SHELF-LIFE EVALUATION OF TOTAL MIXED RATION PELLET ON ITS CHEMICAL COMPOSITION FOR DAIRY GOATS

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DECLARATION

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

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ABSTRAK

Masalah utama dalam ransum campuran penuh ialah kandungan air yang tinggi. Kandungan air yang tinggi di dalam makanan ransum campuran penuh akan menggalakkan pertumbuhan kulat dan yis di pelet. Pertumbuhan kulat dan ragi boleh menyebabkan pembaziran makanan kerana banyak nutrient telah rosak menjadi bahan yang tidak diingini semasa fasa pemanasan. Tambahan pula, bahan basah akan terlalu panas pada suhu purata dan serta-merta akan rosak apabila terkena suhu persekitaran yang lebih tinggi. Untuk mengatasi masalah ini, analisis proksimat dan jangka hayat ransum campuran penuh akan dibincangkan dalam kajian ini. Untuk menentukan sifat kimia pelet, analisis proksimat dijalankan. Untuk analisis statistik, data akan di analisis menggunakan analisis varians sehala (ANOVA). Hasil analisis fiber pada hari ke 60, 45, 30, 15 and 0 masing- masing ialah 2.964, 3.023, 5.129, 12.451 dan 27.256. Selain itu, nilai protein pada hari ke 0, 15, 30, 45 and 60 masing- masing adalah 10.283, 9.889, 8.492, 13.195 dan 1.136. Kemudian, nilai lipid yang dimulakan dengan 5.446 pada hari ke 0, 4.173, 3.427±0,271, 2.157 dan 1.499 pada hari ke 15, 30, 45 and 60 masing-masing. Tambahan pula, bahan kering dimulakan dengan 93.727 pada hari ke 0 dan diteruskan dengan 93.473, 93.34, 92.791 dan 91.142 pada hari ke 15, 30, 45 dan 60. Kemudian, pada hari ke 0 dan 15, kandungan kelembapan masing- masing ialah 6.527 dan 6.273. Walau bagaimanapun, pada hari ke 30, 45 dan 60, nilai kelembapan masing- masing ialah 6.527, 7.67 and 8.037 masing-masing. Akhir sekali, analisis abu pada hari ke 15 ialah 7.738 dan pada hari ke 30, 45 dan 60 masing-masing ialah 6.487, 3.906 dan 3.563.

Kata kunci: pelet ransum campuran penuh, formulasi makanan, jangka hayat, komposisi kimia

Shelf-Life Evaluation of Total Mixed Ration Pellet on its Chemical Composition for Dairy Goats

ABSTRACT

The main problem in the conventional total mixed ration (TMR) is the higher moisture content. The high moisture content of TMR will encourage the mould and yeast at the pellet. It is also can lead to feeding waste because many nutrients are broken down into undesirable materials during the overheating phase. Furthermore, the wet substance can overheat at average temperature and spoil instantly when exposed to higher ambient temperature. To overcome these problems, proximate analysis and shelf life of TMR were discussed in this study. The chemical composition of the pellet in different timeline, day 0, 15, 30, 45 and 60 were determined using proximate analysis. For statistical analysis, the data was analysed using one-way analysis of variance (ANOVA). The result of crude fibre content in day 60, 45, 30, 15 and 0 was 2.964, 3.023, 5.129, 12.451 and 27.256 respectively. Next, the value of crude protein in day 0, 15, 30, 45 and 60 were 10.283, 9.889, 8.492, 13.195 and 1.136 respectively. Then, the result of fat content that started with 5.446 in day 0, 4.173, 3.427, 2.157 and 1.499 in day 15, 30, 45 and 60 respectively. Furthermore, dry matter result start with 93.727 in day 0 and continued with 93.473, 93.34, 92.791 and 91.142 in days 15, 30, 45 and 60 respectively. Next, in day 0 and 15, the moisture content was 6.527 and 6.273 respectively. However, in days 30, 45 and 60, the value of moisture content pellet was 6.527, 7.67 and 8.037 respectively. Lastly, result of ash analysis in day 15 is 7.738 and in day 30, 45 and 60 which were 6.487, 3.906 and 3.563 respectively.

