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Proximate composition and physico-chemical parameters of water hyacinth (*Eicchornia crassipes)* ensiled with breadfruit (*Artocarpus altilis)* as feed for WAD goats

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Abstract

Scarce forages and low digestibility are major challenges of dry season feeding of ruminants in the tropics. This can be overcome by conservation of forages through ensiling with unconventional and inexpensive materials containing high fermentable carbohydrates. Water hyacinth, an invasive water weed with high biomass yield was ensiled with graded levels of breadfruit and assessed for its potential as a feed resource. Breadfruit was included in silages at 0% (control, T1); 10% (T2), 20% (T3), 30% (T4) and 40% (T5) with sawdust added at a constant inclusion level of 10% to serve as absorbent. Proximate composition and silage quality assessment were determined after 30 days of ensiling. Results showed that dry matter (%) of silages ranged between 14.21 (T1) and 28.44 (T4). Ash contents (g/100g) reduced ($P<0.05$) as breadfruit inclusion increased in the silage diets. Crude protein (g/100g) was higher ($P<0.05$) in T1 (12.03) than T5 (9.18) but was similar in T2, T3 and T4 (10.50, 10.72, 10.28) respectively. The appearance, odour and texture of the silages in T3-T5 had acceptable physical attributes while pH values ranged from 4.65 – 5.40. It is concluded that the leaves and stem of water hyacinth ensiled with breadfruit have potential as feed for ruminants in terms of nutritional and physico-chemical attributes.

Keywords: Nutritive value, silage, water hyacinth, breadfruit, WAD goats

Introduction

One of the major constraints limiting the development of livestock production in many developing countries is inadequacy of animal feed resources, and this is predicated upon dwindling access, both quantitatively and qualitatively, to feed resources. It is increasingly important to devise strategies for ensuring continuous accessibility to quality feedstuff by ruminant animals all year round. Concerted efforts in research has been directed towards improvement and supplementation of grasses especially in the dry season with crop residues, industrial and agro-industrial by products as well as the use of legume and browse plants. Other forms of interventions are conservation of grasses and legumes in the form of hay, straw and silage. Silage making is an important tool for farmers in preservation of surplus feed during the wet season in ensuring all year round availability of feed (Ibhaze *et al*., 2015). Many researchers have worked on the production of silages with different forages. One of these forages is *Eichhornia crassipes* (Water hyacinth) which is a rigorous, free floating, fresh water weed of the family Pontederiaceae. This forage's nutritive value is well documented (Mako, 2010; Akinwande *et al.,* 2011). For sustainability, there is need for conservation of this forage. However, there is dearth of information on the conservation of water hyacinth as silage. Inclusion of silage additives helps to improve silage quality and animal performances. Molasses, sugar beet, bagasse and most recently sugar cane have been used as fermentation stimulant. Other additives such as wheat offal (Akinwande *et al*., 2011), poultry litter, citrus pulp and cassava peels (Falola *et al*., 2013) have been documented as ensiling material, however, cost and availability are often a limiting factor.

Breadfuit (*Artocarpus artillis*) contains easily fermentable carbohydrates in form of sugars in its matured state and is available in excess of requirement because of its underutilization. Literature is scanty on the utilization of breadfruit as an additive in silage production. The environmental impact of water hyacinth and breadfruit has been a cause for concern. This study was therefore, designed to investigate the suitability of breadfruit as fermentable carbohydrate source in water hyacinth silages.

Materials and methods

Experimental location

The research was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Osun State. The site is between latitude 7°31 8.4”N and longitude 4° 31 15.96”E in the tropical rainforest ecological zone of Nigeria (Amujoyegbe *et al*., 2008).

Silage production

Water hyacinth (WH) was collected from water bodies around Itoikin, in Lagos State. Breadfruits (BF) were sourced from a farm in Ipetumodu, Osun State while saw dust (SD) was collected at a saw mill at Ondo Road, Ile Ife. Leaves and stem of water hyacinth plants collected were wilted and used. The WH were chopped into smaller pieces of about (2cm – 3cm) to aid compaction and mixed with chopped BF (fermentable carbohydrate source) at varying inclusion levels of 0%, 10%, 20%, 30%, 40% of the total silage diet while sawdust was included at a constant level of 10% in all treatments. The WH: BF: SD mixture were packed, compacted and sealed in a thick polythene bag to create an anaerobic condition for proper fermentation. The silage was done for thirty (30) days (Kuikui *et al*., 2015) after which they were opened.

Physico-chemical parameters

Physico-chemical parameters assessment of silages was determined as described by Kilic (1986). The appearance of the silage in term of colour was assessed using a colour chart. The smell and texture of the silage was adjudged by six (6) individuals while the pH of the silage was determined using a pH meter.

Proximate components

Samples of each silage diet was taken and oven dried at 65 ^{0}C until constant weight was obtained for dry matter determination after which they were milled and ether extract, crude fibre, Crude protein, ash and Nitrogen Free Extract of the diets were determined according to the standard procedures of AOAC (2000)

Statistical analysis

All data collected were subjected to analysis of variance (ANOVA) using the procedure of SAS (1999). Significant treatment mean values were compared using the Duncan Multiple Range Test of the same package. The mean obtained for Dry matter intake was ranked using SPSS 2.0.

