EFFECT OF PELLETING ON NUTRITIONAL VALUE OF TOTAL MIXED RATION FOR PRE-WEANING AND POST-WEANING GOATS

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DECLARATION

I hereby declare that the work embodied in here is the result of my own research except as cited in the references.

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ABSTRACT

The number of goats in Malaysia decreased by 0.7% in 2016, to 145 999. However, as the world's population is expected to reach 9.1 billion people by 2050, demand for goat meat is expected to increase by 60%. (Brito et al., 2016). There is a lack of understanding in Malaysia about the diet of lactating sheep and goats. Since the TMR feeding method is impractical for small herds, regular tracking of high moisture ingredients is essential. Ingredients can be sorted by animals, the feed can get overheated and rotten, and the feed cannot be stored for an extended period of time. The main concerns are its physical form and higher moisture content. Napier grass makes up 40% of the total TMR composition, and it has a moisture content of 60-78%, resulting in a moisture content of 50% in finished TMR. As an alternative, the conventional TMR can be pelleted to increase the efficiency of the TMR use. Therefore, the nutritional values of feedstuff of TMR pellets, this analysis was conducted. Therefore, the current study aims to determine the nutritional values of TMR ingredients as well as to evaluate the effect of pelleting on the nutritional contents of TMR. Pre-weaning goats cTMR chemical composition 90.27 % of DM, 35.82 % of FC, 62.01 % of EE, 3.69 % CP, 44.46 % of Ash and 8.95 % Moisture while TMRp contain 94.86 % of DM, 30.68 % of CF, 17.05 % of EE, 3.75 % of CP, 55.98 % of Ash and 4.07 % of moisture. Post-weaning chemical composition for CTMR 90.27 % of DM, 35.82 % of CF, 62.01 % of EE, 3.69 % of CP, 44.46 % of Ash and 8.95 % of Moisture while TMRp contain 94.86 % of DM, 30.68 % of CF, 17.05 % of EE, 3.75 % of CP, 55.98 % of Ash and 4.07 % of Moisture. In conclusion, TMRp formulation for pre-weaning and post-weaning had most nutrient loss since undergo pelleting process but only CP and DM increased.

Keyword: *TMR, TMR pellet, pelletizing, creep feeding (CF), growing ration (GR), lactating ration (LR)*

ABSTRAK

Bilangan kambing di Malaysia berkurangan sebanyak 0.7% pada 2016, kepada 145 999. Namun, memandangkan populasi dunia dijangka mencecah 9.1 bilion orang menjelang 2050, permintaan terhadap daging kambing dijangka meningkat sebanyak 60%. (Brito et al., 2016). Kurang kefahaman di Malaysia tentang pemakanan biri-biri dan kambing yang menyusu. Memandangkan kaedah pemakanan TMR adalah tidak praktikal untuk kumpulan kecil, pengesanan tetap bahan-bahan kelembapan tinggi adalah penting. Bahan-bahan boleh diisih mengikut haiwan, suapan boleh menjadi terlalu panas dan busuk, dan suapan tidak boleh disimpan untuk jangka masa yang lama. Kebimbangan utama adalah bentuk fizikalnya dan kandungan lembapan yang lebih tinggi. Rumput napier membentuk 40% daripada jumlah komposisi TMR, dan ia mempunyai kandungan lembapan 60-78%, menghasilkan kandungan lembapan 50% dalam TMR siap. Sebagai alternatif, TMR konvensional boleh dibuat pelet untuk meningkatkan kecekapan penggunaan TMR. Oleh itu, nilai pemakanan bahan makanan pelet TMR, analisis ini dijalankan. Oleh itu, kajian semasa bertujuan untuk menentukan nilai pemakanan bahan TMR serta menilai kesan pelet terhadap kandungan nutrisi TMR. Kambing pra-cerai susu cTMR komposisi kimia 90.27 % daripada DM, 35.82 % daripada FC, 62.01 % daripada EE, 3.69 % CP, 44.46 % daripada Ash and 8.95 % Moisture while TMRp contain 94.86 % daripada DM, 30.68 % daripada CF, 17.05 % daripada EE, 3.75 % daripada CP, 55.98 % daripada Ash and 4.07 % daripada moisture. Post-weaning chemical composition for CTMR 90.27 % daripada DM, 35.82 % daripada CF, 62.01 % daripada EE, 3.69 % daripada CP, 44.46 % daripada Ash and 8.95 % daripada Moisture while TMRp contain 94.86 % daripada DM, 30.68 % daripada CF, 17.05 % daripada EE, 3.75 % daripada CP, 55.98 % daripada Ash and 4.07 % daripada Kelembapan. Kesimpulannya, formulasi TMRp untuk pra-cerai susu dan selepas cerai susu mempunyai kehilangan nutrien yang paling banyak sejak menjalani proses pelleting tetapi hanya CP dan DM yang meningkat.

Kata kunci: *TMR, TMR pellet, pelletizing, creep feed (CF), ration tumbuh (GR), lactating ration (LR)*

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CHAPTER 1

INTRODUCTION

1.1 Research Background

The livestock industry contributes significantly to the Malaysian economy in terms of added value and employment. The contribution of the small ruminant industry to agricultural production growth is becoming increasingly significant, and it deserves special attention. The aim is to increase sheep and goat meat consumption from 9% to 35% by 2015, which would necessitate an increase of 1.5 million head (Wan et al., 2013). In 2016, Malaysia's goat population fell by 0.7% to 145 999 heads. However, demand for goat meat is growing across the world, as the world's population is projected to reach 9.1 billion people by 2050, resulting in a 60% rise in food demand (Brito et al., 2016). In Malaysia, there is a shortage of knowledge on the diet of lactating sheep and goats. This breed cannot perform well without understanding their dietary nutritional requirements for different physiological periods, as dairy breeds need different amounts of energy for maintenance, lactation, and development.

Creep feeding is a way of feeding only the kids. Creep feeding would help the kids gain weight and train them to eat feed, making weaning easier. It is safer to use a commercial creep feed of at least 16% crude protein and a coccidiostat. For every kilogram of animal gain, approximately 6kg of feed are needed. The faster growth triggered by creep feeding may be advantageous in terms of generating show prospects. Creep feeding is a nutritional enrichment technique used to increase off-spring production during the preweaning stage of livestock management. The method includes supplying supplementary feed to offspring in an environment away from the dams.

Total mixed ration (TMR) is a ground-breaking term of feeding and food delivery to cattle. TMR is the most effective method for balancing animal nutrition and improving nutrient utilization, resulting in the animals' best productive and reproductive results. TMR diets have been linked to ruminal steady state, rumen fermentation pattern stabilization, and improved energy and protein consumption in the rumen (Coppock et al., 1981). The practice of feeding dairy animals complete mixed rations made up of fibrous crop residues has gained popularity in recent years. Total rations have the aim of including a mix of all feed ingredients, including roughages, without allowing the animal to choose a single ingredient (Khan et al., 2010).

As a result, TMR is used, in which animals are fed a diet that includes both forage and concentrates and provides all the required nutrients. TMR feeding has many advantages over traditional feeding, particularly in terms of dry matter intake (DMI), milk yield, and milk composition. Post-weaning lambs feeding a 14% crude protein rising ration had a 22% higher dry matter digestibility than the control and other care classes. There were no major variations in nutritional digestibility between the lactation rations with different metabolizable energy contents. The optimum crude protein and metabolizable energy levels in creep feed, expanding, and lactating rations TMR, which can also be used as a guideline for TMR pellet (TMRp) formulation. Hence, the current research aims to determine the nutritional values of TMR ingredients as well as to evaluate the effect of pelleting on the nutritional contents of TMR.

1.2 Problem statement

Since the TMR feeding system is not practical for small herds, it is vital to track high moisture ingredients daily. Animals can sort ingredients, the feed can become overheated and spoiled, and the feed cannot be kept for a prolonged period. Its physical shape and higher moisture content are the major issues. Napier grass contributes 40% of the overall TMR composition, and Napier grass contains 60-78% moisture, resulting in a moisture content of 50% in finished TMR. Also at average temperatures, a wet substance will overheat and spoil easily when exposed to higher ambient temperatures. The high moisture content of TMR encourages mold and yeast development in the presence of nutrients. As a result of microbial fermentation, the ration can become overheated, and if the process is continued for an extended period, the ration may spoil. Many nutrients are broken down into unhealthy materials during the overheating phase. If ingested, overheated feeds can produce an unpleasant taste and flavor that is unsuitable for ruminants, resulting in low nutrient availability. According to some recently published research reports, feed nutrients, especially carbohydrates, are particularly vulnerable to degradation during microbial growth, resulting in lower feed energy content and, as a result, lower milk production from dairy animals. Feed spoilage not only has an economic impact on dairy farms, but it also leads to emissions. Furthermore, in standard TMR feeding, the risk of ingredient sorting by the animals cannot be prevented. Consequently, there could be feed waste. Nonetheless, if they are pelletized, this research has market prospects in the future. In a mixing, handling, or feeding operation, pelleting prevents the segregation of ingredients. By feeding a pelleted meal, the animal is more able to produce a totally mixed diet than one that has been separated using these techniques. It also reduces pollution. The suggested formulation is treated in the pellet mill in such a manner that the fiber remains physically involved, keeping the rumen chemically stable. These pellets may be fed according to the animal's dry matter intake in terms of body weight, growth, milk quality, milk composition, and body condition ranking. It will have all the animal's nutritional requirements, except for water.

1.3 Objective

- To determine the nutritional values of feedstuff for TMR pellet
- To formulate the TMR pellet for pre-weaning and post-weaning goats based on the optimum TMR formulation
- To evaluate the effect of pelleting process on the nutritional contents of TMR

1.4 Hypothesis

In Malaysia, there is no development and guideline in converting the TMR into TMR pellet specializing for different lactation and weaning stages of dairy goats. Therefore, it is hypothesised that TMR pellet can be developed and characterised using a new formulation. It is also hypothesised that there will be different chemical and physical characteristics between TMR pellets for pre-weaning and post-weaning goats. The development of TMR pellet using local ingredients can contribute to feed industry commercialization by lowering feed costs and increasing feed production based on nutritional and economic factors.

1.5 Significance of Study

TMR pellets are unique in that they can be fed to herds of all sizes, including small, medium, and large herds. TMR pellets also have a consistent composition, supplying a consistent volume of dry matter. TMR pellets have a high dry matter quality, making it simple to feed the animal specifically. TMR pellets have not yet been produced locally using local feed materials focused on various lactation and weaning stages of sheep and goats, notwithstanding the fact that TMR pellets have been used in other countries. It is true that there is no clear nutrient requirement or feeding protocol that can be used as a guideline for raising small ruminants, especially sheep, in Malaysia's tropical climate. As a result, developing TMR pellets can have a significant impact on ruminant farming livestock, especially smallholder farmers.

CHAPTER 2

LITERATURE REVIEW

2.1 Total Mixed Ration

TMR is a feeding system for dairy ruminants. The aim of a TMR diet is for each rumen to absorb the necessary amount of nutrients in each bite. A rumen's diet should consist of high-quality forages, a balanced grain and protein diet, as well as vitamins and minerals. The activities can be split into groups using a TMR diet, such as at least three milk production groups and one dry rumen group. The ability to control the TMR on a regular basis result in healthier ruminants, increased milk intake, and reproduction. Maximum dry matter consumption, which should be compliant with manufacturing and breed, is the key to formulating TMR. The practice of feeding dairy animals complete mixed rations made up of fibrous crop residues has gained popularity in recent years. Total rations have the aim of including a mix of all feed ingredients, including roughages, without allowing the animal to choose a single ingredient (Khan et al., 2010). The benefits of a TMR include improved use of low-grade roughages, standardized feed consumption, and reduced feed waste, a safe rumen fermentation area, limited fermentation losses, and ammonia release fluctuation (Rao et al., 2014). Dry ingredients like hay and other concentrates/ingredients are chopped or ground to the appropriate particle size, then stirred together to make the mixture as consistent as possible. This well-mixed diet is known as a TMR, and it has many benefits when fed to ruminant animals, including the ability to feed a large herd easily, better dry matter consumption, good rumen pH, better nutritional use, less digestive problems, and, overall, improved milk yield.

