in treatment B and lowest in treatment C which ranged between 43.05 to 93.51g.There was significant (P<0.05) differences between treatment B and treatment A, C and D with no significant (P>0.05) differences between treatment A, C and D.

The Crude fibre (CF) intake ranged from 161.62 to 264.54 g with treatment B having the highest and treatment D having the least. Also, there was no significant (P>0.05) differences between treatment A,C and D but there was significant(P<0.05) differences between treatment B and treatment C,D and A. The Crude protein (CP) intake ranged from 115.72 to 189.21 g with treatment B having the highest and treatment D had the least while there was no significant (P>0.05) differences between treatment A,C and D but there was significant (P<0.05) differences between treatment B and treatment C also D and A.

The Nitrogen free extract (NFE) ranged from 424.20 to 616.08 g with treatment B having the highest and treatment D having the least. Also, there was no significant differences (P>0.05) among treatment A, C and D but there was significant (P<0.05) differences between treatment B and C, also D and A. The Dry matter intake as a % of body weight (DMIBW) ranged from 3.29 to 4.40 with treatment B having the highest and treatment D had the least while there was no significant (P>0.05) difference among treatment A,C and D but there was significant(P<0.05) differences between treatment B and C, also D and A.

Cost of feed of the ensiled diet fed to Yankasa ram ranged from 52.95-84.40 with treatment B having the highest and A had the lowest while there was significant (P<0.05) difference between treatment A and B, also B and C. There was no significant(P>0.05) difference between treatment C and D.The cost of feed/kg gain ranged from 926.50 to 1093.40 with treatment C having the highest cost while A had the least.There was no significant(P>0.05) difference among all treatments.

Table 7: Performance of Yankasa rams fed Rice straw, Soybean meal and Garlic oil

	Treatments				
Parameters	A	B	C	D	LSD
Initial Weight(kg)	19.00	19.00	19.00	19.00	0.50
Final Weight (kg)	23.00^{c}	26.25^{a}	24.63^{b}	23.50^{c}	0.69
Average daily gain (g)	57.50^{b}	77.50^{a}	65.00^{b}	62.50^{b}	10.19
Feed:gain ratio	14.53^{a}	15.76^{a}	14.42^{a}	13.19^{a}	3.22
Feed intake(g)	830.22^{b}	1221.94^{a}	930.85^{b}	808.39^{b}	194.14
Dry matter Intake(g)	783.38^{b}	1156.81^{a}	868.07^{b}	773.25^{b}	182.57
Organic matter Intake(g)	766.71^{b}	1063.31^{a}	843.32^{b}	719.11^{b}	167.45
Ether extract(g)	24.70^{c}	56.27^{ab}	60.24^{a}	50.94^{b}	9.29
Ash(g)	51.30^{b}	93.51^{a}	43.05^{b}	53.12^{b}	15.12
Crude fibre(g)	168.98^{b}	264.54^{a}	194.00^{b}	161.62^{b}	47.54
Crude protein(g)	135.36^{b}	189.21^{a}	138.24^{b}	115.72^{b}	28.54
Nitrogen free extract(g)	449.84^{b}	616.08^{a}	498.32^{b}	424.20^{b}	90.48
DMIBW	3.41^{b}	4.40^{a}	3.60^{b}	3.29^{b}	0.63
Cost of feed intake(N/day)	52.95^{c}	84.40^{a}	71.28^{b}	66.96^{b}	12.9
Cost of feed/kg gain(N/kg)	926.50^{a}	1088.30^{a}	1104.30^{a}	1093.40^{a}	233.92

a, b, c means with different superscripts across a row signify significant (P>0.05) differences
DMIBG: Dry matter intake as a percentage body weight gain

Nutrient Digestibility of Yankasa rams fed Rice straw, Soybean meal and garlic oil

Nutrient digestibility result of Yankasa ram fed Rice straw, Soybean meal and garlic oil results is presented in Table 8. All parameters evaluated were significantly (P<0.05) difference across all the treatment except for crude protein which had no significant (P>0.05) differences for all the treatment. The Dry matter digestibility was ranged 50.67 to 69.3 (%) with significant (P<0.05) differences between animal fed on 1litre garlic oil (B) and those on 2litre and 3litre (C and D respectively) but no significant (P>0.05) differences between treatment C and D likewise treatment B and control (A).Treatment B had the highest while D had the least.