Keywords: TMR pellet, feed formulating, shelf life, chemical composition

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
CP	Crude protein
CF	Creep feed
GR	Growing ration
LR	Lactating ration
ME	Metabolize energy
PFAD	Palm fatty acid distillate
PKC	Palm kernel cake
TMR	Total Mixed Ration
DM	Dry Matter
HCl	Hydrochloric acid
H_2SO_4	Sulfuric acid
NaOH	Sodium hydroxide
H_3BO_3	Boric acid

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Dairy goat farming is a fast-growing livestock industry in Malaysia and a potentially profitable venture, although it is still in its infancy. However, there are issues and challenges in developing and improving the dairy goat industry that farmers must face. The demand for goat's milk also very small because of the goaty odour. Grading of goat's milk should be implemented to eventually deliver the quality of milk that meets customer satisfaction.

Next, farmers involve in dairy goat farming would experience better viability and sustainability in their goat farming business simply because milk production will provide the farmers constant cash flow. The availability and suitability of dairy goat breeds for this country will provide an impetus for large-scale dairy goat farming in Malaysia. In addition, the potential of value-added dairy goat products can increase the local and export market.

The increase of small ruminant production is important as the world's population grows, and people continue to eat meat. An intensive and long-term fattening scheme necessarily involves rapid gains and less labour at a lower rate. Many studies conducted to see how pelleted and conventional total mixed rations (TMRs) with 15 % and 25 % wheat straw affected development, nutrient digestibility, nitrogen balance, liver enzymes, blood metabolites, and full blood counts (Malik et al., 2020). Both pelleted TMR treatments increased feed intake and growth efficiency.

Evaluation of the pellet plays important roles in order to increase the quality of the goat's milk. The main problem that occur in making pellet is that its physical form and higher moisture contents. In instance, Napier grass. Napier grass contributes 40% of total composition of TMR and 60-78% moisture is present in Napier grass, which results in the moisture content of 50% in finished TMR. At higher ambient temperatures, a substance with a high moisture content may become overheated and spoiled at normal temperatures. The high moisture content of TMR encourages mould and yeast development in the presence of nutrients. If the microbial fermentation process is prolonged for an extended period of time, the ration can become overheated and spoiled. It is expected that grain-based pellet following the heat treatment can be stored up to 3 to 6 months. But TMR pellet has not been investigated its shelf-life. Therefore, this current study aims to evaluate the chemical composition of TMR pellets at different time points, day 0, 15, 30, 45 and 60.

1.2 Problem Statement

The physical form and higher moisture content of TMR are the major issues in pellet. It is because Napier grass contributes 40% of the overall TMR composition, and Napier grass contains 60-78 percent moisture, resulting in a moisture content of 50% in finished TMR. Also, at average temperatures, a wet substance will overheat and spoil quickly when exposed to higher ambient temperatures.

Next, the high moisture content of TMR encourages mould and yeast development in the presence of nutrients. As a result of microbial fermentation, the ration can become overheated, and if the process is prolonged for an extended period of time, the ration may spoil. Many nutrients are broken down into undesirable materials during the overheating phase. If overheated feeds are obtained, the pellet can produce an unpleasant taste and flavour that is unsuitable for ruminants, as well as low nutrient availability. Furthermore, goat is a picky eater that can lead to feed wastage.

1.3 Hypothesis

Ho: There is no significant difference in proximate analysis of TMR pellet on day 0, 15, 30, 45 and 60.

H1: There is a significant difference in proximate analysis of TMR pellet on day 0, 15, 30, 45 and 60.

1.4 Objectives

- To evaluate the proximate analyses of TMR pellet for goats.
- To assess the shelf life of TMR pellets at days 0, 15, 30, 45 and 60

CHAPTER 2

LITERATURE REVIEW

2.1 Dairy industry in Malaysia and world

Malaysia is one of the largest milk importers countries in the world after China, Mexico, Algeria, the Russian Federation, Indonesia, Saudi Arabia, and the Philippines, is (FAO, 2019). However, despite the fact that fluid fresh milk production rose by 48.32 percent from 2007 to 2016, it did not keep pace with rising consumer demand for dairy products due to Malaysia's high population, income, and urbanization rates during the current decade. (Sim & Suntharalingam, 2015; Dong, 2006). Over the last few decades, the Malaysian dairy cattle industry has faced numerous challenges. Despite attempts by the Malaysian government, dairy farmers, and other industry stakeholders to increase local milk production, it remains undeveloped.