2.3 Total Mixed Ration Pellet (TMRp)

In the production of poultry feed, pelleting is the most popular thermal processing technique. Pelleting has been shown to improve feed consumption, feed quality, and weight gain in broiler chickens, with enhanced digestibility, reduced product isolation, and energy expended during prehension, as well as increased palatability (Behnke 1998). TMRp are being fed to fattening lambs instead of conventional loose concentrate plus forage. As the TMR was pelleted, feed consumption and average daily benefit increased, but apparent total tract digestibility of nutrients (organic matter, crude protein, neutral detergent fibre, acid detergent fibre, and ether extract) and serum parameters remained unchanged, while apparent total tract dry matter digestibility decreased significantly. The addition of TMRp to the diet raised overall short-chain fatty acid concentrations thus lowering rumen pH. The physical shape of the TMR had little effect on the rumen microbial population at the phylum level, but it did shift significantly at the genus level. Lambs fed the TMRp had higher liveweight at slaughter and hot carcass weight than lambs fed the conventional TMR (c-TMR), though dressing percentage and meat consistency were unaffected. Finally, feeding TMRp to fattening lambs increases growth efficiency mostly due to increased feed intake. TMRp feeding is a viable option for vigorous lamb fattening operations (Li et al, 2021). TMRp have a lower moisture content, making them easier to prepare, handle, ship, store, and eat. Owing to the lower moisture content of this substance, there should be minimal/no spoilage/losses due to microbial fermentation. Since pellets are tightly bound during the pelleting process, they are less likely to be separated by animal or separated during processing, feeding, packaging, transportation, and unloading. These pellets have a higher dry matter volume, making them easier to feed animals more precisely than a c-TMR, which could have a higher and volatile moisture content. Finally, because of their lower moisture content, these pellets can have a long shelf life. When properly cooked, it can be processed for months without losing nutritional value. Because of its longer shelf life, it can be exported to distant locations, allowing farm animals to be raised in areas where forage cultivation is limited or non-existent. Since TMRp have low feed wastage and spoilage, they will increase the profitability of livestock output. It can be more environmentally sustainable since this feeding scheme is supposed to result in less ingredient spoilage.

TMRp have an advantage over c-TMR. In one instance, for example, the pellets have little or no chance of being sorted for additives that are unpalatable to cows, which is a big issue with feeding c-TMR. This may be due to the physical shape of the pellets, which are closely attached because of the high pressure used during the pelleting process in the pellet mill. Since these pellets are not very strong, they can be fed without soaking or softening in water. As a result, animals can easily consume enough dry matter to meet the dry matter requirements for a given body weight and production level.

Extrusion, crushing, freeze palletisation, globulation, and balling are all examples of pelleting processes (Supriyaet al., 2012). In terms of pellet physical properties, Kaliyan and Morey (2009) described pellet quality as the pellets' friability and weight. The proportion of friable in the pellets is referred to as friability. Compressive resistance and effect are all measured by strength. Several existing methods developed by the researcher can be used to determine these qualities in pellets used in the feed industry (Kaliyan and Morey, 2009). In another scenario, a TMRp with a moisture content of 10-12% is formulated, resulting in a dry matter content of 88-90%. Overheating or spoilage by yeast and moderate growth can be reduced because of this. Since a higher amount of moisture is needed for mold and yeast formation, this is not present in these TMRp. In c-TMR with moisture levels of 40-45%, it is a frequent cause of overheating and feed waste. However, owing to the lower moisture content of pellets, this is not to be planned.

2.2.1 Ingredients of TMRp

2.2.1.1 Palm Kernel Cake (PKC)

PKC is often used as the primary ingredient in feedlot cattle and buffalo rations. Feedlot cattle in Malaysia are usually fed up with 80% PKC, with live weight gain (LWG) of 0.6-0.8 kg day-1 for local

(Kedah-Kelantan) cattle and 1-1.2 kg day-1 for crossbred cattle. PKC at nearly 100 % has been fed to feedlot cattle with no adverse effects if the supply of calcium and vitamins (especially A, D, and E) is adequate to meet their needs. Supplementing the conventional diet has been found in several trials to be beneficial. Beef cattle rations containing 30% to 50% PKC resulted in better production and increased LWG. In Malaysia, full feeds based on PKC are commonly produced as pellets, cubes, or TMR. Rice bran, brewer's malt, palm oil mill effluent (POME), tapioca waste, urea, salt, and minerals are all common ingredients (Wan et al., 2003). PKC is advised to be used at a 30% standard in sheep rations. Cu toxicity in sheep can be caused by long-term feeding of PKC at elevated inclusion levels (>80%). Sheep are particularly vulnerable to Cu poisoning. Cu accumulates in the liver of certain sheep breeds (especially crossbreds), causing liver damage. The dilemma can be solved by combining 100 ppm zinc sulphate or 5.2 mg kg-1 ammonium molybdate with 440 mg kg-1 sodium sulphate in the rations (Hair-Bejo, 1995). PKC has been shown to be a potential source of energy and protein in ruminant and non-ruminant compound feeds. PKC is a high-energy, low-cost component that can be used in ration formulations for a variety of livestock. PKC is readily available throughout the year in Malaysia, making it ideal for growing domestic beef and milk supplies. In Malaysia, PKC-based compound feeds in the form of pellets or cubes, as well as TMR, are still widely used for livestock feeding (Wan et al., 2003).

2.2.1.2 Rice Bran

Rice bran is a misnomer or, at the very least, a perplexing word since it may refer to a variety of rice by-products of varying concentrations. However, rice bran is what it is, and it has been recognized as such in literature and trade. It's an unusual ingredient in that it has high nutritional value but is underappreciated by most nutritionists; it's readily available but hardly traded on the commodity market Rice bran is a misnomer or, at the very least, a perplexing word since it may refer to a variety of rice by-products of varying concentrations. However, rice bran is what it is, and it has been recognized as such in literature and trade. It's an unusual ingredient in that it has high nutritional value but is underappreciated by most nutritionists; it's readily available but hardly traded on the commodity market. Understanding how rice bran is made and the complications it causes will help nutritionists find this unusual product and confidently include it in pig and poultry diets (Mavromichalis., 2019). Understanding how rice bran is made and the complications it causes will help nutritionists find this unusual product and confidently include it in pig and poultry diets (Mavromichalis., 2019). The extra fat and calories in rice bran, it can be used as a weight gainer for underweight goats. This same consistency makes it an excellent winter food for goats who need additional internal heating. Rice bran is available in the form of pellets or flakes in animal feed stores near you (Lee, 2021).

2.2.1.3 Copra Meal

Since copra meal is abundant and inexpensive in some parts of the world, using it in poultry diets will help the poultry industry. Its use as a feeding material will also benefit the coconut industry and the environment by reducing the amount of copra waste generated (Sundu et al., 2009). As a by-product of the extraction of coconut oil and coconut milk from coconut kernels, copra meal is an essential feed ingredient. The annual production of copra meal in Thailand ranges from 17,000 to 25,000 metric tons (Index Mundi, 2018). Because of its low cost and nutritious content, the by-product is mostly used in the animal feed industry. Copra meal from the coconut milk industry has 4.07 % crude protein, 36.22 % crude fat, and 72.61 % crude carbohydrate, respectively (Limmanee et al., 2017).

Copra meal is available all over the world. In 2010, global copra production totaled 5.2 million tons, with 1.86 million tons of copra meal produced. The Philippines is the largest producer of copra and coconut oil (42% in 2009), led by Indonesia (25%) and India (12%). Half of copra meal production is exported, with the Philippines alone exporting 0.5 million tons (62.5% of total production) (FAO, 2011; Oil World, 2011; USDA, 2013). Copra meal was once a common feed ingredient in Europe, but imports have dropped significantly since the 1990s, from 950,000 t in 1992 to 15,000 t in 2013. (USDA, 2013).

Copra meal is notable for its high content of non-starch polysaccharides, especially mannan and galactomannan (25-30%), which are known to have antinutritional properties in monogastric organisms. These constituents are also responsible for copra meal's low bulk density (0.56 g/cm3 vs. 0.75 for soybean meal) and high-water retaining capability (4.14 g water/g feed vs. 2.77 for soybean meal), all of which are physical characteristics that restrict consumption (Sundu et al., 2009). Copra meal, on the other hand, can consume up to half its own weight in molasses, which is a valuable property in compound feed production (McDonald et al., 2002).

2.2.1.4 Napier Grass

Forage is the most significant feed supply for ruminants all over the world. Forage is a grass or legume that is used to feed animals in a variety of ways. It can be used as pastures or fodder (cut and hold grass), or it can be stored as hay, silage, or haylage. Several varieties of forages may be used to feed livestock as hay or fodder. Napier grass, as well as other grasses (humidicola grass, centrosema, and glyricidia) are considered fine palatable fodder for goats in Malaysia (Aswanimiyuni et al., 2018). It has been introduced as a forage plant to nearly every tropical and subtropical area on the planet. It is a highly adaptable plant that can be cultivated in a variety of environments and processes, including dry or wet climates, smallholder, or large-scale agriculture. It is a valuable forage that is widely used in the tropics, especially in cut-and-carry systems (Mannetje, 1992; FAO, 2015). Napier grass is a full-sun species that can still produce in partial shade but not total shade under a thick canopy of trees (Francis, 2004).

There was no substantial change in goat growth success when Napier grass were fed to them. When compared to those feeding Guinea grass, those fed Napier grass gained the most weight and had the lowest DMI and FCR. In livestock production, a low FCR is needed because it ensures that more performance can be achieved with less feed. It is suggested that they use Napier grass as a possible grass to achieve the best growth efficiency and lowest feeding costs for their everyday ranch operations. Furthermore, as compared to guinea grass, Napier grass produced a higher annual yield, making it a better option for farmers (Aswanimiyuni et al., 2018).

2.2.1.5 Soya Hull

Soybeans are the second most planted field crop in the United States, after corn, with 77.5 million acres planted in 2009, yielding

235,000 short tons of soybean meal. Soybean production in the United States was worth $29.6 billion on the farm in 2008-09, second only to corn among U.S. crops. Soybean meal is the most important ingredient obtained from soybean production, accounting for 50 to 75 % of the value based on soybean oil and meal rates (Chen et al., 2010). For feed, soybean hull is normally combined with soybean meal (SBM) (Chen et al., 2010). In the dairy industry, soy hulls are used as a partial substitute for forage and concentrate. The fiber in soy hulls ferments quickly and is easily digested. This, along with the product's low non-structural carbohydrate content, makes it an especially good source of energy and fiber, resulting in a very favorable rumen fermentation pattern.

