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ORIGINAL RESEARCH ARTICLE

# Silage-making and its influence on cattle production at the University of Ibadan

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## ABSTRACT

***In order to resuscitate milk production at the University of Ibadan, Nigeria, sixty-eight zebu heifers and four in-calf Jersey cows were procured between April and September 2012. However, inadequate land for grazing and the need to provide extra forage for these animals made regular silage production imperative. From June 2012 till August 2013, silage formed a regular part of the daily ration for cattle on the Dairy Farm, University of Ibadan. On the average, zebu heifers received about 40-50% of their daily forage allowance from pasture and 50-60% from silage. Jersey cows on the other hand received about 30% of their forage allowance from pasture and 70% from silage. Silage offered to cattle on the farm was a composite of elephant grass, cassava peel and brewer's spent grain or poultry litter. Sometimes, composite silage of legume, moringa leaf and cassava peel was also offered. Dry matter intake (DMI) of zebu heifers increased from 2.7 to 5.6 kg/day (2 – 3.8 % of bodyweight, BW, respectively) when silage was introduced while average DMI of Jersey cows was 12 kg/day (3.6 % BW). Growth rate of zebu heifers varied from 0.4 – 0.8 kg/day with the upper limit of this range obtained when silage formed a regular part of their daily diet. Average daily milk yield of Jersey cows fed silage was 10.2 kg/day while lactation yield was 2353 kg. These observations indicate that the use of composite silage as part of daily ration for zebu and Jersey cattle enhanced the productivity of these animals in Ibadan.***

**Keywords:** growth rate, intake, Jersey cows, milk yield, silage, zebu heifers

## INTRODUCTION

Dairy cattle production at the University of Ibadan dates back to the 1960s and thrived through the early 1980s with a mixed stock of German Brown, Holstein Friesian, White Fulani cattle and their crosses. A small stock of Ndama cattle was also kept for beef production purposes. These animals were raised under a fairly intensive and mechanized system where silage formed a significant part of their daily ration (personal communication with L.O. Ngere). Milk production from the University Dairy Farm however declined from the late 1980s and totally ceased by mid 1990s due to a series of management problems. Efforts to resuscitate the Dairy Farm came to fruition between 2010 and 2012 when the Dairy Farm was renovated and restocked through the intervention of the University Council and the Educational Trust Fund (ETF).

As part of efforts to revive the moribund Dairy Farm, sixty-eight Sokoto Gudali heifers were sourced from the north-western states of Sokoto, Kebbi and Zamfara in April 2012 while four in-calf Jersey cows and a bull were sourced from Shonga, Kwara State in September 2012. The management system adopted for the zebu heifers was semi-intensive with grazing combined with stall-feeding of silage and concentrate while an intensive system (with partial grazing) was adopted for the exotic Jersey cattle. Due to the limited grazing area available to these animals at the University of Ibadan, silage was used to augment about 50-60 % of forage allowance for the indigenous cattle while 70 % of forage allowance to the Jersey cattle was supplied through silage on a daily basis. Several silo types

and materials were assessed at different periods to determine the most suitable for our local conditions. The concrete bunk silo was found to be stable, durable and amenable to commercial production while elephant grass with cassava peel was found to be cheap, available and sustainable for medium to large scale silage production in Ibadan. The purpose of this report is to describe the silage-making activities at the Dairy Farm, University of Ibadan and its influence on livestock production between June 2012 and August 2013.

## SILAGE RESEARCH AT THE UNIVERSITY OF IBADAN

Prior to 2012, a series of silage research was initiated at the Department of Animal Science, University of Ibadan (Babayemi, 2009; Babayemi *et al*., 2010; Ibhaze *et al*., 2011; Olorunnisomo 2011a,b; Olorunnisomo *et al*., 2011) with a view to preserve surplus forage and provide cheap and nutritive feed for ruminants during the dry season. Outcome of these trials provided the template for formulating simple silage-making technologies adapted for smallholder ruminant production systems, and small to medium-scale commercial cattle production systems. Native grasses, forages, crop residues and other local feed resources suitable for silage-making were identified and methods for ensiling them were highlighted. Other studies identified elephant grass, maize stover, cassava peels, corn cobs, brewer's spent grain, legume forages, poultry litter among other ingredients as cheap, available and sustainable resources for silage-making in the tropics (Rahman *et al*., 2003; Chaudhry and Naseer, 2006; Kennedy 2006; Olorunnisomo and Fayomi, 2012; Olorunnisomo, 2013).