Results and discussions

Table 1: Chemical composition (g/100g) of Water hyacinth and breadfruit silage diets

Parameters/Treatment	WH	BF	T1	T2	T3	T4	T5	SEM	Prob
Dry Matter	9.10	73.47	14.21^{d}	15.99^{c}	28.03^{a}	28.44^{a}	26.64^{b}	0.55	<0.0001
Ash	23.02	5.57	14.75^{a}	13.80^{ab}	12.86^{bc}	11.72^{c}	9.64^{d}	0.78	0.0003
Ether Extract	1.80	5.77	1.67^{ab}	1.43^{b}	2.42^{ab}	2.53^{a}	2.70^{a}	0.30	0.0499
Crude Fibre	18.20	6.90	21.48^{c}	30.00^{a}	23.21^{bc}	25.25^{b}	15.23^{d}	1.30	<0.0001
Crude Protein	10.55	5.23	12.03^{a}	10.50^{b}	10.72^{b}	10.28^{b}	9.18^{c}	0.26	0.0008
Nitrogen free Extract	37.33	76.53	35.89^{a}	28.28^{b}	22.76^{c}	21.88^{c}	36.62^{a}	2.68	<0.0001

$^{a, b, c, d}$: ***means within same row with different subscripts differ significantly (P < 0.05).*** **T1: 90%WH +10% SD; T2: 80%WH+10%BF+10%SD; T3: 70%WH+20%BF+10%SD; T4: 60%WH+30%BF+10%SD; T5:50%WH+40%BF+10%SD. WH=Water Hyacinth; BF=Breadfruit;**

Table 1 shows the proximate composition of the experimental diets. The dry matter (g/100gDM) content of silages ranged between 14.21 (T1) and 28.44 (T4). Dry matter content increased with the inclusion of breadfruit in the silages. This agrees with the findings of Olorunnisomo and Fayomi (2012), when they ensiled different legumes or elephant grass with cassava peels. The increase in dry matter across the diets may be attributed to the relatively higher dry matter of breadfruit

Table 2: Physico-chemical parameters of Water hyacinth and breadfruit silage diets

Parameter	T1	T2	T3	T4	T5
Appearance	Dark brown	Brown	Light brown	Light brown, White Patches	Light Brown, White patches
Smell	Not pleasant	Pleasant	Pleasant, faintly acidic	Pleasant with fruity smell	Pleasant with fruity smell
Texture	Wet, Firm	Wet, Firm	Moist, Firm	Moist, Firm	Moist, Firm
pH	5.40	4.73	4.65	4.76	4.45

T1: 9 0%WH +10% SD; T2: 80%WH+1 0%BF+10%SD; T3: 70%WH+20%BF+10%SD; T4: 60%WH+30%BF+10%SD; T5:50%WH+40%BF+10%SD. WH=Water Hyacinth; BF=Breadfruit; SD=Sawdust

The reverse however, is the case with ash content. Ash contents (g/100g) reduced ($P<0.05$) as breadfruit inclusion increased in the silages. This may be as a result of the higher ash content of WH compared to that of BF. This high value obtained from the present study could be attributed to high rate at which effluents flow into the water body from which the WH were sourced and for the fact that water hyacinth is used for water bioremediation (Alvarado *et al.*, 2008). However, the high ash content of water hyacinth indicates that the plant may be a good source of minerals for ruminants. Crude protein (g/100g) was higher ($P<0.05$) in T1 (12.03) than T5 (9.18) but was similar in T2, T3 and T4 with the values 10.50, 10.72 and 10.28, respectively. Crude protein (CP) level obtained in this study for the diet is lower than the value of 12 – 16 % reported by Reza and Khan (1981) but similar to values of 10.76 g/100g for Water Hyacinth ensiled with PKC and 10.83 for Water hyacinth ensiled with wheat offal (Akinwande *et al.*, 2011). The level of CP decreased in diets with increasing level of breadfruit inclusion, this can be attributed to the low crude protein content of breadfruit, however the CP meets the protein requirement for ruminants which is 8g /100 g DM (NRC, 1981). The CP ranges were sufficiently high to warrant utilization of the plant as a feed resource for ruminant animals.

Physico-chemical parameters of WH and BF silage are presented in Table 2. Colour of silages ranged from Dark brown to light brown, while the smell/odour ranged from not pleasant to pleasant with fruity smell. Texture ranged from wet and firm to moist and firm while the pH ranged from 4.65 – 5.40. Silage with higher levels of breadfruit had white patches which may have resulted from the colour of the breadfruit mixed with the brown colour from the fermented WH leaves. Good silage usually exhibits the original colour of pasture or any forage ('t Mannatje, 1999). This was in order as the prevalent brown colour of silage was the colour of the WH after wilting. Water hyacinth ensiled without breadfruit had unpleasant and pungent smell while silages with higher level of breadfruit exhibited a pleasant and fruity smell which is characteristic of good quality silage and as such was well preserved (Oduguwa *et al.*, 2007). All the silages had firm textures though with varying moisture content.

Silages with no breadfruit and those with 10% breadfruit were observed to be wet while the others were moist. This observation showed that inclusion of breadfruit in the silage enhanced the texture of the mixture. This agrees with the findings of Ososanya and Olorunnisomo (2015) when they reported better texture in brewers waste silages ensiled with corn cobs. The lower pH observed with increase in breadfruit inclusion in the silage showed that inclusion of breadfruit in the silage enhanced the quality as the pH values observed fell within the range of 3.5 – 5.5 classified to be pH for good silage (Menesses *et al*., 2007).

Conclusion

The study showed that water hyacinth ensiled with breadfruit up to 40% inclusion level can be useful feed resource in ruminant feeding in terms of its quality assessment and chemical composition.

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