2.2.1.6 Molasses

Molasses is a viscous dark brown substance that is formed as a byproduct of sugar production. As the liquid cools after dissolving sugars at high temperatures, the sugar crystals settle out, leaving the molasses, which was traditionally blended back with the pulped fibers to create molasses sugar beet feed. Feeding molasses to farm animals improves pasture/hay digestion, increases milk production, aids in body condition and appetite maintenance, and reduces feed waste. Cane sugar, which has similar properties to molasses, is a less expensive choice. Molasses can help finely ground feeds become less gritty and powdery. It serves to make a feed mixture more palatable and edible to livestock in this capacity. Molasses may be used to substitute lost sugar and trace minerals, as well as to aid fermentation in low-quality forages, especially those with low sugar levels (Senthilkumar et al., 2016).

2.3 Dairy Goats

Mutton consumption in Malaysia rose by nearly 30% from 19,309 tons in 2009 to 43,703 tons in 2014. Mutton imports increased by nearly 48% from 18,400 tons in 2009 to 27,248 tons in 2014. In the livestock industry, a breed's productivity, especially its ability to achieve the target market weight, is critical for any producer looking to optimize profit (Norhayati et al., 2018).

While still in its infancy, dairy goat farming is a rapidly growing livestock industry in the country and a potentially lucrative enterprise. Farmers, on the other hand, must deal with problems and difficulties in the growth and advancement of the dairy goat sector (Jamaluddin, Idris, Roslaini, 2012). The most productive dairy goat breed is the big Saanen goat, which produces between 1 and 3 gallons of milk per day. Even though Saanens have been domesticated for decades, they will still engage in a headbutting competition for supremacy. Just 13 dairy breeds, or 9% of all breeds, are recognized in Asia. These breeds also have a low-to-medium milking ability. Many of the so-called "improved dogs" have never been seen outside of their home countries. There are also 13 dual-purpose (meat and milk) goats, which are less well-known and produce varying milk yields. Many of these breeds' ability is yet to be determined (Devendra, C. 2012).

2.3.1 Creeping Feeding

Creep feeding is the process of supplementing suckling children's diets with a concentrate feed in addition to their dam's milk by hiding the feed from their dams. Creep feeding, which is done with a creep feeder or a creep pen, is normally initiated when children are two to three weeks old. The most common method of creep feeding is to set up a creep pen that children can enter but does not (Tatiana S., N.D.). Adults are unable to reach the feeder due to the size of the cracks, which are too large for them to pass into. Creep feeding would help the kids gain weight and train them to eat feed, making weaning easier. It is best to use a commercial creep feed of at least 16% crude protein and a coccidiostat. For every pound of animal gain, approximately 6kg of feed are needed. The faster growth caused by creep feeding may be useful in terms of generating show prospects (Goats,2019).

2.3.2 Growing Feeding

If the young goats are replacement doe kids or commercial goats would decide how they are handled after weaning. The amount of dry matter and the amount of energy consumed will determine how much weight you gain. In general, for market animals, the highest rate of benefit is preferred. For replacement animals, the focus should be on rumen growth and gut ability, rather than on rate of benefit. Goats with a larger gut capacity as adults would be able to absorb more feed and, as a result, satisfy nutritional needs for higher yield. The protein content of the grain may have a significant impact on weight gain. After weaning, Tanabe et al. (1975) found that a 16% grain blend could be served. Since dry matter would be less in these smaller children, it is advisable to ensure a higher amount of protein (19%) in early weaning circumstances. Protein levels in the grain mix can be decreased as growth and weight rise. The type of protein will influence the rate of development. Following weaning, fish meal, soybean meal, and field bean meal produced the best results. The experiment did not contain linseed meal (oilcake). If the percentage of urea in the grain does not exceed 2.25%, urea may be effectively substituted for part of the soybean meal (Haryu, 1975). With urea, there may be issues with palatability, and it's also necessary to make sure the grain mix has enough energy to use the protein efficiently.

CHAPTER 3

METHODOLOGY

3.1 Total mixed ration ingredients and experimental diets

The elements of TMR feeds must be supplied equally for greater pellet moulding efficiency; however, the size of each material varies based on the kind of material. The formulation of TMR consisted of Napier grass, copra meal, soybean meal, soya hull, rice bran, molasses mineral premix, sodium bicarbonate and sodium chloride for pre-weaning goat diet and Napier grass, copra meal, soybean meal, soya hull, molasses, corn meal, PKC, mineral premix, sodium bicarbonate and sodium chloride for post-weaning goat diet (Table 3.1). Sodium bicarbonate was used as a pellet binder in both TMR All of ingredient was from local products, which was ordered and received one month before research was started. While Napier grass was ordered and received with 3 different date and 60kg of fresh Napier grass each time of order. Once fresh Napier grass arrived, fresh Napier grass was put into the oven 105º C and left for 2 days.

. Dietary treatments include two different TMR diets for pre-weaning and post-weaning dairy goats; 1) cTMR for pre-weaning dairy goats; 2) TMRp for pre-weaning dairy goats; 3) cTMR for post-weaning dairy goats and 4) TMRp for post-weaning dairy goats.

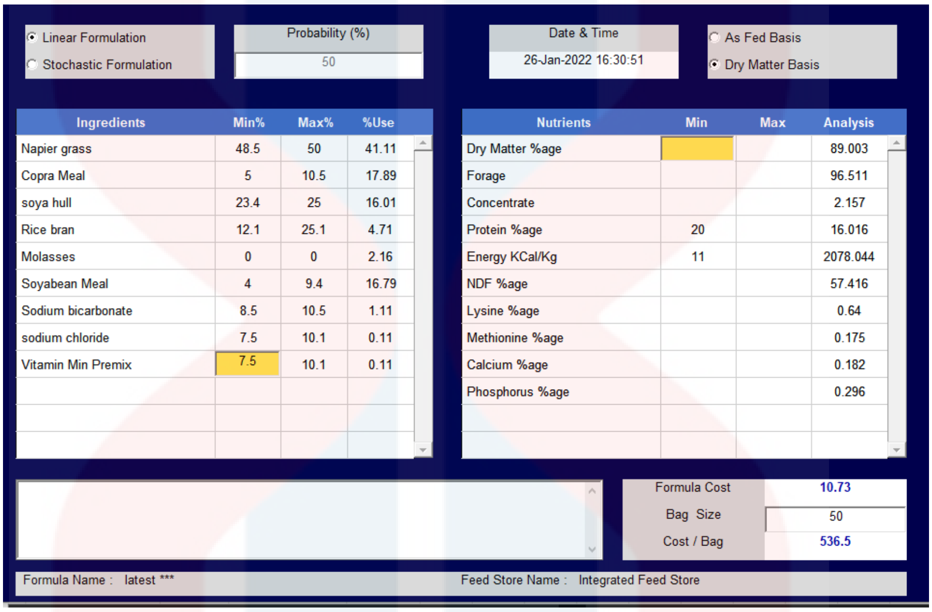
Table 3.1: Feed Formulation of TMR Pellets and formulation (%) of experimental diets

Ingredient	Feed Formulation (%)			
	Pre-weaning		Post-weaning	
	cTMR	TMRp	cTMR	TMRp
Napier Grass	40.0	40.0	60.0	60.0
Copra Meal	18.4	18.0	6.8	6.3
Soybean Meal	16.9	16.4	16.8	16.3
Soya Hull	16.8	5.0	5	16.3
Rice Bran	5.6	5.1	-	-
Molasses	2.1	2.5	2	2.5
Corn Meal	-	-	5.5	5.0
Mineral Premix	0.1	0.1	0.1	0.1
Sodium Bicarbonate	-	1.5	-	1.5
Sodium Chloride	0.1	0.1	0.1	0.1
PKC	-	-	3.7	3.2
Total	100	100	100	100
Calculated ME (MJ/kg DM)	11	11	11	11
Calculated CP (%)	18	18	16	16

Notes: ME- Metabolize energy, CP-Crude protein, PKC- Palm kernel cake.

Ingredients in mineral premix (per 50 g) (Glovet Premix Plus, Global Veterinary); 320 mg Mn, 200 mg Zn, 1500 mg Mg, 500 mg Fe, 50 mg Cu, 15 mg Co, 20 mg iodate, 10 g P, 5500 mg salt, 1300 mg Ca, 50 000 i.u Vitamin A, 8000 i.u Vitamin D3, 10 mg Vitamin

E. Other ingredients: Formic acid, citric acid, malic acid, tartaric acid, lactic acid and orthophosphoric acid.



● Linear Formulation
○ Stochastic Formulation

Probability (%): 50

Date & Time: 26-Jan-2022 16:30:51

○ As Fed Basis
● Dry Matter Basis

Ingredients	Min%	Max%	%Use
Napier grass	48.5	50	41.11
Copra Meal	5	10.5	17.89
soya hull	23.4	25	16.01
Rice bran	12.1	25.1	4.71
Molasses	0	0	2.16
Soyabean Meal	4	9.4	16.79
Sodium bicarbonate	8.5	10.5	1.11
sodium chloride	7.5	10.1	0.11
Vitamin Min Premix	7.5	10.1	0.11

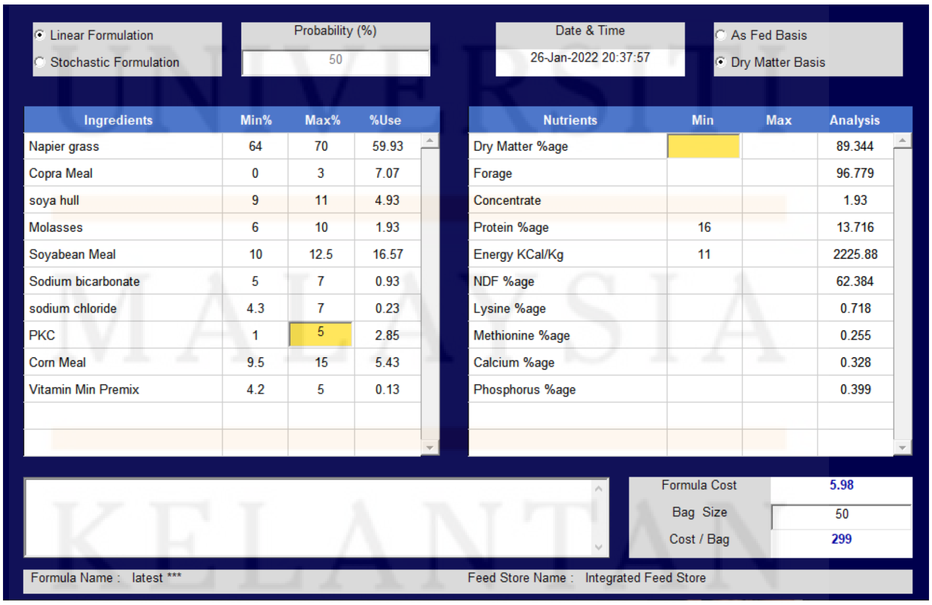
Nutrients	Min	Max	Analysis
Dry Matter %age			89.003
Forage			96.511
Concentrate			2.157
Protein %age	20		16.016
Energy KCal/Kg	11		2078.044
NDF %age			57.416
Lysine %age			0.64
Methionine %age			0.175
Calcium %age			0.182
Phosphorus %age			0.296

Formula Cost	10.73
Bag Size	50
Cost / Bag	536.5

Formula Name : latest ***

Feed Store Name : Integrated Feed Store

Figure 3.1 TMR formulation for pre-weaning goats



● Linear Formulation
○ Stochastic Formulation

Probability (%): 50

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○ As Fed Basis
● Dry Matter Basis

Ingredients	Min%	Max%	%Use
Napier grass	64	70	59.93
Copra Meal	0	3	7.07
soya hull	9	11	4.93
Molasses	6	10	1.93
Soyabean Meal	10	12.5	16.57
Sodium bicarbonate	5	7	0.93
sodium chloride	4.3	7	0.23
PKC	1	5	2.85
Corn Meal	9.5	15	5.43
Vitamin Min Premix	4.2	5	0.13

Nutrients	Min	Max	Analysis
Dry Matter %age			89.344
Forage			96.779
Concentrate			1.93
Protein %age	16		13.716
Energy KCal/Kg	11		2225.88
NDF %age			62.384
Lysine %age			0.718
Methionine %age			0.255
Calcium %age			0.328
Phosphorus %age			0.399

Formula Cost	5.98
Bag Size	50
Cost / Bag	299

Formula Name : latest ***

Feed Store Name : Integrated Feed Store

Figure 3.2 TMR formulation for post-weaning goats

3.2 Preparation of TMR pellet

3.2.1 Mixing

To improve mixing and feed use, ingredients grounded to the appropriate particle size. After 2 days, dried Napier grass was grinded into small size using grinder machine to make all the ingredient mixed well during mixing process. Few ingredients also undergo grinding process into small pieces.