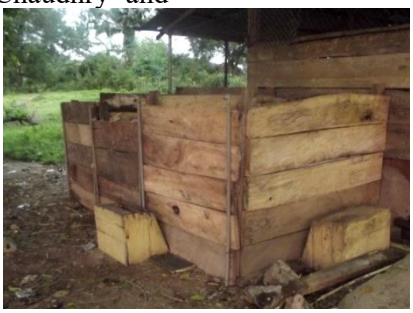
### Silage-making activities at the Dairy Farm, University of Ibadan

A peculiar challenge at the Dairy Farm which made regular silage-making imperative was the reduced grazing area due to the development of physical structures on land that was erstwhile designated for grazing. This greatly reduced the carrying capacity of the land and posed a serious restriction on stocking density and productivity of livestock.

### Type of silo

In deciding the most appropriate method for ensiling available forage, several silo types were assessed which included, plastic drum silos, old water storage tanks, wooden bunk silos and concrete bunk silos. Each of these silos made good silage, however, the plastic drum (120 – 160 L capacity) and the concrete bunk silo (2.2 x 3.6 x 1.4 $m^3$) were found to be more effective and stable for longer periods (unpublished observation). Hence, in smallholder operations where small quantities of silage are required daily to feed livestock, the plastic drum silo is recommended to reduce aerobic spoilage during feed-out. However where a large quantity of silage is required for feeding cattle on a daily basis, the concrete bunk silo is more appropriate. Although the concrete silo was expensive to build, it was more stable, durable, flexible for manual or motorized compaction and amenable to medium or large scale operations.

Plastic drum silo



Wooden silo

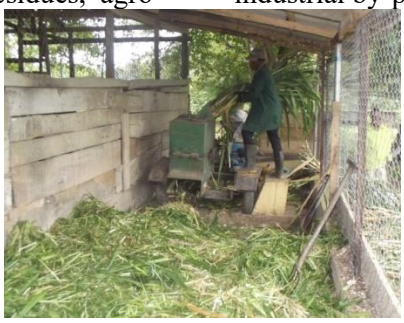
Concrete silos

### Silage materials

Again, given the plethora of resources available for making silage, a number of organic and inorganic materials were tested for their suitability in making silage on commercial scale. These materials included grasses, legume forages

and pods, moringa forage, crop residues, agro-industrial by-products, poultry litter, urea, etc.

Elephant grass plot



Chopped grass

Chopped cassava peel

**Grass silage -** Guinea grass (*Panicum maximum*) and elephant grass (*Pennisetum purpureum*) are the most prominent forage species in Ibadan. Guinea grass is an invasive but palatable species found on roadsides and cleared fields, hence it provides most of the grazing for ruminant animals in the southwest of Nigeria. Elephant grass on the other hand is less palatable but high yielding. It is found mostly on the banks of streams and waterlogged areas. It is usually rejected by grazing animals during the wet season but consumed during the dry season when other grasses are scarce. These attributes made it the prime target for stall-fed animals and silage-making. Of the two grasses, elephant grass appears to be better suited to silage-making because it is high yielding, abundant during the wet season and compacts well when chopped (Babayemi, 2009; Olorunnisomo, 2011a, b). Based on these observations, elephant grass was established on a plot at the Dairy Farm, University of Ibadan for the sole purpose of providing forage for silage-making. Molasses and cereal grains are the traditional sources of readily fermentable carbohydrates used for improving the ensiling quality of tropical grasses (Yakota *et al*., 1992; Bilal, 2009). Since these materials are expensive in Nigeria, cassava peel was adopted as a cheap source of readily fermentable carbohydrate for elephant grass silage at the Dairy Farm. Maize stover which also belongs to the grass family was sometimes used to augment or replace elephant grass when making silage on the farm.

**Legume and Moringa leaf silages** - The low protein content of grass silage seriously limits its nutritive value for ruminant animals. The need to provide high protein basal diet for dairy cattle (indigenous and exotic) stimulated research into legume and moringa leaf silage for cattle at the University of Ibadan Dairy Farm (Olorunnisomo and Fayomi, 2012; Olorunnisomo, 2013; Olorunnisomo, 2014). Result from these studies (Table 1) reveal that legume or moringa foliage ensiled with cassava peel provided high protein basal diets that enhanced milk production in zebu and Jersey cattle.