However, during the last decade (2007-2016), production of fresh milk in Malaysia grew by 48.32 percent. According to Malaysia's Department of Veterinary Service (DVS) data, milk production in Malaysia increased to 36.9 million kilograms in 2017 from 24.77 million kilograms in 2007 (DVS, 2018). According to an FAO statistic, Malaysia is still one of the world's top importers of milk and dairy goods. Furthermore, Malaysian government has financed the dairy cattle industry. DVS has attempted to offer professional consultation, veterinary services, and breeding guidance to farmers, with the farmers' only responsibility being to prepare the land and labour (Boniface, 2010). The support from the government and other industry stakeholders make the dairy industries in Malaysia increased.

Current situation of dairy industries over the forecast era, global milk demand is expected to increase at a rate of 1.6 percent per year (to 997 Mt by 2029, faster than most other main agricultural commodities). Cow herds are predicted to increase faster in countries with low yields than normal yields, so the estimated growth of cowherds (0.8 percent p.a.) is marginally higher than the projected average yield growth (0.7 percent p.a.).

The country that are projected to contribute more than half of the increase in global milk output over the next ten years are India and Pakistan which both major milk producers will be accounting for more than 30% of global production in 2029. However, overall per capita demand for fresh dairy products in Europe and North America is constant or even falling, but demand for dairy fat has been changing for many years.

In the dairy industry, feeding methods have a greater impact on profitability than any other single factor. Feed costs account for 60-80% of the variable costs of milk production. According to Capper et al., 2009 (Kennedy et al., 2009), cows on fixed pastures lose weight and produce less milk than cows on free stalls (Hernández-Mendo et al., 2007) because they absorb less dry matter than cows raised indoors. In terms of nutrient density, grazing animals may have limited milk production compared with complex diets (Soriano et al., 2001). Animals need energy to achieve their maximum genetic potential.

2.2 Dairy goat feeding

In small farm systems and agriculture, tiny ruminants play a significant economic and ecological role (Devendra et al., 2001). The goat is one of the first domesticated small ruminant animals, having been used for meat and milk in the Middle East from at least 2500 B.C. (Dubeuf and Boyazoglu2009; Salah 2005).

Goats may be found in many sorts of environments, although they are more common in the tropics and arid zones of developing countries. 97.3 percent of the world's goats (roughly 617 million) are located in underdeveloped countries. 65.9% are found in Asia, 27.4% in Africa, 3.5 percent in Europe, and 3.0% in the Americas. There are 191 million dairy goats in the globe, with 47.7% of them living in the 25 least developed nations (FAO STAT 2012).

More than 55% of the total cost of dairy goat raising is feed costs account. As a result, many farmers are more concerned with lowering the cost of feeding a goat every day than improving their feeding performance. Dairy goat is like other ruminant animals such as cows and sheep which has a special digestive system that helps it to eat and absorb fibrous foods that would otherwise be inaccessible to non-ruminant animals. Feeding is the most significant non-genetic influence affecting milk structure and transition properties. Furthermore, in order to satisfy nutritional needs, goats are fed by mixing different feedstuffs into a palatable and suitable ration. (Schmidely & Sauvant, 2001).

Dairy goats are kept in a variety of production systems, including intensive and extensive, the latter of which are carried out by a variety of people, including pastoralists, smallholders, and frequently in marginal areas where it is the only source of protein and a means of subsistence for marginal people (Devendra et al., 2007).

Several dietary factors influence the fat content of milk and the yield of dairy goats. Concentration, consumption, and source of dietary non-fibre carbohydrates, particle size of feeds and fibre, use of probiotics in the diet, such as yeast, amount, physical characteristics, and FA composition of dietary fat supplement are the most significant.