All components measured and transferred to a mixer, where shaken together for 10 minutes. The component was inserted gradually which starting with smallest particle size to biggest size of ingredient. and lastly, molasses was put evenly to avoid TMR to coagulated and not spread evenly. The resulting mash then be moved to a storage bin

3.2.2 Pelleting

Two pelleting factors, hammer mill screen size (3.2mm and 6.5mm screen openings) and die size (4.031.8mm and 6.444.5mm, hole diameter x effective thickness), used to create the pellet variations. The main shaft of the pellet mill rotated at 10,650rpm. The feeder screw rotated at a speed of 7rpm. Extruding biomass grinds into a circular cross-sectional die generated pellets. The frictional heating of the die during pelleting caused the rise in temperature. By forcing air into the pellets, they were cooled to room temperature for 30 minutes.

The moisture content of the pellets measured by drying about 25 g of each sample for 24 hours at 103°C in a forced-air oven (ASABE Standard S358.2, 2008). On a dry basis, moisture content expressed as a percentage. Using an auto control environmental chamber (Model 518, Electro-tech systems Inc., Glenside, PA) to push air around the samples at a set relative air humidity and temperature, equilibrium between the air and the biomass samples achieved. All the samples were taken at a temperature of 25°C. The working range for relative humidity in the air was 11–98%. The samples weighed every 3–5 days before they reached a steady weight.

3.3 Proximate Analysis of Feed Sample

Water, ash, crude protein, ether extract and crude fibre the 5 ingredients used to partition nutrients in feed. The dry matter (DM), crude protein (CP), crude fibre (CF), Ether extract (EE) and ash content of each TMR sample all measured. Basic protocols of the Association of Official Analytical Chemists [AOAC] used to perform completely different procedures and instrumentation (1995).

3.3.1 Dry Matter Analysis

1 g of cTMR and TMRp were weighed using electronic balance for dry matter analysis with three replicates respectively. The cTMR and TMRp was dried using oven at 105°C for 24 hours (AOAC International, 1995). The dry weight assessed the next day to assess the dry matter content in cTMR and TMRp, which determined using the following formula:

$$\%\mathrm{DM} = \frac{\mathrm{W}f \ \ \mathrm{x}\ 100}{\mathrm{W}i} \tag{3.1}$$

Where,

%DM = Percentage of DM

W_i = Initial weight of sample

W_f = Final weight of sample

3.3.2 Crude Protein Analysis

The crude protein content of cTMR and TMRp feed determined using the Kjeldahl procedure, which consists of three steps: digestion, distillation, and titration. Gerhardt Kjeldaterm and Gerhardt Vapodest were used in this process.

3.3.2.1 Digestion

About 1g of each sample was weighed and inserted into the digestion tube filled with 2 piece of Kjeltab tablet in each tube respectively. next, 12ml of concentrated sulfuric acid was added into each of digestion tube in the fume chamber before place into digestion rack. Before that, the digestion block of Gerhardt Kjeldaterm id fumed on and set up 10 400 as pre-heating. The sample were put into digestion rack and the lids was to close tightly on the top of digestion tube in order to prevent the sulphuric acid from vaporized out of the chamber. Then, the samples were left for digest completely finish and let cooled.

3.3.2.2 Distillation

The preparation of receiver should be done before distillation process. The receivers were prepared by adding 250 ml of distilled water into a beaker. Next, 10 g of boric acid, 2.50 ml of bromocresol green and 1.75 ml of methyl red was added and placed on the hot plate for stirring purposes. Before, use the Gerhardt Vapodest distillation machine, it needs to run for clean the system twice. Thus, it must be repeated for each new sample once. After the sample from digestion cooled down, the digested samples were diluted with 80 ml of distilled water and 50 ml 45% of sodium hydroxide (NaOH) before transferred into distillation unit. An amount of 30 ml of receivers were put on the receiver platform and distilled for a few minutes. Next, the distilles which are green in colour were collected whereas receiving flask need to be removed from the unit for titration process.

3.3.2.3 Titration

The distilled receiver was titrated with standard 0.1M hydrochloric acid (HCL) to reach pink colorization end point. the volume of HCL used for the titration was recorded. The determination of CP content in the sample was calculated using equation:

$$\%N = \frac{(T-B)\ x\ N\ x\ 1.4007\ x\ 100}{sample\ weight\ (mg)} \tag{3.2}$$

$$\%CP = \%N \ x \ F \tag{3.3}$$

Where,

T = Volume of titrant used for feed sample

B = Volume of titrant used for blank sample

N = Normality of titrant

%CP = Percentage of CP

F = Conversion factor for nitrogen to protein

3.3.3 Crude Fibre Analysis

The Fibrebag system used to test the crude fibres in a feed sample from TMR pellets. The feed treated with various detergents, boiled in detergent, cleaned (except for acid detergent lignin), rinsed, and purified several times. The waste that hasn't melted cleaned, measured, and then incinerated. The crude fibre material in the sample refers to the mass loss during incineration.

$$\%\ \mathrm{CF} = \frac{\mathrm{W}i - \mathrm{Wf}}{\mathrm{Ws}} \mathrm{x} 100 \tag{3.4}$$

Where,

% CF = Percentage of crude protein

W_i = Dry weight residue before ashing

W_f = Weight of residue after ashing

W_s = Weight of sample

3.3.4 Crude Fat Analysis

The fat content of TMR samples determined using the Soxtec method. To achieve a steady heat, the empty cups heated in a furnace for 30 minutes and then allowed to cool for 20 minutes before being weighted as an original. The samples were then weighted at about 1g before being placed in a sample tube containing folded cotton. After that, the cups filled with 80 mL of petroleum ether. The sample tubes were then inserted into the system by moving up the thimble and attaching the magnet to the top of the sample tube, while the petroleum ether cups placed under the sample tube with the cup holder. To keep the petroleum ether from evaporating in the condenser, the temperature and software correctly set up, and the tap water for the reflux condensers opened each time before the system ran. Any time the beeping sound were occurred, the thimble forced down. Before being weighed as the final cup weight, the cup must be reheated in the furnace for 30 minutes and then allowed to cool for 20 minutes. This calculation was used to calculate and quantify the fat content:

$$\%\mathrm{EE} = \frac{\mathrm{W}f - \mathrm{W}i}{\mathrm{W}s} \text{ x } 100 \tag{3.5}$$

Where,

%EE = Percentage of extract ether (EE)

W_i = Initial weight of the aluminum cup

W_f = Final weight of the aluminum cup

W_s = Weight of the samples

3.3.5 Ash Content Analysis

The crucibles were weighed as initial weight. 1g of each TMR samples put in the crucible and incinerated in the furnace at a temperature of 500-600°C for one hour before being cooled in the desiccators overnight. Then, final weight of the crucible containing the ash was recorded. The following formula used to measure the ash content:

$$\%\ \text{Ash} = \frac{Wf - Wi}{Ws} \times 100 \tag{3.6}$$

Were,

% Ash = Percentage of ash

W_i = Weight of the crucible with sample

W_f = Weight of the crucible with ash

W_s = Weight of the sample

3.4 Data Analysis

The data was analysed using independent T-Test, whereas the Levene’s test for homogeneity of variances in SPSS Statistics used to distinguish the treatment means at the 95% confidence level ($P < 0.05$). The data was obtained as mean ± standard error (SE).

CHAPTER 4

RESULT AND DISCUSSION

4.1 Chemical composition of TMR ingredients.

Based on the proximate analysis that was done, the data was shows at (table 1). Soybean meal contain 75.23 % of DM, 20.71 % of CP, 11.34 % of CF, 0.80 %of EE, 7.13 % of Ash and 9.77 % Moisture. Sodium bicarbonate contain chemical composition 82.11 % of DM, 0.00 % of CP and EE, 0.00 % of CF, 0.00 % of Ash and 3.58 % Moisture. Chemical composition for Sodium chloride is 88.54 % of DM, 0.00 % for CP and EE, 0.00 % of CF, 35.07 % of Ash and 0.53 % of Moisture. Next, Copra meal contain 89.97 % of DM, 10.14 % of CP, 15.14 % of CF, 4.84 % of EE, 3.71 % of Ash and 9.78 % of Moisture. Chemical composition of Soya Hull, 90.91 % of DM, 10.36 % of CP, 62. % of CF, 4.69 % of EE, 3.71 % of Ash and 9.78 % of Moisture. Mineral premix chemical composition contain is 93.46 % of DM, 0.00 % of CP, 0.85 % of CF, 0.45 % of EE, 6.55 % of Ash and 2.69 % of Moisture. Chemical composition of PKC is 65.33 % of DM, 10.61 % of CP, 59.20 % of CF, 16.00 % of EE, 70.61 % of Ash and 6.22 % of Moisture. Rice Bran chemical composition contain is 71.46 % of DM, 5.97 % CP, 12.94 % of CF, 10.26 % of EE, 31.01 % of Ash and 10.15 % of Moisture. Chemical composition of Molasses is 52.62 % of DM, 1.62 % of CP, 4.95 % of EE, 90.84 % of Ash and 49. % of Moisture. Dried Napier grass chemical composition contain is 88.13 % of DM, 5.97 % of

CP, 13.82 % of CF, 3.73 % of EE, 3.88 % of Ash and 12.96 % of Moisture. Chemical composition of Corn meal contain is 94.96 % of DM, 1.06 % of CP, 14.59 % of CF, 1.42 % of EE and 9.92 % of Moisture.

