Livestock Production

Silage and Fermented TMR

− Preparation Manual −




Instituto de Investigação Agrária de Moçambique (IIAM)
Japan International Research Center for Agricultural Sciences (JIRCAS)

Feed Resource

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○ Introduction

The major constraint on livestock production in the tropics is the shortage of good-quality feed, especially in the dry season. In Mozambique, native grasses and crop by-products are the main sources of roughage for ruminants, including cows, sheep, and goats, and the requirements for livestock feed often exceed the forage accessible during the dry season. When ruminants do not acquire high-quality roughage, milk and meat production decreases, and the incidence of disease may increase.

Some agricultural by-products can be stored fresh as silage to facilitate ruminant feeding during the dry season. The main factor that determines feed quality and affects animal production is how crop by-products are dealt with after harvest. Therefore, it is important to develop effective techniques to optimize the use of alternative agricultural by-product resources for animal feed, to meet the nutrient requirements of animals. Silage and total mixed ration (TMR) prepared with locally available feed resources can help achieve this goal.

This manual is based on the results of the project [Food Security in Africa]. This work was supported by the Japan International Research Center for Agricultural Sciences (JIRCAS), Japan, and Instituto de Investigação Agraria de Moçambique (IIAM), Mozambique.

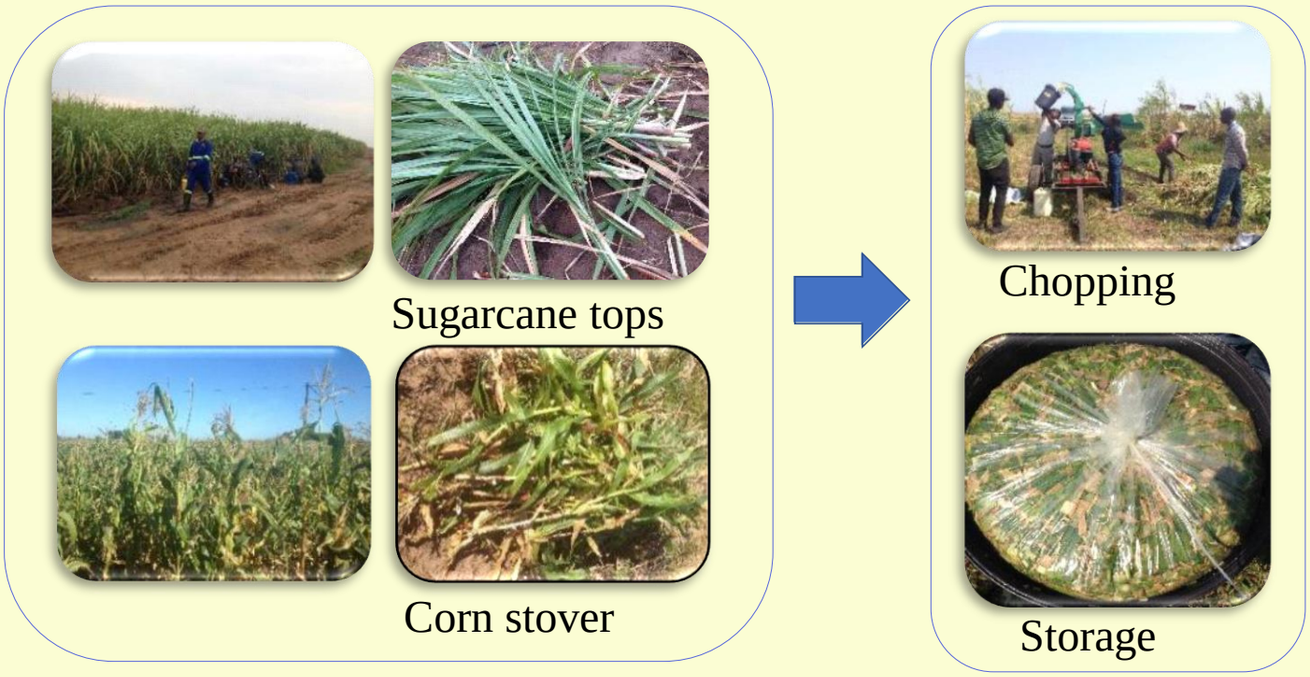
We hope that this manual will serve as a useful reference on silage production for researchers and farmers.

IIAM JIRCAS 国際農研

○ What is silage?

Silage is fermented feed made from fresh forage crops, grasses, and crop by-products that is acidified and preserved through fermentation. It can be fed to ruminants, such as cattle, sheep and goats. The fermentation and storage process is called ensiling, and the storage container is called the silo.