The Organic matter digestibility ranged 52.67 to 64.40 (%) with treatment B having the highest and D had the lowest. The significant differences were same as dry matter digestibility.

Ether extract was ranged 61.95 to 83.06 (%) with significant (P<0.05) difference across all the treatments A- D, treatment B had the highest value while control (A) had the least. The Ash was ranged 60.54 to 80.10 (%) with no significant (P>0.05) differences among treatment B - D but there were significant (P<0.05) differences among all those fed on garlic oil (B, C and D) and the control (A).

There was no significant (P>0.05) difference for Crude protein ranged 50.48 to 70.97 for all the treatment with treatment B having the highest value and control A had the least. The Crude fibre was ranged 25.60 to 56.89.Animals fed on 1litre garlic oil (B) had the highest nutrient digestibility crude fibre while those fed on 3litre had the least and there was no significant (P>0.05) differences between treatment C and D also between treatment A and B but there was significant (P<0.05) difference between those supplemented with garlic oil at different levels. The Nitrogen free extract was ranged 58.45 to 69.54 with treatment B having the highest and treatment D had the least also, the significant differences were same as crude fibre.

Table 8: Nutrient Digestibility of Yankasa ram fed Rice straw, Soybean meal and Garlic oil

	Treatments				
Parameters	A	B	C	D	LSD
Dry matter	56.65^{ab}	69.30^{a}	53.34^{b}	50.67^{b}	12.99
Organic matter	60.22^{ab}	64.40^{a}	58.87^{b}	52.67^{b}	12.74
Ether extract	61.95^{d}	83.06^{a}	79.56^{b}	68.56^{c}	3.76
Ash	60.54^{b}	80.10^{a}	76.06^{a}	78.13^{a}	8.11
Crude protein	50.48^{a}	70.97^{a}	61.57^{a}	60.40^{a}	30.41
Crude fibre	40.86^{ab}	56.89^{a}	32.02^{b}	25.60^{b}	16.37
Nitrogen free extract	64.54^{b}	69.54^{a}	62.44^{b}	58.45^{b}	12.09

a,b,c,d means with different superscript across a row signify significant (P>0.05)differences

DISCUSSION

Physical characteristics

Good silage usually preserves the original colour of the pasture or any forage(Mannatje 1999).The brown colour obtained in the present study was in order. It was close to the original colour of the grass which was an indication of good quality silage that was well preserved (Oduguwa *et al.,* 2007).The silage with 1litre of garlic oil exhibit pleasant aroma which is an indication of well made silage. Kung and Shaver (2002) that pleasant smell is accepted for good silage.

Ammonia and pH of ensiled diet

The results for Ammonia showed significant differences among all treatments. The results showed that Ammonia decreases as garlic oil level increases also compared to untreated rice straw.Feed supplemented at 1 litre produced more ammonia as compared to 2 and 3litres which is similar to results of Parthasarathy and Pradhan (1983).Treatment A had the highest while D is the lowest.

The pH of feed ensiled with garlic oil at different level increased and this is in close agreement with results reported by (Harrison *et al*.,1995).The pH values obtained were moderate, indicating that potentially satisfactory silages were produced. The pH (4.3 to 5.1) values observed in this study was similar to that reported by Titterton *et al*.,(2002) and lower from the report of Muhammed *et al*., 2009) who recorded 5.3 to 5.7.Contrary to the report by Tjandraatamadja *et al*., (1993) who recommended pH 4.2 for tropical silage. There were slight increase in legumes result in pH shift from acidic to approaching neutral.The pH value of the silage was within the range of 3.5 to 5.5 classified to be pH for good silage (Menesses *et al*., 2007). Generally, pH is one of the simplest and quickest way of evaluating silage quality. However, pH may be influenced by the moisture content and the buffering capacity of the original materials. Silage that has been properly fermented will have a much lower pH(more acidic) than the original forage.