Table 4.1 Chemical composition (%) of sample ingredients

Type of ingredients	**Dry Matter (%)**	**Crude Protein (%)**	**Crude Fibre (%)**	**Ether Extract (%)**	**Ash (%)**	**Moisture (%)**
Soybean Meal	75.23 ± 5.97^{abcd}	20.71 ± 0.73^{e}	11.34 ± 3.21^{a}	0.80 ± 0.21^{a}	7.13 ± 1.96^{a}	9.77 ± 0.28^{d}
Sodium Bicarbonate	82.11 ± 5.95^{bcd}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	91.42 ± 9.54^{bc}	3.58 ± 0.38^{b}
Sodium Chloride	88.54 ± 1.97^{bcd}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	0.00 ± 0.00^{a}	70.07 ± 41.39^{c}	0.53 ± 0.01^{a}
Copra Meal	89.97 ± 3.56^{cd}	10.14 ± 0.72^{d}	15.14 ± 2.50^{a}	4.84 ± 1.49^{a}	3.71 ± 0.75^{a}	9.78 ± 0.26^{d}
Soya Hull	90.91 ± 0.91^{cd}	10.36 ± 0.31^{d}	62.57 ± 34.53^{b}	4.69 ± 0.56^{a}	4.88 ± 0.15^{a}	10.13 ± 0.29^{d}
Mineral Premix	93.46 ± 1.50^{cd}	0.00 ± 0.00^{a}	0.85 ± 0.43^{a}	0.45 ± 0.07^{a}	6.55 ± 3.06^{a}	2.69 ± 0.02^{b}
PKC	65.33 ± 10.34^{ab}	10.61 ± 0.13^{d}	59.20 ± 0.00^{b}	16.00 ± 1.76^{a}	70.61 ± 1.54^{bc}	6.22 ± 0.38^{c}
Rice Bran	71.46 ± 4.87^{abc}	5.97 ± 0.69^{c}	12.94 ± 4.27^{a}	10.26 ± 0.77^{a}	31.01 ± 21.70^{ab}	10.15 ± 0.24^{d}
Molasses	52.62 ± 1.54^{a}	1.62 ± 0.40^{b}	-	4.95 ± 1.29^{a}	90.84 ± 5.03^{c}	49.13 ± 0.43^{f}
Dried Napier Grass	88.13 ± 2.27^{bcd}	5.97 ± 0.37^{c}	13.82 ± 2.32^{a}	3.73 ± 0.93^{b}	3.88 ± 1.93^{a}	12.96 ± 0.43^{e}
Corn Meal	94.96 ± 2.94^{d}	1.06 ± 0.31^{ab}	14.59 ± 2.97^{a}	1.42 ± 1.42^{c}	-	9.92 ± 0.03^{d}

4.2 Nutritional values of TMR for Pre-weaning and Post-weaning goats

4.2.1 Effect of pelleting on nutritional values of TMR for pre-weaning goats

Based on the proximate analysis in (table 2), DM of TMRp with 94.86 % are higher than cTMR with 90.27 %. However, in term of CF, cTMR are higher than TMRp which 35.5 % of cTMR and 30.68 % of TMRp. Next, cTMR contain higher EE content (62.01 %) than TMRp which was 17.05 %. c-TMR contains 3.69 % of CP and 44.46 % of ash content whereas TMRp contain 3.75 % of CP and 55.98 % of ash content. The highest moisture content of c-TMR was the highest which were 8.95 % compared to TMRp only contain 4.07 % of moisture. The T-test revealed that all the analysis was shown that there were no significant different ($p<0.05$) between the groups which all the analysis obtained p value bigger than 0.05 and thus resulting no significant different among them.

Table 4.1 Chemical composition of TMR for pre-weaning goats

Sample	cTMR	TMRp	P-value
Dry Matter	90.27 ± 0.20	94.86 ± 0.63	0.12
Crude Fibre	35.50 ± 19.69	30.68 ± 4.80	0.23
Ether Extract	62.01 ± 17.90	17.05 ± 7.38	0.12
Crude Protein	3.69 ± 0.25	3.75 ± 0.16	0.53

Ash	44.46 ± 3.66	55.98 ± 17.58	0.14
Moisture	8.95 ± 0.89	4.07 ± 0.41	0.20

The result from proximate analysis indicates that both c-TMR and TMRp for pre-weaning goats contain higher dry matter content as well as lower in moisture content. Previous study reported that commercial pellet was developed and formulated with low water content which was less than 13% in order to enhance for long term storage (Lou, 2018). This finding enhances our understanding about animal feed and concentrates which contained ingredients that can deteriorate over time. Many feed products and minerals are hygroscopic in nature and may bind and lump together after prolonged storage which can change the appearance of product. To be exact, most of the animal feed should be consume within 3 months from the manufacturing date for the best result. Thus, the moisture content in TMRp should not exceed 13% as it can inhibits the process of deterioration which can affect the quality and nutritive value of the pellet.

The result of the study reveals that there is a clear difference between of the dry matter content percentage between of each of the sample composition. For DM analysis, the highest DM content is 94.86 % that were from the sample TMRp. This is because the DM content increase after undergoes high pressure and high temperature.

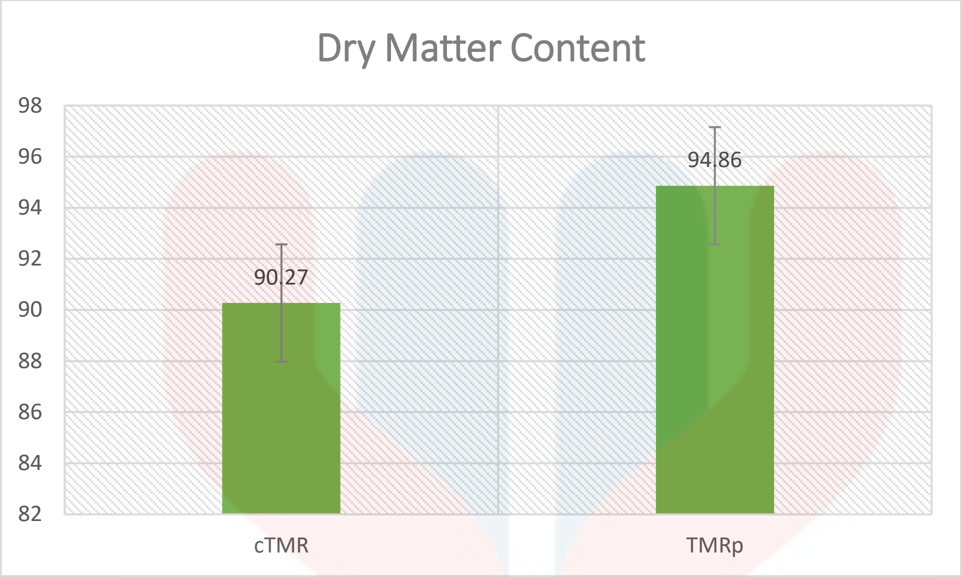

Figure 4.1 Dry matter (DM) content of TMR for pre-weaning goats

For commercial reasons, it is essential to control moisture content in order to compensate for losses that occur during grinding and cooling process. Hence, a sufficient moisture is important as it can reduce the energy usage during pelleting process as well as to ensure the production runs smoothly by lowering the risk of blockages.

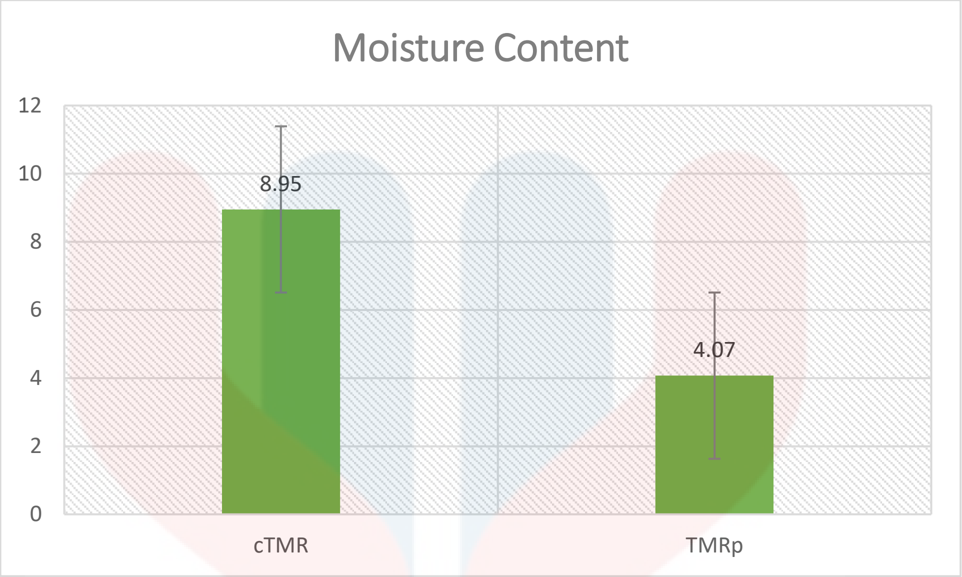

Figure 4.2 Moisture content of TMR for pre-weaning goats

On the other hand, cTMR was significantly higher in water content about 8% compared to TMRp since TMRp undergoes pelletizing process which cause moisture loss in sample. This was agreed by Lisowski et al. (2020) during pelleting, the average moisture in the pellet material fell by 0.50 % The moisture content of pellet materials was reduced by 2.57 %, while the addition of calcium carbonate reduced it by 6.44 %. Calcium carbonate considerably reduced the moisture content of the pellets generated. Differences in the moisture content of the material, as well as its sensitivity to alterations caused by calcium carbonate. Moisture in the material during compaction promotes bonding via van der Wall's forces, resulting in a larger particle contact area. The pellet density was strongly impacted by compressive force, particle size, and moisture content of 12–15 % According to Lisowski et al., goods made from biomass with a lower moisture content (5–10%) were denser, more stable, more durable than those made from biomass with a greater moisture content (15%). (2020). Cha et al. (2018) also state that pelleting process mostly cause moisture loss in TMRp which cause by pellet molding. Since the TMRp was pressed onto a die fixed with a rotary roll at high temperature and high pressure in pellet molding machine.

TMRp nutritionally contain higher CP which up to 3.75% than cTMR. According to the Zhong et al. (2018) CP content in sample increased due to the pelleting. Ahmed et al. (2020) the CP digestibility of a compound pellet feed (50 % ground Napier grass + 50 % concentrate mixture) was significantly increased (p 0.01) when compared to its mash and conventional feeding (separate grass and concentrate feeding). The high temperature and high-pressure during pelleting process might triggered increasing CP content in TMRp.

For CP analysis, the analysis was only done to sample cTMR and TMRp. the value of CP is 3.69 % and 3.75 %. The highest CP value was achieved by sample TMRp. For pre-weaning goats feeding, pre-weaning goats requires around to 16% of CP in their diet. Therefore, the CP content are not reached the general CP requirement in pre-weaning goats nutrition for both samples. Because feed processing involves a mix of shear, heat, residence time, and water, partial denaturation of the proteins in the feed may occur, resulting in increased digestibility. Heating enhances protein digestibility by inactivating enzyme inhibitors and denaturing the protein, perhaps exposing new enzyme attack sites (Islam et al. 2017) The increased nutritional content of CP in TMRp is probably due to the pelleting and molding, which results in the pelleting TMR may affected the CP content.

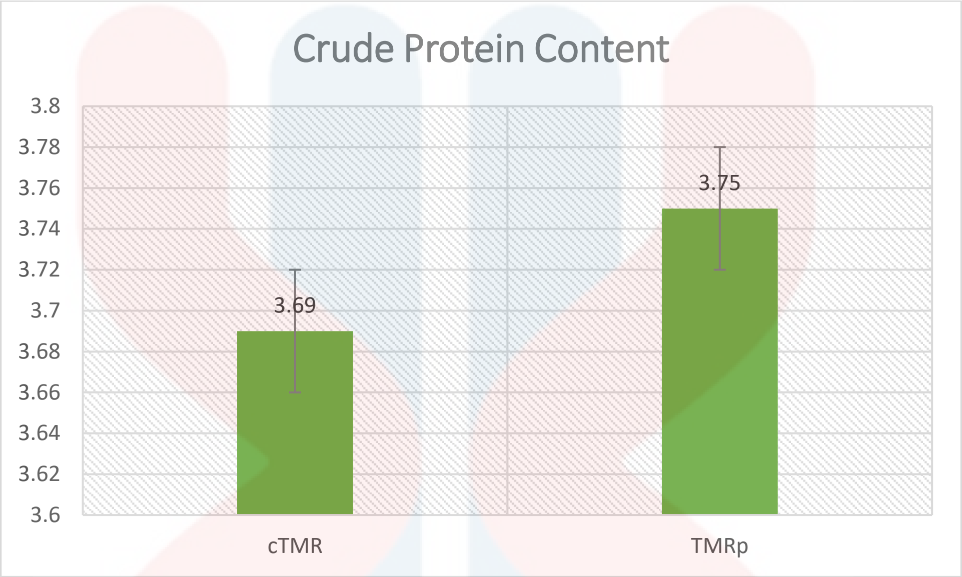

Figure 4.3 Crude protein (CP) content of TMR for pre-weaning goats

The fiber content of the cTMR and TMRp is above the minimum CF criteria for pre-weaning goats which are around to 15% (Predith et al. 2020). The explanation for this is that the Predith et al. (2020) observed that a greater percentage of effective fibre increased rumen motility, muscularization, and rumen volume, and that these kids had a thicker rumen muscular layer. The other explanation is the ingredient that being used cause high in CF content which mostly the ingredient was used are high in CF content based on proximate analysis.

