Microbial Population and Fermentation Characteristics of Total Mixed Ration Prepared with Local Feed Resources in Mozambique

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Presenter Information

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Key words: Fermentation quality; Local feed resource; Total mixed ration

Abstract

To effectively utilize locally available feed resources for dairy cattle in Africa, fermented total mixed ration (TMR) was prepared using Napier grass, corn meal, wheat bran, formula feed, and mineral and vitamin mix. The fermentation quality of TMR were analyzed after 14 days of ensiling. Before ensiling, aerobic bacteria were the dominant bacteria, after ensiling, lactic acid bacteria counts increased rapidly and became the dominant bacteria in TMR. After 14 days of ensiling, aerobic bacteria, coliform bacteria, yeasts, and molds showed lower ($P < 0.05$) counts in TMR than those before ensiling. The dry matter (DM) of TMR was adjusted to 45.50%, their crude protein and neutral detergent fiber contents were approximately 11.48, and 55.25% of DM, respectively. After 14 days of ensiling, TMR fermented to a good quality, the pH was reduced to 3.90; the lactic acid and ammonia nitrogen contents were 1.01 and 0.31% of FM, respectively; the propionic acid and butyric acid were too low to detect. The results confirm that fermented TMR prepared with local feed resources can attain a good quality in Africa.

Introduction

The principal constraint on livestock production in African dairy farms is feed shortage, in terms of both quantity and quality. Napier grass (*Pennisetum purpureum* Schum.) is a particularly important forage used in the feed of dairy cattle on large- and small-scale farms in Africa (Kebede et al. 2018) due to its perennial vegetative cycle, drought tolerance, rapid regrowth, and high dry matter (DM) yield. Traditional livestock feeding methods in countries such as Mozambique consist of simple grazing on native grassland, with crop by-products used as supplementary feed. However, this feeding pattern cannot meet the nutritional requirements of dairy cattle, and low-quality roughage decreases animal production and quality (Wiedmeier et al. 2002). The fermented total mixed ration (TMR) ensures year-round availability of balance nutritious and palatable feed for ruminant, and now it is used as a good feed conservation method worldwide for animals (Cao et al. 2010). TMR can be prepared using roughage, concentrates and mineral-vitamin premix through the combination of crop and food by-product, feed additives and trace element into a single-mix feed to satisfy animal nutrient requirements. However, limited information is available on the use of TMR composed of fresh forage, crop

by-products, and concentrates in Africa. The purpose of this study was to examine the microbial populations and ensiling characteristics of TMR prepared with local available feed resources.

Materials and methods

The TMR was conducted at an experimental farm of the Agricultural Research Institute of Mozambique (IIAM, Matola, Mozambique) in May 2018. The experimental treatments were local general diet (LGD, control) and TMR. Native grass was obtained from a representative natural grassland in Matola, Mozambique. The LGD is comprised of 40% native grass, 40% Napier grass (second-cutting at the early flowering stage), 18% corn meal, and 2% mineral and vitamin mix on a DM basis. The TMR consisted of 50% Napier grass, 15% corn meal, 15% wheat bran, 18% formula feed, and 2% mineral and vitamin mix on a DM basis. After harvest, the fresh forages in the LGD and TMR treatments were chopped into 1–2 cm long pieces before ensiling using a chopper (130 DX, ARS Co., Ltd, Osaka, Japan). After mixing the ingredients, the fresh samples of forage, concentrate, LGD, and TMR were collected on the day of cutting in triplicate to determine chemical composition and microbial population. 40 kg of remaining TMR materials was randomly divided into 5 equal parts, and then approximately 8 kg of material was packed separately into one 20 L polyethylene drum (Ka-Kosher Co., Ltd, Sinaloa, Mexico) silo for each replicate. Three silos were prepared for each treatment. All silos were kept at ambient temperature (25–38°C). After 14 days of fermentation, three of five silos were randomly opened to analyze the microbial population, chemical composition, and fermentation quality of fermented TMR. The microbial colonies were counted as viable numbers of microorganisms in log 10 colony-forming unit (cfu)/g on a fresh matter (FM) basis.