**Table 1. Crude protein content of legume and moringa-cassava peel silage and milk yield of zebu cows fed the silage mixtures**

| | Silage mixture (50:50) | | | |
|---|---|---|---|---|
| Parameter | Leucaena-cassava peel | Gliricidia-cassava peel | Enterolobium-cassava peel | Moringa-cassava peel |
| Crude protein content of silage (%) | 17.1 | 16.6 | 14.6 | 14.3 |
| Milk yield of zebu cows (kg/d) | 5.19 | 4.70 | 2.84 | 5.21 |

Source: Olorunnisomo (2013; 2014)

**Urea and poultry litter** - Further to the search for high protein silages, two studies were conducted to assess the use of urea and poultry litter as cheap sources of non-protein nitrogen in cassava peel-based silage (unpublished work). Preliminary results revealed that urea and poultry litter increased the nitrogen content of cassava peel silage and enhanced the performance of cattle fed these silages. Ruminant animals, including cattle, are known to utilize non-protein nitrogen for synthesizing microbial protein which in turn is utilized by the animal for body processes and production purposes (Preston and Leng, 2009). However in using urea, care must be taken to avoid overdosing which may lead to fatal bloat in cattle as was experienced during one of our studies. Addition of 1 - 2% level of urea to fresh cassava peel is considered safe for cassava peel silage.

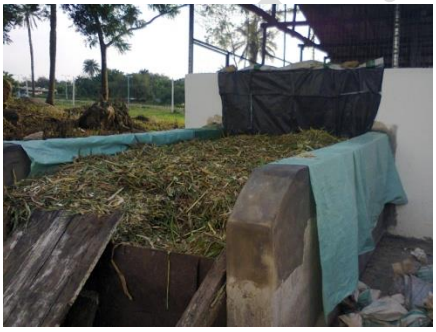
**Composite silages** - Results of preliminary studies by the author and experience from routine silage-making showed that zebu and dairy cattle (Jersey) benefit tremendously when composite silage consisting of several ingredients was offered. Hence, depending on availability of components, three types of composite silages were routinely prepared for cattle at the University of Ibadan Dairy Farm:

- Elephant grass with cassava peel and brewer's spent grain
- Elephant grass with cassava peel and poultry litter
- Legume/moringa foliage with cassava peel

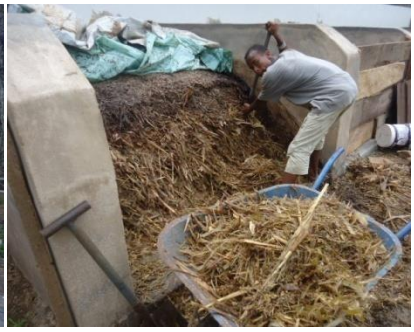
These silage mixtures ensured that protein content of the basal diet was at least 12 % and a palatable diet (high voluntary intake) was available to the animals on a daily basis.

**The silage-making process**

Silage-making operations at the Dairy Farm, University of Ibadan is at present, almost completely manual. Forage (grass, legume or moringa) is harvested from fodder plots within the University using machetes and carted to the processing shed where it is chopped using a locally fabricated forage chopper. Cassava peel is usually sourced from *gari*- processing units around Ibadan which is chopped using the forage chopper. Chopping increases the surface area for fermentative bacteria to act on ingredients and enhances compaction of the ensiled mass (Adegbola and Asaolu, 1986; Yildiz *et al*., 2010). Caked poultry litter is also run through the forage chopper to reduce the particle size. After chopping, silage components are mixed with shovels, loaded into the silo and compacted manually by 2 to 4 workers. The silo is then sealed using thick polythene sheets and weighed down with old tires or sand bags. The silo is left undisturbed for at least 21 days before feeding out. With proper sealing, silage could remain unspoilt for up to 6 months.


Chopped forage in silo


Manual compaction


Feedout

**IMPACT ON CATTLE PRODUCTION**

The intake and growth rate of zebu heifers at the University of Ibadan prior to and after introduction of silage is presented in Table 2 while the intake and milk yield of Jersey cows grazed and fed composite silage at Ibadan is presented in Table 3.

**Intake of cattle**

Prior to use of silage on the dairy farm, estimated dry matter intake (DMI) of zebu heifers was 2.7 kg/day representing about 2% of their bodyweight (BW). Intake of animals at pasture was estimated using a quadrate. The quadrate measuring 1 x 1m was thrown inside the paddock in a random manner before cows were grazed and herbage within the quadrate was cut to 5cm height. After grazing, the quadrate was thrown again and herbage measured. The difference between herbage on offer before grazing and after grazing (corrected to the size of the field and animal number) was assumed to be the daily pasture intake per animal. Silage intake was measured by deducting remnants from the quantity served. When silage was introduced, DMI of zebu heifers increased to 5.6 kg/day or 3.8% BW. For Jersey cattle fed silage, estimated DMI was 12 kg/day or 3.6% BW. The DMI of zebu and Jersey cattle fed silage at Ibadan was relatively high when compared to 1.2 – 3.3% BW reported for cattle elsewhere in the tropics (Karue *et al*., 1973; Kimambo *et al*., 1996).