Compared with hay, silage is affected less by the weather, and has lower production losses. The result is inexpensive, labor-saving, and nutritious roughage. In addition, the amount of concentrate can be reduced by providing nutrient-rich silage.



Silage preparation

Various silo types

○What is fermented TMR?

TMR is a feed that mixes roughage, concentrate, minerals, vitamins, etc. to meet the nutritional needs of dairy cattle.

TMR has advantages, such as effective use of agricultural by-products, increased milk production and milk fat ratio, reduced feed costs, labor savings, and decreased digestive system diseases. However, it has some disadvantages, such as the need to raise animals on farms due to the different nutritional requirements of low- and high-yielding dairy cattle.

Fermented TMR is prepared by adjusting the TMR moisture to 50%–60% and fermenting it as silage. The benefits of using fermented TMR are as follows:

① It uses agricultural by-products effectively;
② Feeding animals requires less labor;
③ The feed is more palatable for the animals; and
④ It can be use as commercial feed.

Small farms
can make TMR by hand.

Large farms need to
use a mixer.

○ Steps in silage preparation

Harvest

Forage crops and grasses should be harvested during the growth stage for a high nutrient yield. For example, Napier grass is generally harvested before the flowering stage, and crop stalks should be used immediately after harvest. Delaying harvest reduces the protein content and increases the lignin content, which not only causes nutrient loss, but also affects silage digestibility.

Adjusting moisture

The target forage moisture is 60%–70% for ordinary silos and 50%–60% for fermented TMR. Values outside these ranges result in greater fermentation loss and poor quality. Material with high moisture content at harvest should be left to dry in the field in the sun.

Chopping

Chopping speeds up fermentation and improves quality. However, chopping forage material into pieces that are too short can lead to digestive disorders. The target length is approximately 1 cm.

Packing

If the materials are compressed, the density in the silo will increase, and high-quality silage will be produced. It is desirable to finish compressing the silage quickly.

Sealing

Sealing is very important. After packing, the silo should be sealed quickly and carefully. It can be covered with a waterproof blue trap and compacted with old tires.

Opening the silo

When opening the silo, the fermentation quality must be checked. Make sure to remove any mold and spoilage on the surface.

Additives

If the silage preparation conditions are insufficient, it is necessary to use additives to prepare silage. Selection of the appropriate additives depends on the material conditions and preparation method. A lactic acid bacteria inoculant can be used to improve the fermentation quality of silage.

Precautions

If silage fermentation fails or aerobic spoilage occurs, any moldy silage should be removed completely. When feeding livestock, monitor the animals' health carefully.

○Bunker silos

Silage prepared in a bunker silo requires densification, fast packing, and quick sealing.

Napier grass

Wilting

Chopping

Packing

Tread pressure

Sealing

○ Drum silos

A smallholder can prepare silage in drums.
Silage prepared in drums can be stored for up to 1 year if the seal is good.

Silage prepared in a drum silo.

An opened drum silo and cattle feeding.

○ Plastic bag silos

Smallholders can prepare silage using plastic bags.
Doubled plastic bags can be used for short-term storage for up to 2 months.

Silage prepared in plastic bags.

The silage is well fermented.

Excellent palatability for cattle fed silage.

○ Silage-based feeding model for cattle

Morning Grazing—Afternoon Silage Feeding

Milking dairy cattle corn bran 2 kg
Beef cattle no feed

↓ **07:00–08:00**

Grazing on native grassland

↓ **08:00–14:00**

Feeding Napier grass silage

↓ **14:00–17:00**

	Dairy cattle	Beef cattle
Formula feed	**2 kg**	**0 kg**
Corn bran	**2 kg**	**2 kg**
Silage	**5–10 kg**	**5–10 kg**