Results and Discussion

The DM values of Napier and native grass were 20.40 and 24.44%, and their crude protein (CP) contents were 7.35 and 10.46% on a DM basis, respectively (Fig. 1). DM, CP, and ether extract (EE) content were higher ($P < 0.05$) in the TMR and fermented TMR treatments than in the LGD treatment, whereas neutral detergent fiber (NDF) and acid detergent fiber (ADF) contents were lower ($P < 0.05$). The chemical composition did not differ markedly between TMR and fermented TMR, indicating that TMR fermentation preserves well for feed nutrients. The low lactic acid bacteria (LAB) counts and high aerobic bacteria counts were observed in fresh grasses, LGD, and TMR before ensiling (Fig. 2). However, fermented TMR displayed satisfactory fermentation quality. LAB remained the dominant population in fermented TMR compared to other microorganisms related to silage fermentation. After 14 days of ensiling, mold counts were below detectable levels in fermented TMR. The fermented TMR silage was of good quality, with high lactic acid content (1.01% of FM), and a relatively low pH (3.90) and ammonia nitrogen (NH_3-N) values (0.31 % of FM), and the propionic acid and butyric acid were not detected (Fig. 3). These results suggest that epiphytic LAB grew well in the TMR fermentation environment and produced sufficient lactic acid to inhibit the growth of other

harmful microorganisms such as bacteria and reduce silage pH, resulting in high-quality of fermented TMR.

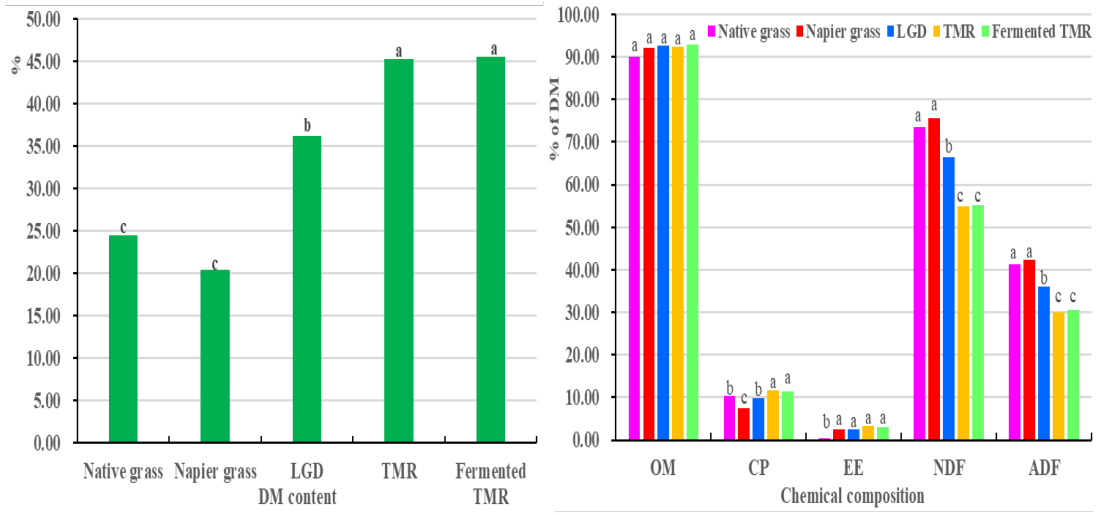

Fig. 1 Chemical composition of Native grass, Napier grass, local general diet (LGD), total mixed ration (TMR) and fermented TMR.