Kung and Shover (2002) in their interpretation of silage analyses stated that good quality grass and legumes silage pH values in the tropics ranges between 4.3-4.7.The pH value of 4.3 obtained in this study was in agreement with 4.2 to 5.0 reported by Babayemi (2009).

Chemical Composition of diet

The Crude protein, Crude fibre, Ether extract and Dry matter for soybean meal and Rice straw corresponds with the result of Aiad *et al*. (2008). Addition of garlic oil to the feed made the crude protein to drop for the ensiled diets A- D while the ether extract increased from Diet A-D which is similar to the report of Anonymous (1994). The feacal matter analysis was carried out according to standard procedures of the AOAC (2005) for determination of moisture, DM, CP, EE, CF, ADF, NDF and Ash while NFE was calculated by differences.

Performance Characteristics

Garlic oil supplementation at different levels significantly affects feed consumption of growing Yankasa rams (Table 7). Along the feeding trials compared with the control, animals on Treatment B (litre garlic oil inclusion) tended have the highest feed intake. The result are in agreement with the reports of El Ashry *et al.* (2006), Aid *et al.* (2008) and Zaki *et al.* (2000) who reported a decrease in feed consumption as garlic oil supplementation to rice straw increases with a higher intake for the lowest level of garlic oil in feeding calves. The data of the average daily gain (Table 7) revealed that garlic oil at 1litre significantly ($P<0.05$) increased compared to other treatments receiving garlic oil. Also, B showed the best feed to gain ratio but the difference among the group were not significantly ($P>0.05$) difference. These result might be due to the effective to improve immunity and decrease debility incidence which agree with the findings of Aboul-Fotouh *et al*. (2000), Safaa (1999) and Aboul-Fotouh *et al.*(1999) they reported that nutrition plays important role in diminishing growth rate.

The final weight increased in all treated group and those on 1litre (B) had the highest final weight. This weight gain may be due to the fact that the addition of garlic oil help to supply protein to these groups but which reduces as the level of garlic oil increases and also resulted to higher digestibility of Crude protein, Crude fibre and Organic matter. This result agree with those mentioned by Diab *et al.* (2002) who obtained highest growth performance in calves fed garlic oil. Feed intake decreased as the level of supplementation of garlic oil increases also feed: gain ratio which is similar to Nidaullah e*t al.* (2010) who reported a reduction in the feed intake of calves fed garlic supplement. Yang *et al.* (2010a) clearly demonstrated that garlic had a greater feed intake response at low dose (0.4 g/day) whereas higher doses have no effect on intake (1.6 g/day) in steers. In this experiment, DM intake increased from control level as compared to when 1 litre of garlic oil was added, but decreases as the garlic oil level increases also same for Organic matter intake which is similar to the result of El-Ashry *et al*. (2006) when garlic oil and onion were added to wheat straw and soybean meal fed to growing buffalo calves.

Cost of feed (N/kg) for treatment B increased compared to control but later reduced as level of supplementation of garlic oil increases. This may be as a result of intake by the animal.