**Table 2. Dry matter intake and growth rate of Sokoto Gudali heifers grazed and supplemented with composite silage at Ibadan**

| Parameter | Before silage | With silage |
|---|---|---|
| | Dry matter Intake* | |
| Dry matter intake (kg/d) | 2.7 | 5.6 |
| Dry matter intake (%BW) | 2.0 | 3.8 |
| % increase in DMI | - | 124 |
| | Growth rate | |
| Growth rate (kg/d) | 0.4 | 0.8 |
| % increase in growth rate | - | 100 |

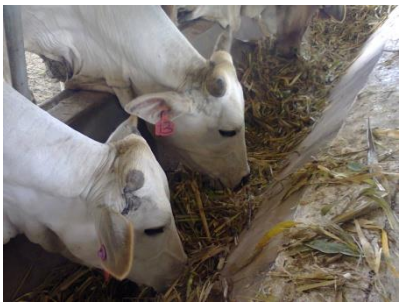
*Intake of animals in pasture was estimated using a quadrate while silage intake was determined by deducting remnants from silage offered.

**Growth rate of heifers**

Between April 2012 and August 2013, weight of selected zebu heifers was estimated on a monthly basis and used for estimating the growth rate (average daily gain) of the entire zebu herd. Growth rate of zebu heifers within this period varied from 0.25 – 0.96 kg/day. Mean growth rate of heifers before introduction of silage was 0.4 kg/d (Table 2). After introduction of silage, growth rate of zebu heifers increased to a mean value of 0.8 kg/d. This represents a 100% increase in growth rate and shows clearly that these animals were underfed prior to introduction of silage.

Jersey cows eating silage

Composite silage



Zebu heifers eating grass silage

**Milk yield**

From September 2012 when the Jersey cows arrived at Ibadan to August 2013, composite silage consisting of elephant grass, cassava peel and brewer's spent grain formed a regular part of their daily ration. Average daily milk yield varied from

7.3 – 10.7 kg while lactation yield varied from 674 – 2391 kg (Olorunnisomo *et al*., 2013). The lower limit of this range was obtained from cows that had stillbirths. When the milk yield of cows with normal births was considered, average daily milk yield of Jersey cows in Ibadan was 10.2 kg while lactation yield was 2353 kg (Table 3). These figures compare favourably with milk yield of Jersey cows in Pakistan (Nawaz *et al*., 1993) and was higher than milk yield from Jersey cows raised in Ethiopia (Hunde *et al*., 2015). The high milk yield of these cows may be attributed to their genetic make-up, good management and good nutrition (based mainly on composite silage).

**Table 3. Dry matter intake and milk yield of Jersey cows grazed and supplemented with composite silage in Ibadan and other Jersey cows in the tropics**

| Parameter | Ibadan[1] | Pakistan[2] | Ethiopia[3] |
|---|---|---|---|
| Dry matter intake[4] (% BW) | 3.60 | - | - |
| Daily milk yield (kg/d) | 10.2 | 9.47 | 6.41 |
| Lactation yield (kg) | 2353 | 2889 | 2155 |

[1]Olorunnisomo *et al.* (2013); [2]Nawaz *et al*. (1993); [3]Hunde *et al*. (2015); [4]intake of animals in pasture was estimated using a quadrate while silage intake was determined by deducting remnants from silage offered.

## CONCLUSION

Silage-making is traditionally designed to provide forage to ruminants during the dry season when forage is scarce, however, in recent times it has increasingly been used as a regular part of cattle rations worldwide, especially in intensive beef and dairy operations. At the University of Ibadan where grazing land has dwindled tremendously, regular silage-making has become imperative for feeding the cattle stock. Since silage-making is less dependent on weather conditions than hay, it provides an ample opportunity for increasing the carrying capacity of the limited grazing land available to cattle at the University. Introduction of silage as a regular part of daily rations for cattle significantly increased dry matter intake of these animals. Growth performance of zebu heifers and milk production from Jersey cows also increased when composite silage was introduced. Regular silage-making is recommended for intensive and semi-intensive cattle production in Nigeria, particularly in areas where grazing is limited by small land areas, legislation or communal conflicts.

## CONFLICT OF INTEREST

There is no conflict of interest with regards to the publication of this study

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