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Napier Silage Formulation as Fodder Conservation for Goats During Monsoon Season

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Abstract— Silage is a type of feedstock that had undergone several steps of forage fermentations that served as alternative feedstock for ruminants. Hence, the project aimed to formulate Napier grass silage formulation that suitable to maintain weight and health of goats during the monsoon season. Napier silage was formulated without adding any imported crops. Goats' body weight gain was measured as indicators of the feed formulation efficiency and goats' performance. A total of twenty adult goats with body weight approximately 30-40 kg were fed with Napier silage formulation for 3 months (October to December). Body weight and daily milk production was measured on Day 7, 14, 21 and 28 of every month. The goats fed with Napier silage were able to maintain healthy weight and health during the monsoon season. The findings found that the Napier silage formulation is recommended as fodder conservation for goats during monsoon season.

Keywords— Napier silage, fodder conservation, goats, body weight, monsoon season.

1. Introduction

Recently, the global goat population has expanded in which most of them have been contributed by the Asian countries (FAOSTAT, 2018). In Malaysia, goat farming plays a vital role in the national agricultural sector (Department of Veterinary Services, 2018). In Malaysia the goat farming generates high economic returns to the farmers. However, factor in the success of ruminant industry is closely related to the growth of agricultural industry which is the ability to supply crops for livestock feed [4]. Maintaining of nutritious livestock feed can be done by emphasize the need to maintain a good source of forage and crops either imported or local. Nutrition is one of important factor in goat farming system to maintain the goat productivity. According to Nampanzira et al., (2015), goat productivity can be achieved by improving feeding and nutrition as well as maximizing the used of the available feed resources [5]. The ruminant industry in Malaysia relies on local food ingredients and is partly mixed with some ingredients or supplements from imported ingredients [6]. The main local ingredients used in ruminant food including rice bran, oil palm frond, sago, and broken rice while the imported materials were used such as soybean, corn gluten and other additives to enhance the feed composition [6].

Although the advent of new animal feed from local crops and imported materials, the issue of proper livestock feed shortage remains a problem for the ruminant industry in Malaysia to increase livestock productivity [7]. This leads to the necessity of importing feeds and forages for the livestock industry. Massive importation of feed has been practiced in our country to prosper the ruminant industry growth over the decades. Imported feed are more commonly used by local farmers as it is believed to have higher quality and capability in promoting goats' productivity [8]. Nevertheless, imported crops are expensive and continuous practice is

expected to be non-cost-effective. Thus, a major effort to reduce the burden of feed imports is to increase the use of local feed resources [9].

Despite various feed resources for goats, many goat producers in Malaysia have faced multiple challenges including providing proper feedstock during monsoon or wet season. This problem can be solved through the preservation of ruminant feedstuffs into hay (dried fodder) or silage (wet fodder) depending on the climate condition and the food resources availability [10]. Silage can be prepared based on local crops and more importantly, it can help local goat farmers to maintain the goat feedstock during wet season [11]. In the East Coast of Malaysia including Pahang, the state is prone to floods and heavy rain from October to January. Hence, proper goat's feedstock formulation can help goat farmers to not allowing their goats to graze on pasture area during monsoon season because of safety and also potential for parasitic infections. Hence, silage feedstock is one of alternative that can serve as fodder conservation for goats during monsoon season in the East Coast region, Malaysia.

However, most silage formulation in Malaysia incorporated with imported crops such as corn, maize, soy waste and forage sorghum varieties which are not sustainable to be applied as fodder conservation in future. For instance, it has been documented that by-product such as rice straw and soy-based crops can also be used as alternative feed due to it is abundant, however those crops do not provide sufficient nutrients for goats [12]. Hence, the silage incorporated with imported crops is not the best solution to provide good nutrient to goats. More importantly, this approach can contribute for preserving food security especially in ruminant sector in Malaysia. Goat feeding can represent high amount of production cost. As an alternative to find cheaper but yet can help farmer to cut the budget for imported feed prices and able to maintain body weight and health condition especially during monsoon season, silage production based on local crops is essential to be introduced. Therefore, this project aimed to formulate silage formulation using Napier grass as a local crop that suitable to maintain weight and health of goats during the monsoon season.