The highest CF content is 35.50 % for sample cTMR and followed by sample TMRp which is 30.68 % which is more than the sufficient amount needed for pre-weaning goats feeding. The huge difference between cTMR and TMRp may cause by pelleting and molding, which high pressure and temperature cause

CF content loss. However, Islam et al. (2017) reported that the pelleted diets had a greater crude fibre digestibility than unpelleted feeds. The researcher believed that the CF content was loss during pelleting process.

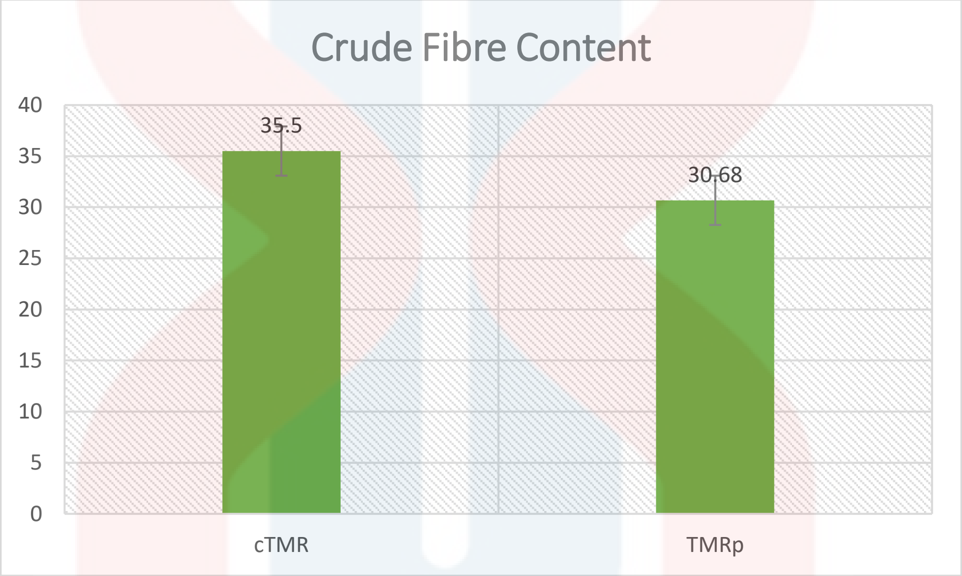

Figure 4.4 Crude fibre (CF) content of TMR for pre-weaning goats

Next, fat is not spread to any large farms, including goats, in sufficient quantities in the feed industry. The use of whole seeds particularly soy has recently been significantly increased, according to Fernandez et al. (2000). The outcome is the number of similar papers released last few years, carcass fat deposits are significantly influenced by the consumption of fat-added diets, while polyunsaturated fatty acids are less likely than saturation to increase the body fat. This would lead to greater consequences of the amount of unsaturated fatty acids in the carcasses of animals feed on this product.

The EE content in the samples is categorized between un-pelleted and pelleted. The highest EE content in the sample is from sample cTMR with the value of 62.01 % and the least is from the sample TMRp with the value of 17.05 %. The presence of sodium bicarbonate decreases the amount of the EE from the sample because the sodium bicarbonate is act as a binder and also fat binding ability of sodium bicarbonate. The sodium bicarbonate presence in TMRp is 1.5%. The fat requirement for pre-weaning goats was around 3% of EE content in the diet (Predith et al. 2020). The p-value of EE content between the samples TMR sample is 0.12 respectively to the composition of the sample which higher than 0.05. This shows that there is no significant between both samples.

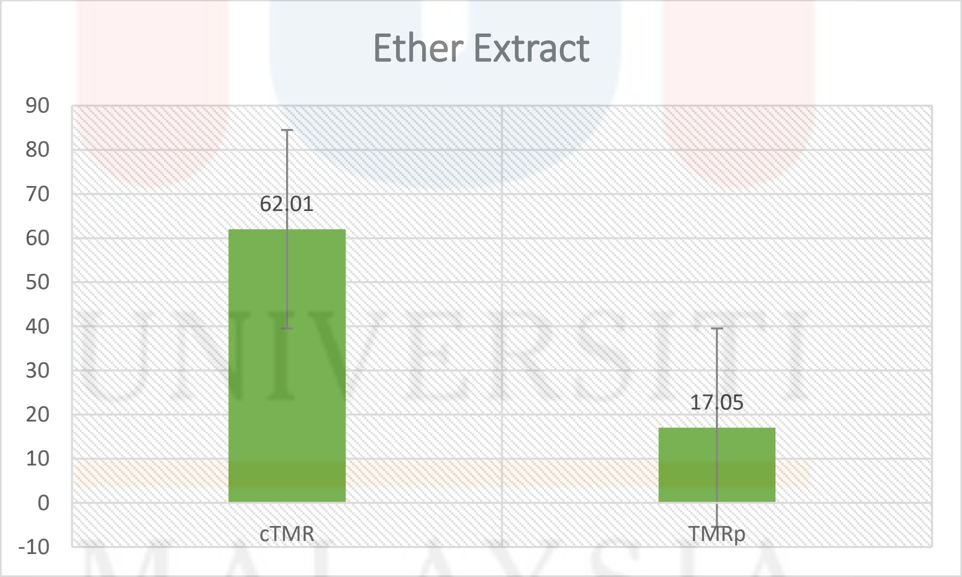

Figure 4.5 Ether extract (EE) content of TMR for pre-weaning goats

The ash content in the sample is the highest at 55.98 % from the sample TMRp and the lowest is 44.46 % from the sample cTMR. There is no significant value from between sample because the p-value exceeds 0.05. That was because of pelleted has high organic matter is either ignited or completely oxidized, leaving an inorganic residue (Ismail et al. 2017). cTMR has low ash content because high CF content that easily oxidized instead of TMRp which hardly oxidized.

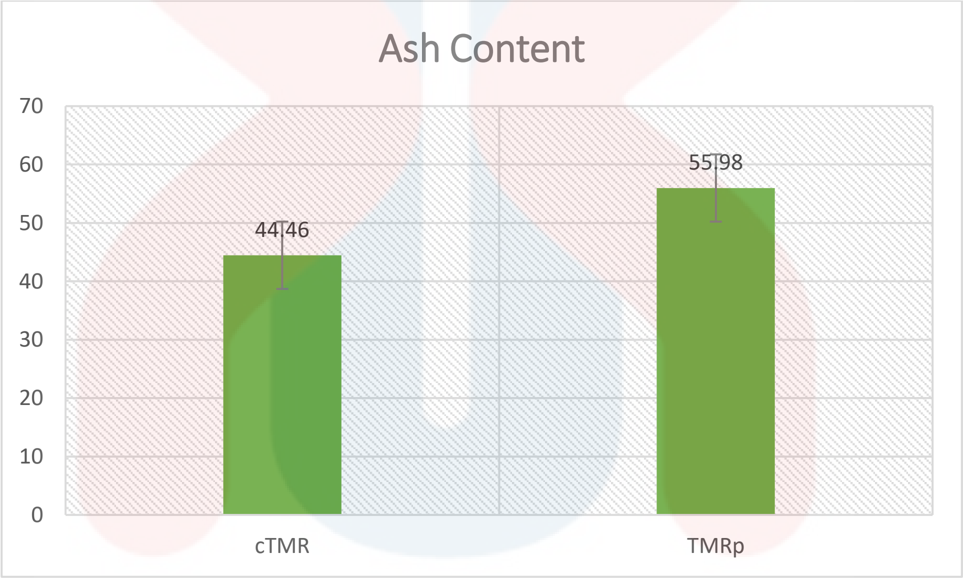

Figure 4.1 Ash content of TMR for pre-weaning goats

4.2.2 Effect of pelleting on nutritional values of TMR for post-weaning goats

Based on the proximate analysis of TMR for post-weaning goats, shows that TMRp had the highest DM content (%) which were 99.06 compared to cTMR only contain 93.86 respectively. However, in term of CF content (%), cTMR contain 35.50 % which was the highest among the other samples, followed by TMRp was 21.66 %. Next, c-TMR contained higher EE content (67.05 %) than TMRp which were 3.71 %. But CP of the TMRp were the highest compared to c-TMR which is 3.47 % and 2.06 % respectively. c-TMR contained 44.53 % of ash and 9.49 % of moisture content whereas TMRp contain 6.16 % of ash and 7.13 % of moisture content. The independent T-test revealed that all the analysis shown that there were a significant different ($p<0.05$) between the groups except for the CP and moisture which obtained p value bigger than 0.05 and thus resulting no significant different among them.

Table 4.3 Chemical composition of TMR for post-weaning goats

Sample	cTMR	TMRp	P-value
Dry Matter	93.86 ± 10.70	99.06 ± 0.46	0.05
Crude Fibre	35.50 ± 15.70	21.66 ± 0.32	0.02
Ether Extract	67.05 ± 12.10	3.71 ± 1.33	0.05
Crude Protein	2.06 ± 0.18	3.47 ± 0.24	0.63
Ash	44.53 ± 2.06	6.16 ± 0.62	0.06

Moisture	9.49 ± 0.36	7.13 ± 0.57	0.44

According to the results of proximate analysis, both c-TMR and TMRp for post-weaning goats had higher DM content and lower moisture content. According to a previous study, commercial pellets were designed and prepared with a low water content of less than 13% to improve long-term storage (Lou, 2018). The study's findings show that there is a significant variation in DM content percentage between each of the sample compositions. For DM analysis, the sample TMRp had the highest DM concentration of 99.06 %. This is due to the fact that when high pressure and high temperature are applied, the DM content increases.