The cost of feed/kg gain was highest for treatment C and lowest for treatment D as compared to control. Treatment B in which the lowest level of garlic was used had the best price for each gain in weight which might be due to the fact that the treatment resulted in significantly higher digestibility and consequently higher live weight gain compared to control and other treatment. Also, for best utilization of the feed by the animals.These results are in agreement with those obtained by Abou-fotouh *et al.* (2000)

Nutrient Digestibility

Data in Table 6 indicated that supplemented diet with 1litre garlic oil (B) fed to the growing Yankasa rams significantly ($P<0.05$) tended to improve digestibility coefficients of all nutrients and showed the highest value. These findings reveals that 1litre inclusion of garlic oil may be the most suitable concentration for rumen activity compared with other ratios in C and D but the improvement in Organic matter digestibility, Crude fibre digestibility and Ether ester digestibility was not significant compared to control diet (A). On the other hand, the diet D which was supplemented with 3 litre of garlic oil showed significantly ($P<0.05$) the lowest value of digestibility which indicated that the level may inhibit the rumen activity. For the level 2 litre of supplementation, the values of digestibility of all nutrient was not significantly ($P<0.05$) affected compared with control diet except for Ether ester and Ash it was lower. So, that level may inhibit the activity of cellulolytic microorganism. These results are in agreement with those found by El Ashy *et al.* (2006), Aiad *et al.* (2008), Moawad (1998), Zaki *et al.* (2000) and Khir and Ibrahim (2007). Culen *et al.,* (2005) reported that the inclusion of garlic oil at higher level caused a significant reduction in dry matter and organic matter digestibility. It could be explained with garlic's high oligofructose and insulin content (Gibson 2007).In the study of Shalaby *et al.* (2006), protein digestibility decreases with increasing level of garlic. Similar results were reported by Soltan and El-laithy (2008) that incorporation of garlic oil in sheep diets did not improve feed intake and protein digestibility coefficient significantly as garlic oil level increases as compared to the control group. In this connection, El-

Afify (1997) reported that sulphur compound in garlic are considered as active antimicrobial agents, improve immunity and therefore stimulate growth and improve nutrients utilization which also have mode of action similar to antibiotics (Ibrahim *et al.*, 2004).

CONCLUSIONS

It was concluded that garlic oil effects on daily gain and dry matter intake vary depending on its level, the ingredients fed high or low protein and fibre and also animal response. Optimal additive level based on animal health, nutrient digestibility and daily gain was for 1litre. Therefore, garlic oil could be used successfully and safely in rations to improve the performance of growing rams.

REFERENCE

Aboul-Fotouh, G.E., S.M. Allam, E.I. Shehata andAbd S.N. El-Azeem, (2000). Effect of some medicinal plantsfeed additives on milk production and composition of lactating buffaloes.Egyptian J.Nutrition and Feeds, 3(1): 31-41.

Aiad, A.M., Neamat, I. Bassuany, A.A. Afify and F.M. Abo-Donia,(2008). Adding natural juice of vegetables and fruiting to ruminant diets:(a) Lemon, onion and garlic juice supplement to diets fed to suckling buffalo calves and its effect on digestibility,growth, performance and fungi count.World J.Agric. Sci.,4(2):149-156.

Anonymous, 1994. Garlic. Lawrence Review of Natural Products.

A.O.A.C. (2005). Association of Official Analytical Chemist. Officials Methods of Anslysis 18th Edition AOAC Inc, Arlington, Virgina USA. 1094pp

Babayemi, O.J.,(2009). Silage quality, dry matter intakeand digestibility by African dwarf Sheep of Guineagrass (*Panicum maximum cv ntchisi*) harvested at4 and 12 week regrowths. Afr. J. Biotechnol., 8:3988-3989.

Barton, M.D., (2000). Antibiotic use in animal feed and its impact on human health. Nutr. Res. Rev., 13: 279-299.

Benchaar, C., Calsamiglia, S., Chaves, A.V., Fraser, G.R., Colombatto, D., McAllister,T.A., and Beauchemin, K.A. (2008). A review of plant-derived essential oils in ruminant nutrition and production.", Anim. Fd. Sci. Technol. 145: 209-228.

Calsamiglia, S., M. Busquet, P.W. Cardozo, L. Castillejos and A. Ferret, (2007). Invited review: Essential oils as modifiers of rumen microbial fermentation. J. Dairy Sci., 90: 2580- 2595.