2. Materials and methods

This project was carried out at a commercial farm in Kuantan, Pahang for a period of 180 days from September 2018 until December 2018. In this project, 20 goats aged one-year-old and weighing in the range of 30-40 kg were selected. The goats in the farm were reared mainly for meat production purpose.

Silage formulation using only Napier grass as a main local crop was formulated and given to the goats. Formulated silage feeding consists of Pennisetum sp. (Napier grass) as the main ingredient and other additional ingredients such as molasses, effective microbes, vitamins and minerals. Molasses act as additive and effective microbes to enhance goat's digestive system. Vitamins and minerals are vital for regulation of metabolism, skin, immune function and growth. In this research, a patent for the Napier silage formulation had been filed under PI 2019000412, "A feed composition comprising Napier silage". The invention discloses a feedstock composition for ruminants comprising 70 to 90 % by weight of Napier grass, 6 to 9 % by weight of molasses, 8 to 10 % by weight of microbial extract, 0.1 to 0.5 % by weight of vitamins, and 2 to 3 % by weight of minerals for maintaining healthy weight in ruminants. The nutrient composition of the feed ingredients was assessed before given to the goats. Proximate analysis was done to determine the Napier silage formulations. The proximate analysis was done by using software proximate analysis by Department Veterinary Services Malaysia. Proximate analysis is the most standard analysis procedures carried out on feed samples where it comprises of a series of analyses to evaluate the nutrient characteristic of feeds which includes the following: dry matter, coarse protein, energy content and crude fiber which shows in Table 1.

Table 1: The nutrient composition for feed ingredients used.

No	Feed	DM (%)	CF (%)	CP (%)	E (M/kg)
1	Napier grass	37.0	2.7	14.0	4.1

DM- Dry matter, CF- crude fiber, CP- crude protein, E- energy

Approximately 4 kg of Napier grass were harvested freshly. If Napier grass were harvested in wet condition, Napier grass must be dried before it can be processed as silage. Mechanical processing of whole Napier grass can be achieved by forage harvester, followed by forage cutter (cut into about length about 3 cm) and forage mixer. Ingredients such as molasses, effective microbes, vitamins and minerals were added in the forage mixer together with the Napier grass. The mixture or Napier silage were kept in vacuum condition plastic bag and stored for 21 days in a dark room at an ambient temperature. The silage can be used after day 21. The Napier can be stored up to a year.

The goats were fed according to the assigned feed formulations and kept in their individual pens for monitoring purpose throughout the experimental period of 180 days. The feeding trial for Napier silage formulation lasted for 90 days (day 0 to day 90).

Body weight was measured before implementation (day 0) of the feeding regime and was done again at day 7, 14, 21 and day 28 in every month for six months. The readings were recorded and tabulated for comparison according to a method by [13]. The body weight gain was calculated by using this formula, "Body weight gain (kg) = Final body weight (kg) – Initial body weight (kg)."

3. Results and Discussion

Table 2 shows the body weight of 20 goats when given Napier silage formulation as feed for three months respectively; October (Month 1), November (Month 2) and December (Month 3) which monsoon seasons occurred. After 90 days of feeding trial for Napier silage formulation, the health and growth of 20 goats are observed on their weight gain. The Napier silage maintained healthy body weight (no changes) in goat number 2, 3, 5, 6 and 8; and slightly increment up to 0.4 kg of body weight in goat number 12 during the study. There was a difference of body weight from 20 goats after fed with Napier silage. This indicated that the Napier silage acts as good fodder conservation for maintaining health, diet and growth for goats during monsoon or wet season. These results also support recent finding with feeding Napier grass or combination of Napier grass with oil palm frond increases the rate of growth in the goats and it were recorded corn silage to Napier grass had resulted in goats' growth performances and increases feed intake [14,15]. Other researches also recorded the effect of Napier grass feed on the growth performances of cattle [16, 17].