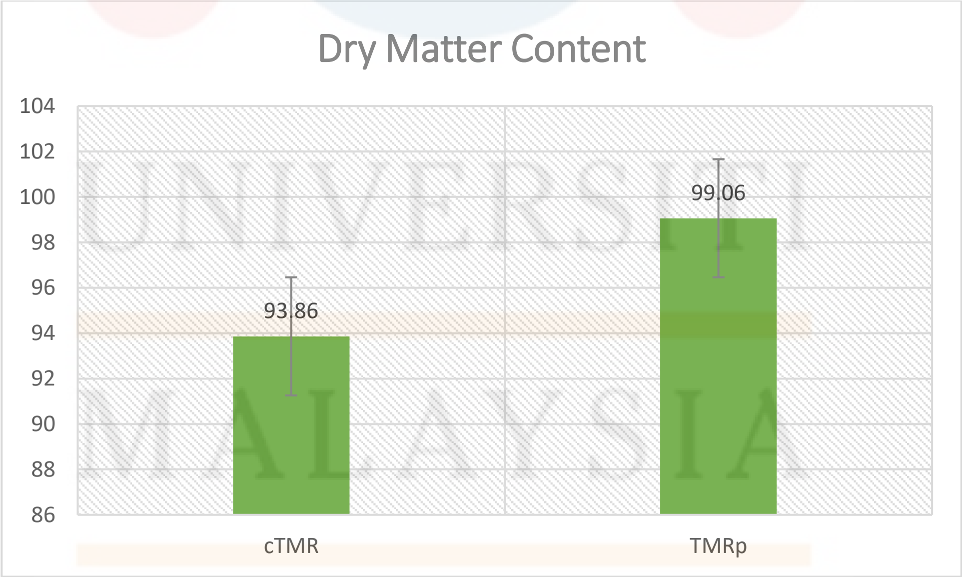

Figure 4.7 Dry matter (DM) content of TMR for post-weaning goats

In comparison to TMRp, cTMR had a much greater water content of roughly 9%, owing to the pelletizing procedure, which causes moisture loss in the sample. According to Lisowski et al. (2020), the average moisture in the pellet material reduced by 0.50 % during pelleting. The moisture content of pellet materials was reduced by 2.57 %, and it was lowered by 6.44 % with the addition of calcium carbonate. Calcium carbonate lowered the moisture content of the pellets produced significantly. Differences in the material's moisture content, as well as its susceptibility to calcium carbonate-induced changes. According to Cha et al. (2018), the pelleting process induces moisture loss in TMRp, which is caused by pellet molding. TMRp was pressed onto a die fixed with a rotary roll in a pellet molding machine at high temperature and high pressure.

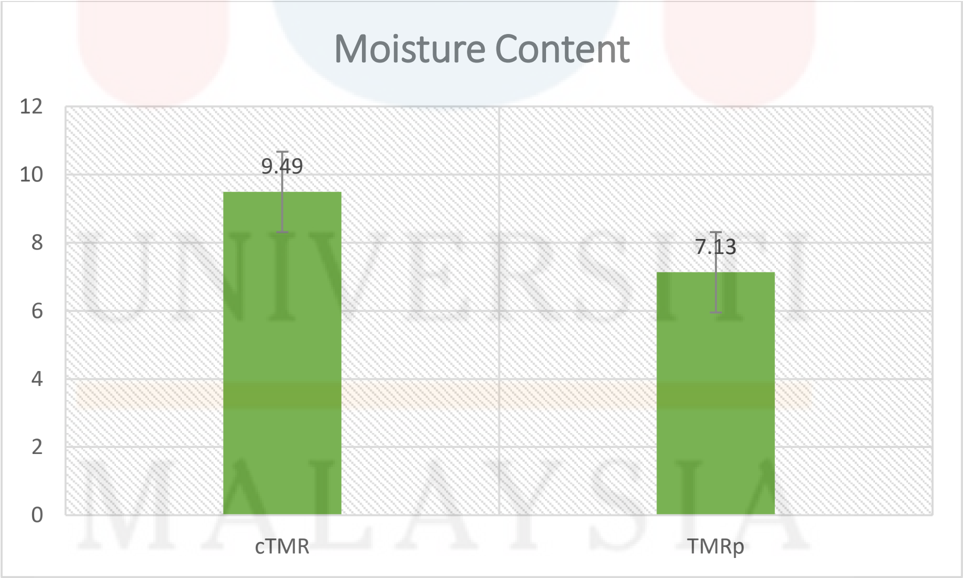

Figure 4.8 Moisture content of TMR for post-weaning goats

Sample cTMR has the greatest CF content of 170.15 15.70 %, followed by sample TMRp, which has a CF content of 21.66 0.32 %, which is more than enough for post-weaning goats feeding. Pelleting and moulding, which produce CF content loss due to high pressure and temperature, may be the source of the large disparity between cTMR and TMRp. Pelletized diets, on the other hand, showed a higher CF digestibility than unpelleted feeds, according to Islam et al. (2017). The CF content was thought to be lost during the pelleting process, according to the study.

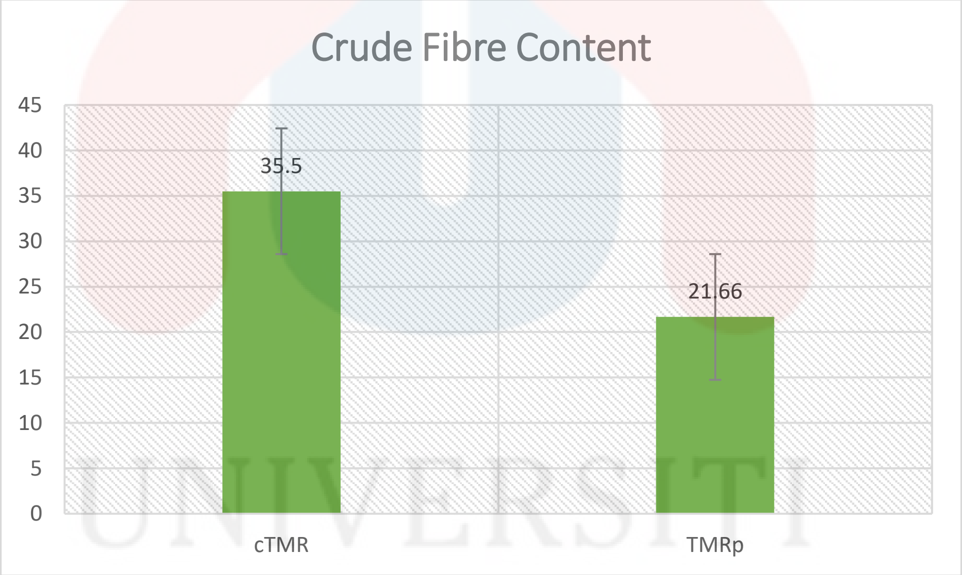

Figure 4.2 Crude Fibre (CF) content of TMR for post-weaning goats

The EE content of the samples is divided into two categories: unpelleted and pelleted. Sample cTMR has the greatest EE content in the sample, with a value of 67.05 %, while sample TMRp has the lowest, with a value of 3.71 %. Because sodium bicarbonate acts as a binder and has fat binding capacity, the presence of sodium bicarbonate reduces the quantity of EE in the sample. TMRp has a sodium bicarbonate content of 1.5 %. The p-value of EE content between the TMR sample and the composition of the sample is 0.05, although the composition of the sample is greater than 0.05. This demonstrates that there is a considerable difference in value between the two samples.

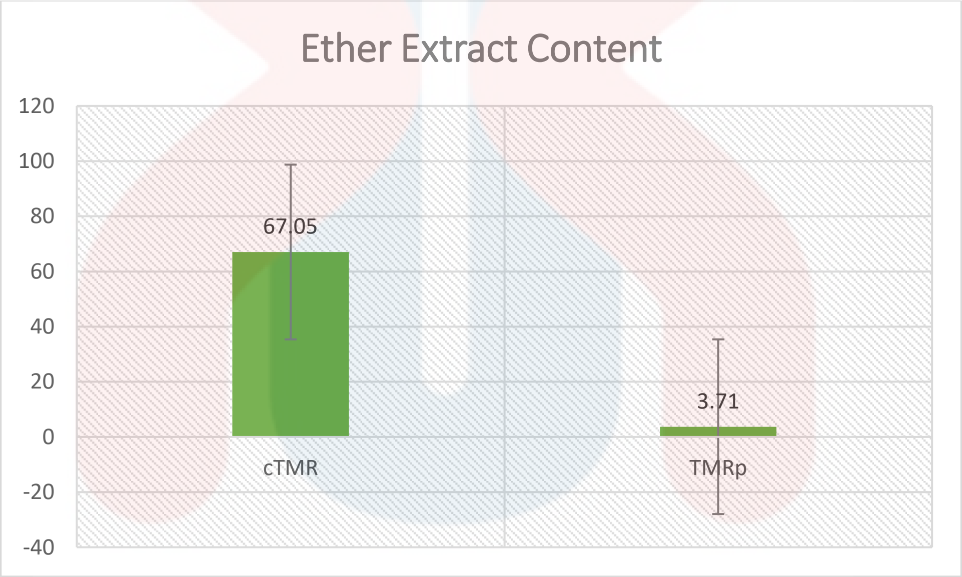

Figure 4.3 Ether extract (EE) content of TMR for post-weaning goats

In the case of CP analysis, only cTMR and TMRp were sampled. CP has a value of 2.06 % and 3.47 %. TMRp was the sample with the highest CP value. Due to the combination of shear, heat, residence time, and water used in feed processing, partial denaturation of the proteins in the feed may occur, resulting in enhanced digestibility. Heating increases the digestibility of proteins by inactivating enzyme inhibitors and denaturing the protein, perhaps exposing new enzyme attack sites. (2017, Islam et al.) The enhanced nutritional content of CP in TMRp is most likely owing to pelleting and molding, which may have impacted the CP content of TMR.

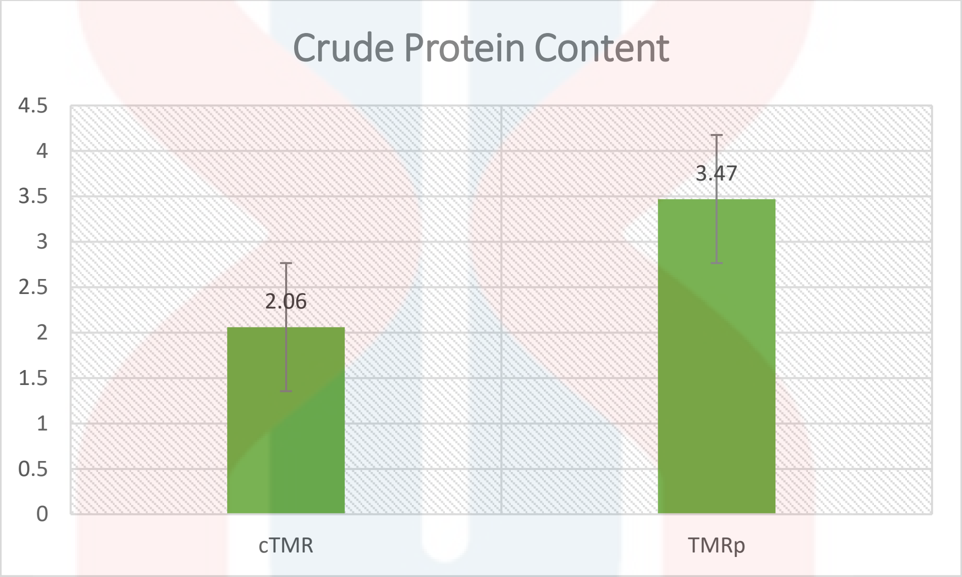

Figure 4.4 Crude Protein (CP) content of TMR for post-weaning goats

The sample with the greatest ash content is 44.53 % from the sample cTMR, while the sample with the lowest is 6.16 % from the sample TMRp. Because the p-value is greater than 0.05, there is no significant value from between samples. Unpelleted has a lot of organic stuff, which becomes burned or totally oxidized, leaving an inorganic residue (Ismail et al. 2017). This might be attributed to the fact that the mineral residue in cTMR was greater than in TMRp.