Formula feed

Corn bran

Morning grazing

Napier grass silage

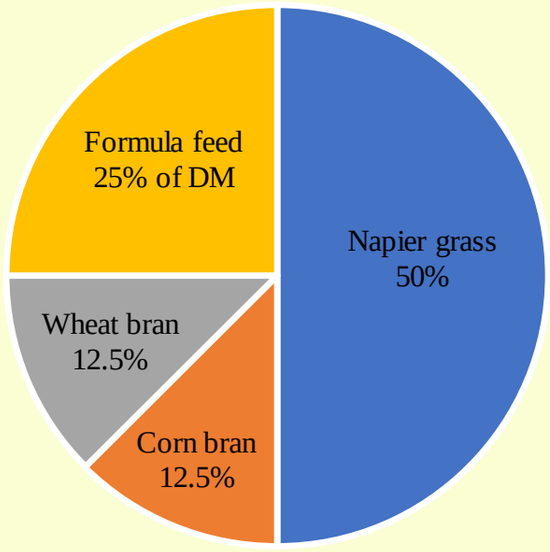
Afternoon silage feeding

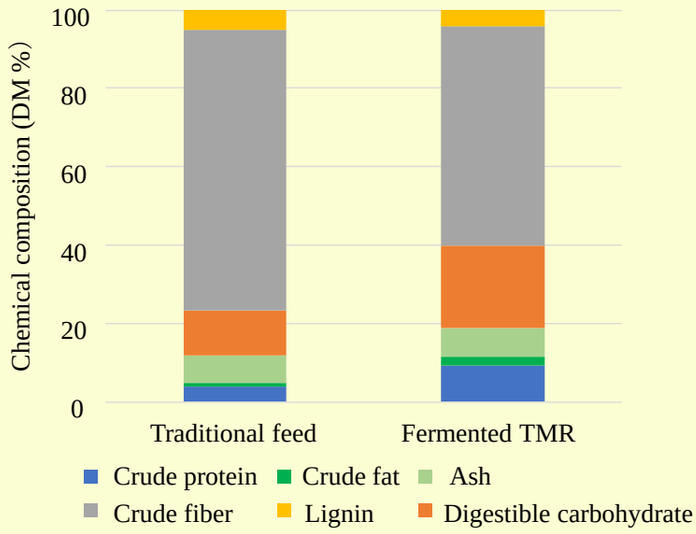
Dairy cattle - high milk production
Beef cattle - high daily gain

↓

Can alleviate feed shortage during the dry season

○ Fermented TMR ingredients and making TMR





Ingredients and chemical composition of traditional feed and TMR

Fermented TMR characteristics
*High nutrient content
*Good fermentation quality
*Excellent palatability
FM, fresh matter.

Fermentation quality of TMR after 10 days of ensiling

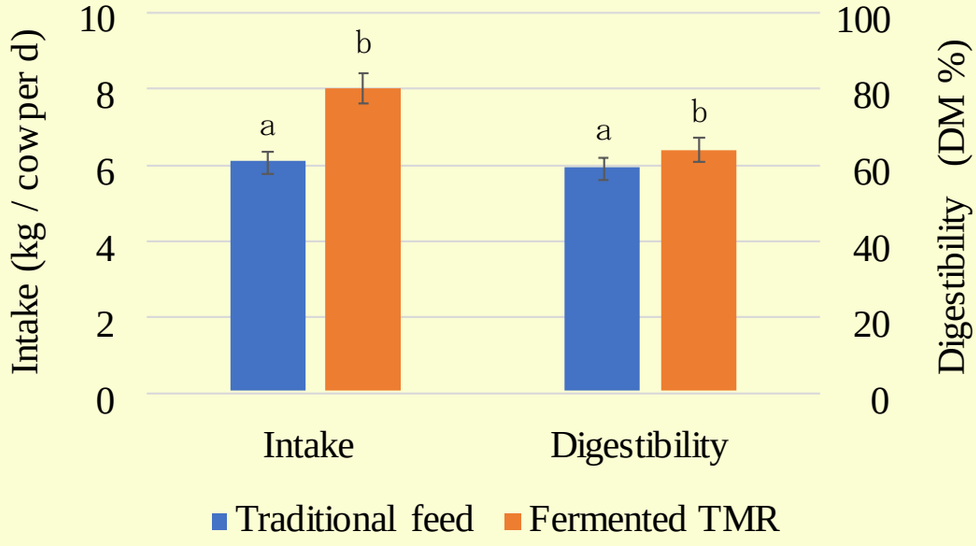
Moisture (%)	64.16
pH	3.80
Lactic acid (% of FM)	1.75
Acetic acid (% of FM)	0.42
Propionic acid (% of FM)	0.00
Butyric acid (% of FM)	0.00
Ammonia nitrogen (g/kg of FM)	0.56

Fermented TMR can be prepared with locally available feed resources.