The quality of Napier grass silage as a fodder is influenced by the use of additive to increase nutrient intake by ruminants [18]. In this study, molasses is used as an additive to preserve the grass and enhance the production of lactic acid bacteria to aid the fermentation process in line with the study by [19]. Rasool et al., (1999) also supports the use of molasses to improve the energy content of silage, ensuring a low pH and inhibits proteolysis [20]. Production of silage generates high concentration of lactic acid which forms glucose which will generate energy for animals to do daily activities [21]. Napier grass also has been proven as good feedstock due to high dry matter and easy to digest by ruminant [14]. Higher intake of energy and protein in daily feed can enhance muscle distribution, physical and biochemical properties of the goat's body, muscle physical and body weight gain of the goats [22]. Protein is essential for growth development and the deficiency in protein intake will decrease the digestion of carbohydrate in the livestock. Other than that, high protein contents in goat feedstock can enhance the production of milk [23]. Protein deficiencies can lead to

poor growth rates and this problem can be prevented by enough supplementation of feed with high protein level likes soy waste [14]. Choosing the suitable forage for livestock is significantly importance for farmers to maintain the growth performance of the animals as well as cost saving.

The study by Aswanimiyuni et al., (2018) has reported Jamnapari goats showed lower feed conversion ratio (FCR) when given Napier grass where the bodies of animals are very efficient for converting feed into desired output [24]. In such cases, the use of Napier grass silage in this study is a good recommendation for farmers to produce goats with more milk or meat from optimum feed consumption, thus saving farm operating costs. This study was conducted during monsoon season and the goats were not allowed to graze to pasture area. It has been documented that it is very difficult to maintain the goats' health and growth especially during wet seasons [25]. The humidity during the wet season favors parasites larval development in vegetation or crops in which can affect goats' health [26]. In such cases, the fodder conservation by using Napier grass can be a control measure against parasitic attacks by preventing goats from grazing openly in the field exposed to the infective eggs on the grass. In addition, this Napier grass silage can be useful to farmers in several states during the monsoon season because the fodder silage can be kept long and not affected by weather factors. The preserved Napier grass into silage form facilitates goat husbandry system because farmers do not have to seek raw food if the food sources are limited due to dry or rainy seasons. Khan et al., (2011) mentioned fodder conservation by silage techniques is a solution to maintain feed availability during feed deficiency periods [27]. This forage conservation can reduce the chances of goat feed to get damage during wet season especially growth of mold. Molds produce aflatoxins that toxic to livestock and interrupt the absorption and breakdown of feed's nutrients. Animals that been exposed to moldy feeds might show reduced feed consumption, diarrhea, reduced gains and reduced milk production [28]. Damaged feed can affect the goat's health as well as increasing operational cost in order to buy the new feed for the livestock. In such case, Napier silage is a recommended feedstock that can be stored longer in good condition. Other than that, silage production was also practiced by farmers in other countries that experienced arid season which forage supply declines during drought [29].

The study discovered the feedstock conservation as silage can be beneficial for maintaining performance of ruminants especially in goats. This study will help the researchers to uncover the critical areas of fodder conservation by using local crops in order to provide sustainable food resources during monsoon season in Malaysia that many researches were not able to explore. Thus, new theory on Napier silage formulation maybe can be practiced by the farmers to enhance goat productivity and reduce cost on feedstock. The authors had filed patent for the Napier silage formulation, PI 2019000412, "A feed composition comprising Napier silage".

4. Conclusions

In conclusion, the Napier silage formulation is recommended as fodder conservation for goats during monsoon season. The suitability of Napier silage formulation without adding any imported crops as fodder conservation also suggests the ability to substitute imported silage formulation for goats. Napier grass used in this study has proven to maintain health and produce optimum weight for healthy goats. The feeds with nutrient content include 37.0% dry matter, 2.7% crude fibre, 14.0% crude protein and 4.1M/kg energy are the best nutrient composition of good quality silage for goat's performance. The findings are supported by study that reported goats fed with Napier grass showed a better growth performance where the optimum feed nutritional value was consisting of 16.6% dry matter, 12.8% crude protein, 46.9% crude fibre and 7.40 MJ/kg DM net energy [24]. If compared to recent study, Napier silage formulation showed higher content of dry matter, lower fibre for easy digestion and adequate protein to produce good metabolic energy to goats. The

used of molasses as an additive to Napier silage is beneficial to improve the quality of silage by increasing the amount of sugar to be converted into lactic acid and subsequently assist the fermentation process. Farmers are encouraged to use Napier grass as fodder because this grass is easy to find, cheap and grows throughout the year especially in Malaysia. It is hoped that this Napier grass silage formulation can be a benchmark for other researchers to produce local forages to produce high-quality feed for animals.