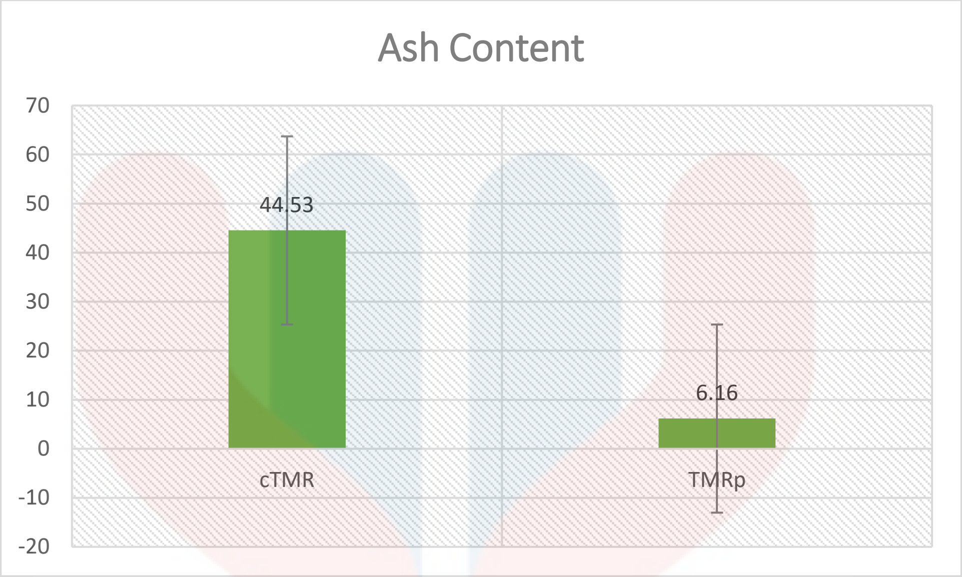

Figure 4.5 Ash content of TMR for post-weaning goats

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In conclusion, TMRp of pre-weaning and post-weaning goats having nutrient loss due to pelletizing process but DM and CP content significantly increased. Based on the study, CF, EE, Moisture, and post-weaning TMRp showing a significant decreasing than the cTMR. The new formulation can be a good protein source to pre-weaning and post-weaning goats. The first objective is to determine the nutritional values of feedstuff for TMRp which was successfully done. Chemical composition of ingredient was calculated using proximate analysis which analyze DM, CP, CF, EE, Ash and Moisture content of each feedstuff. The second objective which is to formulate the TMR pellet for pre-weaning and post-weaning goats based on the optimum TMR formulation. The researcher was using Winfeed 2.8.4 version to formulate the ideal TMR formulation for both pre-weaning and post-weaning goats. The third objective is to evaluate the effect of pelleting process on the nutritional contents of TMR which was successfully done. Chemical composition for each TMR was shown in results and discussion part.

The formulation can be improved by increasing the CF just little bit more because it is barely contained sufficient amount in the current formulation. Moisture content also required to be increase because low Moisture content for TMRp formulation can lead to produce more dust waste during pelletizing. Furthermore, improvement is mostly needed is changing analytic balance in Animal Lab to the better analytic balance because current analytic balance contains more of error which are not good for research purposes.

It is conclude that pelleting process or TMR increased the dry matter, crude protein and ash of pre-weaning TMRp, while pelleting increased dry matter and crude protein of post-weaning TMRp. Feeding pelleted TMR is a feasible strategy for intensive pre-weaning and post-weaning goat operations.

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APPENDIX A

Descriptives

DM

					95% Confidence nterval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Sodium_Bicarbonate	3	82.1123	10.30152	5.94759	56.5219	107.7027	74.42	93.82
Sodium_Chloride	3	88.5421	3.40704	1.96706	80.0786	97.0057	85.65	92.30
Soybeal_Meal	3	75.2316	10.33189	5.96512	49.5657	100.8974	63.63	83.46
Copra_Meal	3	89.9734	6.16517	3.55946	74.6583	105.2885	83.94	96.26
Mineral_Premix	3	93.4553	2.59817	1.50006	87.0011	99.9096	90.65	95.79
PKC	3	65.3260	17.91223	10.34163	20.8295	109.8224	44.64	75.67
Rice_Bran	3	71.4565	8.43633	4.87072	50.4995	92.4135	61.80	77.41
Molasses	3	52.6232	2.67361	1.54361	45.9816	59.2648	50.57	55.65
Napier	3	88.1253	3.92529	2.26626	78.3743	97.8763	84.86	92.48
Soya_Hull	3	90.9138	1.57157	.90735	87.0098	94.8178	89.44	92.56
Corn_Meal	3	94.9555	5.08556	2.93615	82.3223	107.5888	89.47	99.52
Total	33	81.1559	14.64376	2.54915	75.9635	86.3484	44.64	99.52

ANOVA

DM

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5437.775	10	543.778	8.399	.000
Within Groups	1424.291	22	64.741		
Total	6862.067	32			

Descriptives

CP

	N	Mean	Std. Deviation	Std. Error	95% Confidence nterval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Sodium_Bicarbonate	3	.0000	.00000	.00000	.0000	.0000	.00	.00
Sodium_Chloride	3	.0000	.00000	.00000	.0000	.0000	.00	.00
Soybean_Meal	3	20.7067	1.26808	.73213	17.5566	23.8568	19.93	22.17
Copra_Meal	3	10.1400	.72194	.41681	8.3466	11.9334	9.60	10.96
Mineral_Premix	3	.0000	.00000	.00000	.0000	.0000	.00	.00
PKC	3	10.6067	.13317	.07688	10.2759	10.9375	10.46	10.72
Rice_Bran	3	5.9700	.69311	.40017	4.2482	7.6918	5.17	6.39
Molasses	3	1.6233	.40452	.23355	.6185	2.6282	1.31	2.08
Napier	3	5.9700	.37403	.21595	5.0409	6.8991	5.54	6.22
Soya_Hull	3	10.3600	.54286	.31342	9.0115	11.7085	9.93	10.97
Corn_Meal	3	1.0567	.30665	.17704	.2949	1.8184	.81	1.40
Total	33	6.0394	6.33033	1.10197	3.7948	8.2840	.00	22.17

ANOVA

CP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1275.699	10	127.570	422.718	.000
Within Groups	6.639	22	.302		
Total	1282.339	32			

Descriptives

Fibre

	N	Mean	Std. Deviation	Std. Error	95% Confidence nterval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sodium_Bicarbonate	3	37.4574	12.00104	6.92880	7.6451	67.2696	29.36	51.25
Sodium_Chloride	3	11.2800	3.33350	1.92459	2.9991	19.5608	8.85	15.08
Soybean_Meal	3	11.3376	5.55514	3.20726	-2.4621	25.1373	5.64	16.74
Copra_Meal	3	15.1442	4.32925	2.49949	4.3898	25.8987	10.20	18.23
Soya_Hull	2	62.5677	48.82869	34.52710	-376.1407	501.2761	28.04	97.09
Mineral_Premix	2	.8476	.60592	.42845	-4.5964	6.2915	.42	1.28
Rice_Bran	3	12.9366	7.40289	4.27406	-5.4532	31.3264	5.28	20.06
Napier	3	13.8211	4.01017	2.31527	3.8593	23.7829	9.85	17.87
Corn_Meal	3	14.5948	5.14934	2.97297	1.8031	27.3864	8.77	18.53
PKC	2	59.2009	.00000	.00000	59.2009	59.2009	59.20	59.20
Total	27	22.0351	21.57121	4.15138	13.5018	30.5684	.42	97.09

ANOVA

Fibre

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9109.355	9	1012.151	5.757	.001
Within Groups	2988.887	17	175.817		
Total	12098.242	26			

Descriptives

Fat

	N	Mean	Std. Deviation	Std. Error	95% Confidence nterval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Soybean_Meal	3	.8037	.36205	.20903	-.0957	1.7030	.41	1.12
Sodium_Bicarbonate	3	.0000	.00000	.00000	.0000	.0000	.00	.00
Sodium_Chloride	3	.0000	.00000	.00000	.0000	.0000	.00	.00
Copra_Meal	3	4.8356	2.58378	1.49174	-1.5829	11.2540	2.60	7.66
Soya_Hull	3	4.6910	.96599	.55771	2.2913	7.0907	3.70	5.63
Mineral_Premix	3	.4526	.11690	.06749	.1622	.7430	.33	.57
PKC	3	16.0015	3.04076	1.75558	8.4479	23.5552	13.13	19.19
Rice_Bran	3	10.2626	1.33439	.77041	6.9478	13.5774	8.75	11.26
Molasses	3	4.9533	2.23467	1.29019	-.5979	10.5046	3.32	7.50
Napier	3	3.7279	1.60844	.92863	-.2677	7.7235	2.09	5.31
Corn_Meal	3	1.4163	2.45316	1.41633	-4.6777	7.5103	.00	4.25
Total	33	4.2859	5.00855	.87188	2.5099	6.0618	.00	19.19

ANOVA

Fat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	737.979	10	73.798	25.071	.000
Within Groups	64.759	22	2.944		
Total	802.738	32			

Descriptives

Ash

	N	Mean	Std. Deviation	Std. Error	95% Confidence nterval for Mean Lower Bound	95% Confidence nterval for Mean Upper Bound	Minimum	Maximum
Soybean_Meal	3	7.1308	3.38969	1.95704	-1.2896	15.5513	3.75	10.53
Sodium_Bicarbonate	3	91.4228	16.52208	9.53903	50.3796	132.4659	72.53	103.18
Sodium_Chloride	3	154.0743	71.68154	41.38536	-23.9925	332.1411	71.30	195.69
Copra_Meal	3	3.7068	1.30025	.75070	.4768	6.9368	2.26	4.79
Soya_Hull	3	4.8775	.26595	.15355	4.2169	5.5382	4.57	5.04
Mineral_Premix	3	6.5525	5.30776	3.06444	-6.6327	19.7377	.67	10.99
PKC	3	100.6073	2.66919	1.54106	93.9767	107.2380	98.75	103.67
Rice_Bran	3	31.0095	37.58898	21.70201	-62.3667	124.3857	9.25	74.41
Molasses	3	136.8444	8.71141	5.02954	115.2040	158.4847	131.38	146.89
Napier	3	3.8773	3.34991	1.93407	-4.4443	12.1989	.42	7.11
Total	30	54.0103	62.30229	11.37479	30.7463	77.2744	.42	195.69

ANOVA

Ash

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	98646.051	9	10960.672	15.749	.000
Within Groups	13919.626	20	695.981		
Total	112565.677	29			

Descriptives

Moisture

	N	Mean	Std. Deviation	Std. Error	95% Confidence nterval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sodium_Bicarbonate	3	3.5833	.65760	.37966	1.9498	5.2169	3.15	4.34
Sodium_Chloride	3	.5267	.02517	.01453	.4642	.5892	.50	.55
Soybean_Meal	3	9.7667	.48087	.27763	8.5721	10.9612	9.27	10.23
Copra_Meal	3	9.7800	.45431	.26230	8.6514	10.9086	9.46	10.30
Mineral_Premix	3	2.6867	.04041	.02333	2.5863	2.7871	2.65	2.73
PKC	3	6.2233	.66078	.38150	4.5819	7.8648	5.76	6.98
Rice_Bran	3	10.1467	.40992	.23667	9.1284	11.1650	9.91	10.62
Molasses	3	49.1300	.74840	.43209	47.2709	50.9891	48.57	49.98
Napier	3	12.9567	.74070	.42764	11.1167	14.7967	12.48	13.81
Soya_Hull	3	10.1300	.49508	.28583	8.9002	11.3598	9.64	10.63
11.00	3	9.9233	.05132	.02963	9.7959	10.0508	9.88	9.98
Total	33	11.3503	12.70043	2.21086	6.8469	15.8537	.50	49.98

ANOVA

Moisture

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5155.965	10	515.597	2001.634	.000
Within Groups	5.667	22	.258		
Total	5161.632	32