Chenost, M. and C. Kayouli. (1997). Roughage Utilisation in Warm Climates. FAO Animal production and health paper 135,Rome.

Church, D. C., Pond, W. G. (1988). *Basic Animal Nutrition*. 3rd edition. John Wiley and Sons Inc. New York. 458pp.

Coffey,L., Hale,M. and Wells,A. (2004). Goats: Sustainable Production Overview. Retrieved from http://www.attra.ncat.org/attra-pub/PDF/goatoverview.pdf on 12/3/2012.

Cowan, M.M., (1999). Plant products as antimicrobial agents. Clin. Microbiol. Rev.,12: 564-582.

Cullen,S.P.,Monahan,F.J.,and Callan,Y.,(2005).The effect of dietary garlic and rosemary on Growing ram,performance and sensory characteristics of its meat.J.Agric Food Res.2005;44:57-67.

Diab, A. S.; El-nagar, G. O. and Abd-El-hady, Y. M. (2002). Evaluation of *Nigella sativa* L (black seeds;baraka),*Allium sativum* (garlic) and Biogen as feed additives on Growth performance and immuno stimulants of buffalo calves. Suez canal Vet. Med.J.745-750.

El-Afify, S. F. (1997): Nutritional studies on onion and garlic supplement to poultry feed. Ph. D. Thesis, Fac.Agric.,Ain-Shams University.

El-Ashry, M.A., N.E. El-Bordeny, H.M. Khattab and H.M. El-Sayed,(2006). Effect of diet supplemented with medicinal herbs on nutrient Digestibility and some blood metabolites of buffalo calves.Egyptian. J. Nutr. And feed2:179-191.

Gibson,G.R.(2007).Prebiotic for improved gut health.Food Sci.,Technol.2007;Abst:3731.

Harrison,J.H.,R.Blauwiekel and M.R.Stokes.(1995).Fermentation and utilization of grass silage. J.Dairy Sci.,77:3209-3235.

Hart, K.J., D.R. Yanez-Ruiz, S.M. Duval, N.R. McEwan and C.J. Newbold, (2008). Plant extracts to manipulate rumen fermentation. Anim. Feed Sci. Technol., 147: 8-35.

Ibrahim, I. A.; Elam, T. A.; Mohamed, F. F.; Awadalla, S. A. and Yousif, Y. I.(2004). Effect of onion and /or garlic as feed additives on growth performance and immunity in broiler muscovy ducks.The first Sci.Conf.Fac.Vet.Med.Moshtohor Benha-Ras Sedr,Sep.1-4pp.

KNARDA. (2011). Kano agricultural and rural development authority.Metrological station reports temperature record book and management 11: 1-3.

K-SEEDS (2004). Kano State Economic Empowerment and Development Strategy (K-Seeds) PolicyFrameworkRetrievedfromhttp://web.ng.undp.org/documents/SEEDS/Kano State pdf on 12/03/2012.

Kung, L. and R. Shaver,(2002). Interpretation and use of silage fermentation analyses reports. Dept. of Animal and food science, University of DelawareNewark, DE 19717.

McDonald, P., Edwards R. A., Greenhald. (1995). *Animal Nutrition.* 5th edition. Longman. Hongkong.

Mannatje, L.'t'., (1999). Introduction to the conference on silage making in the tropics in Mannetje (eds)silage making in the tropics with particular emphasis on small holders FAO plant productionand protection. Paper, 161.

Menesses, M.D., J. Megias, A. Madrid, F. Martinez-Teruel,.J. Hemandez and J. Oliva,(2007). Evaluation of the phytosanitary, fermentative and nutritivecharacteristics of the silage made from crudeartichoke (*Cynarascolymus* L.) by-products feeding for ruminants. Small Ruminant Res., 70: 292-296.

Muhammed,I.R.,Abdu,M.I.,Iyeghe-Erakpotobor,G.T.,Sulaiman,K.A.,(2009).Ensiling Quality of Gamba Fortified with Tropical Legumes and its preference by Rabbits.Research Journal of applied sciences 4(1):20-25,2009.