○Milk production of dairy cattle fed TMR

Food intake and digestibility were improved in dairy cattle fed TMR

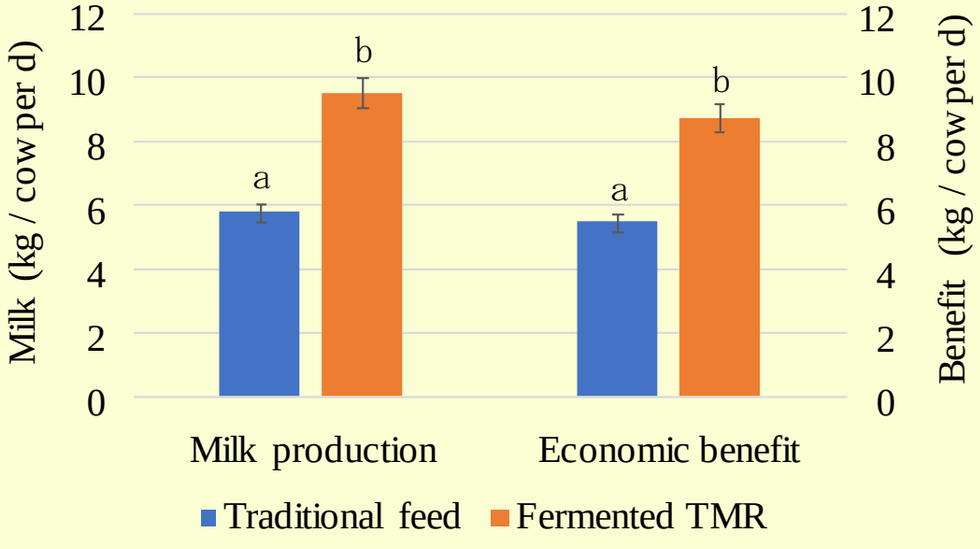
Intake and digestibility in Jersey dairy cattle



DM, dry matter; TMR, total mixed ration.

Dairy cattle fed TMR had improved milk production and economic benefits

Milk production and economic benefits of Jersey dairy cattle



○ Woody plants as feed resources

Woody plants are rich in nutrients and can be prepared as silage that is suitable for ruminant feed.

Comparative analysis of the feed compositions of woody plants and other forages.

Component (% DM)	Woody plants	Napier grass	Corn stover	Sugarcane tops	Alfalfa
Organic matter	89.79	85.72	84.22	94.65	88.40
Crude protein	**26.94**	5.56	6.52	6.77	23.70
Crude fat	**4.10**	1.35	1.57	1.80	2.83
Neutral detergent fiber	39.17	66.74	65.05	76.10	43.78
Acid detergent fiber	19.84	41.53	35.08	42.46	33.55
Acid detergent lignin	6.23	5.68	3.49	5.11	5.96
Water-soluble carbohydrates	8.40	3.10	10.38	7.85	2.04

Data are the average values of several samples; DM, dry matter.

Woody plant silage prepared with crop by-products improves fermentation quality.

Making woody plant silage

Harvesting woody plants

Woody plant silage mixed with corn stover

○ List of main local feed resources

Chemical composition of main feed resources

	DM	OM	CP	EE	NDF	ADF	ADL	TDN
	(%)	…….. DM % ……..						
Grass								
Native grass	19.22	93.38	5.27	1.41	80.21	46.79	5.34	50.59
Native grass hay	90.00	93.64	3.04	0.77	79.37	46.36	6.91	45.52
Napier grass	19.22	93.38	5.27	1.41	80.21	46.79	5.34	40.80
Guinea grass	27.75	90.84	9.87	1.34	71.64	38.57	2.25	53.50
Crop by-product								
Corn stover	42.65	84.22	6.52	1.50	65.05	35.08	3.49	46.52
Corn stover hay	17.25	92.75	4.26	1.05	69.48	38.54	4.32	40.55
Sorghum stover	44.44	94.22	2.49	0.99	78.14	49.31	9.27	49.66
Sugarcane tops	25.68	94.65	6.77	1.80	76.10	42.65	4.13	51.25
Rice straw hay	86.43	94.36	3.09	1.02	84.67	60.23	9.87	40.56
Cow pea hay	87.24	91.86	9.74	0.73	52.67	36.45	4.74	60.79
Cassava foliage	20.15	90.82	24.87	7.05	38.50	29.52	4.22	67.14
Sweet potato foliage	17.25	87.35	15.68	3.45	35.87	27.28	6.41	55.75
Peanut foliage	44.61	69.81	13.98	2.08	27.67	22.81	3.15	47.97
Corn bran	90.00	93.71	18.85	6.21	25.99	8.41	1.48	80.32
Wheat bran	92.30	94.12	18.45	3.15	42.41	13.34	4.14	68.43
Woody plants								
Gliricidia	24.92	90.30	24.91	4.02	52.10	34.52	11.09	57.07
Leucaena	31.18	92.62	25.31	3.41	60.62	37.49	13.40	53.13
Moringa	28.56	90.12	26.98	4.25	31.22	24.90	3.75	66.99

DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; NDF, neutral detergent fiber; ADF, acid detergent fiber; ADL, acid detergent lignin; TDN, total digestible nutrients.

○ Contact information

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