Other than that, Napier grass silage in this study did not use imported raw materials to make the diet formulation more nutritious to goat. The great demand for Napier grass in order to produce Napier silage with high-quality for goat feed. In addition, the use of Napier grass silage can reduce farmers' spending on goat feed as Napier silage can be kept for a year without affecting the nutrition values and is not easily damaged if stored properly. Technological innovation in making this Napier grass silage with using machineries to cut and process the Napier grass can produce many ensiled forages within short duration compared to manual practice. In addition, the silage kept in vacuum condition plastic bag can enhance the good quality of silage production which can prevent the damage feedstock.

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6. Conflict of interest

The authors declare have no conflict of interest.

7. Compliance with ethics requirement

This research had obtained ethical approval from Institutional Animal Care and Use Committee (IACUC), International Islamic University Malaysia (IIUM).

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Table 2: Body weight of 20 goats when given Napier silage formulation as feed for three months.

	Goat no	MONTH 1 (SEPTEMBER)					MONTH 2 (NOVEMBER)				MONTH 3 (DECEMBER)				Difference body weight(kg)
		Day 0	Day 7	Day 14	Day 21	Day 28	Day 7	Day 14	Day 21	Day 28	Day 7	Day 14	Day 21	Day 28	
Napier silage	1	39	39	39	39.2	39.1	39.1	39	39	39.1	39.1	39	39.1	39.2	0.2
	2	30	30	30	30	30.05	30	30	30	30	30.01	30	30	30	0
	3	40.2	40.2	40.1	40	40.2	40.3	40.25	40.25	40.1	40.1	40.2	40.2	40.2	0
	4	30	30	30.2	30.2	30.5	30.2	30.3	30.4	30.3	30.3	30.3	30.4	30.3	0.3
	5	31.2	31.2	31	31.1	31.2	31.21	31.05	31.25	31.2	31.23	31.2	31.2	31.2	0
	6	34.2	34.2	34.3	34.25	34.25	34.2	34.2	34.1	34.1	34.2	34.2	34.2	34.2	0
	7	40	40	40.05	40	40.3	40.2	40.3	40.2	40.2	40.2	40.3	40.25	40.3	0.3
	8	30	30	30.1	30.05	30	30	30.05	30	30.1	30	30.05	30	30	0
	9	39.6	39.6	39.6	39.6	39.7	39.9	39.8	39.9	39.8	39.7	39.9	39.9	39.8	0.2
	10	31.8	31.8	31.7	31.9	31.85	31.85	31.75	31.8	31.8	31.9	31.9	31.85	31.9	0.1
	11	30	30	30.3	30.3	30.4	30.4	30.25	30.2	30.3	30.2	30.3	30.3	30.3	0.3
	12	37	37	37	37.1	37.1	37.1	37.2	37.2	37.3	37.3	37.4	37.4	37.4	0.4
	13	34.5	34.5	34.5	34.5	34.5	34.6	34.6	34.8	34.8	34.7	34.6	34.6	34.6	0.1
	14	38.5	38.5	38.4	38.3	38.5	38.7	38.9	38.9	38.9	38.85	38.8	38.7	38.7	0.2
	15	36	36	36	36	36.3	36.2	36.2	36	36	36.15	36.1	36.15	36.15	0.15
	16	38	38	38.05	38	38	38.15	38.2	38.2	38.1	38.3	38.2	38.2	38.1	0.1
	17	39	39	39	39	39.05	39.2	39.2	39.1	39.25	39.1	39	39	39.05	0.05
	18	30	30	30	30.2	30	30.1	30.2	30.15	31.2	30	30.15	30.2	30.2	0.2
	19	33.8	33.8	33.8	33.85	33.8	33.9	33.9	33.8	33.8	33.8	33.9	33.9	33.9	0.1
	20	35.4	35.4	35.5	35.2	35.4	35.4	35.5	35.5	35.7	35.8	35.5	35.5	35.7	0.3