Nidaullah,H. ,F.R. Durrani,S.Ahmed, I.U. Jan and S.Gul,(2010). Aqueous extract from different Medicinal plants as anticoccidial growth promotive and immunostimulant in broilers.ARPN J.Agricult.Biol.Sci.,5:53-59.

Obi.L.U.(1990). Statistical Method of Detecting Differences Between Treatment Means.2nd Edition.Snap press,enugu,Nigeria.

Oduguwa, B.O., A.O. Jolaosho and M.T. Ayankoso,(2007).Effect of ensiled on physical properties, chemical composition and mineral contents of guinea grass and cassava tops silage. Nig. J. Anim. Prod., 34:100-106.

Ogunlolu, B. T. Jolaosho, A. O. Akintola, T. O. and Aniwe, P. O. (2010). Effects of Length of Storage and Moisture of Cassava Peel, Pineapple Residues and Guinea Grass On Mineral content of Silage Proceddings of the 35th Annual Conference of the Nigeria Society of Animal Production 14th -17th March, 2010, University of Ibadan. Pp 489-490.

Okagbare, G. O., Akpodiete, O. J. (2006). Soybean in preruminant nutrition: a review. *Nig. J.* Anim. Prod.33(1)82-93.

Parthasarathy, M.; K. Pradhan. (1982). Fermentation characteristics and feeding value of ensiled poultry litter containing wheat straw, bargasse or saw dust. Anim.Feed Sci.Technol.7:341-349.

Patra, A.K. and J. Saxena, (2010). A new perspective on the use of plant secondary metabolites to inhibit methanogenesis in ruminants. Phytochemistry, 71: 1198-1222.

Reuter H.D., Koch, H.P. & Lawson D.L. (1996). Therapeutic effects and applications of garlic and its preparations. In: Koch, H.P. & Lawson, D.L. (Eds). *Garlic: the Science and Therapeutic Applications of* Allium sativum *L. and Related Species*, *2nd edition*. Baltimore, MD, USA, Williams & Wilkins, pp. 135–212.

Shalaby, A. M.; Khattab, Y. A. and Abdel rahman, A. M. (2006). Effects of garlic (*Allium sativum)* and chloramphenicol on growth performance, physiological Parameters and survival of bufallo calves.J.Venom.Anim.Toxins Incl.Trop. Dis.,12(2):178pp.

Soltan, M. A. and El-Laithy, S. M. (2008). Effect of probiotics and some spices as feed additives on the performance and behaviour of buffalo calves.J.Venom.Anim.Toxins Incl. Trop.Dis., 12(2):63-80.

Tjandraatamadja ,M.,Macrac.,I.C.,and Norton,R.W.(1993).Digestion by sheep of silages Prepared from mix of Tropical Grasses and legumes J. Agric. Sci.Cambridge.120-407.

Van Soest, P. J Robertson, J. B. and Lewis, B. A (1991). Methods for Dietary Fibre, Neutral Detergent Fibre, Non-Starch Polysaccharides in relation to Animal Nutrition. Journal of Diary Science. 74:3583-3597.

Van Soest, P. J. (2006). Rice straw, the role of Silica and treatments to improve quality. Animal Feed Science Technology 130 (3-4): 137-171.

Wallace, R. J., N. R. McEwan, F. M. McIntosh, B. Teferedegne, and C. J. Newbold. (2002).

Natural products as manipulators of rumen fermentation. Asian-Australas. J. Anim. Sci. 10:1458-1468.

Zaki, A.A., M.R. Mostafa, R.T. Fouad and Z.M. Marei,(2000). Teosint (*Zea mexicanal*) forage Productivity quality and its feeding effect on performance of buffalo calves, Proc. Conf. Anim. Growth Prod. In the 21 century Sakha,18-20 Apri.,pp1737-2440.