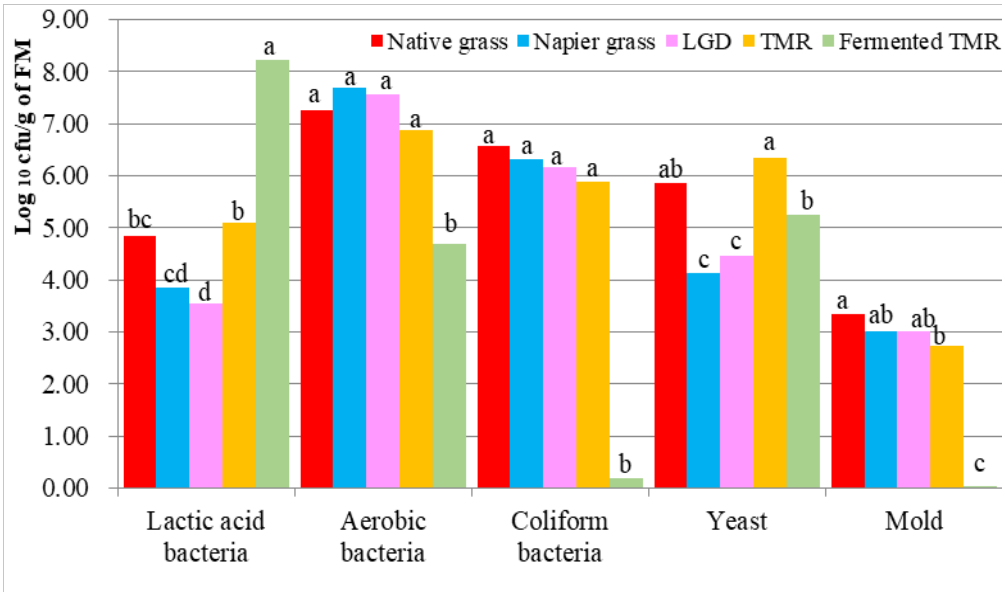

Fig. 2 Microbial population of native grass, Napier grass, local general diet (LGD), total mixed ration (TMR) and fermented TMR.

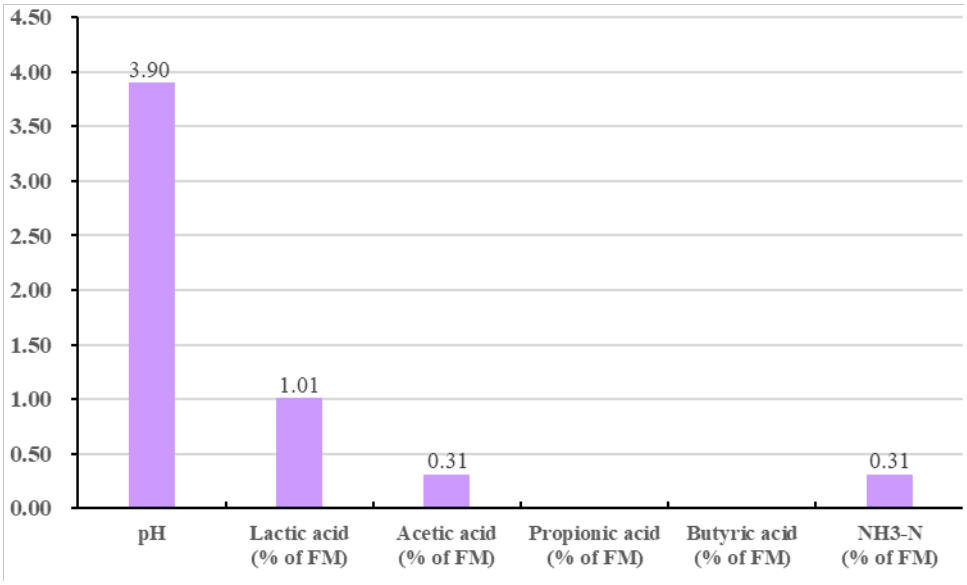

Fig. 3 Fermentation quality of fermented total mixed ration (TMR) silages after 14 days of fermentation.

Conclusions

TMR prepared with local available resources was well preserved and abundant in nutrients for livestock, therefore, that fermented TMR is well suited for feed preservation and may be used as an alternative feed source for dairy cattle in Africa.

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