In dairy goat diets, digestible fibre is particularly essential. A high grain-to-forage ratio does not promote good ruminant behaviour and is an expensive feeding technique. However, feeding methods should be able to fulfil their energy, protein, mineral, and vitamin requirements based on goat's health. When goats are lactating for a long time such as for 10 months, they will need supplementary feeding on a higher nutritional plane (e.g., dairy content second cut alfalfa hay and grain ration).

The essential nutrient that required for the goat are carbohydrates, proteins, fat, mineral and vitamin. As for carbohydrate, the starch and starch found in the grains while fibre (cellulose) are the main component that converts carbohydrate into volatile fatty acids (energy). Next, for proteins are digested and broken down into amino acids in the small intestine before being swallowed. Amino acids are the building blocks of proteins in the body (muscles). Through bacterial fermentation, the rumen plays a key function in breaking down ingested protein into bacterial protein. Protein requirement are higher during lactating. Then, minerals and vitamins are needed for goats' maintenance in order to proper functioning their physiological systems. Due to its failure to produce fat soluble vitamins (A, D, E, and K), a goat's diet must provide fat soluble vitamins (A, D, E, and K).

2.3 Total mixed ration

Total mixed ration (TMR), in which animals are fed a diet that includes both forage and concentrates and provides all of the required nutrients. TMR feeding has a number of benefits over traditional feeding, including increased dry matter intake (DMI), milk yield, and milk composition. Total mixed ration is suitable for cattle, sheep, goats and camels contain roughage and concentrate portions, in order to make sure the animal have a well-balanced diet.

The nutritional composition of the diet can be modified by utilising other feedstuffs and supplements (e.g., sources of rumen undegraded protein (RUP) and vitamins) in addition to preserved feeds when feeding a traditional TMR made daily (hays and whole-crop or grain silages). Ensiling a TMR, on the other hand, sends all nutrients through fermentation, which alters the ration's feeding value by changing nutrient content and availability (Bueno et al., 2020).

Total mixed ration feeding can reduce labour costs and could be tailored to the specific needs of each animal (Schingoethe, 2017). TMR feeding eliminated feed selection and sorting, provided appropriate nutrition in the needed amount, and increased feed utilisation efficiency (Bargo et al., 2003; Morales-Almarázet al., 2010; Charlton et al., 2011; Mendoza et al., 2016; Beigh as al., 2017; Premarathne and Samarasinghe, 2020).

However, the animals can sort for the highly palatable feed components and excluding the longest forage fragments in traditional separate feeding (Hoffman et al., 2006). As a result, traditional feeding methods resulted in a high level of forage waste. Fibre intake is also lower in traditional eating habits than in TMRs. In conjunction with volatile fatty acids, fibre plays an important part in rumen formation (VFA). As a result, traditional feeding produces fewer VFA in the rumen than TMRs. TMR roughages are sliced into smaller pieces, which improves digestibility and decreases heifer selection.

This method is not practical for small herds since high moisture ingredients must be monitored on a regular basis, animals can sort ingredients, feed may become overheated and rotten, and feed cannot be kept for long periods of time. Low moisture total mixed ration pellets are produced for feeding livestock animals to solve the problems associated with feeding conventional total mixed ration mash. TMR can improve animal efficiency and reduce the problems associated with feeding conventional total mixed ration mash.

2.4 Physical pre-treatment of feed resources

Various pre-treatment technologies often work in the same way and may provide the same result: lignocellulose structural modification. Various aspects of the material are degraded, and hemicellulose and lignin fibres can be broken down in this stage. (Taylor et al., 2019). The cellulose structure has been simplified. A monomer fragment and a glucose molecule can be found here. However, it would be difficult to establish a true representation of the cellulosic structure because of the extensive hydrogen bonding and glycosidic linkages, particularly because the true size is dependent on the parent material. The sugar composition of lignin differs from that of cellulose's glucose.

Next, mechanical or manual sorting is often used to physically pre-treat biomass wastes left over from the liquid biofuels manufacturing sector (e.g., seeds cake and energy crop stalks) (Taylor et al.,2019). This is where the cellulosic structure's crystallinity can be reduced. As a result, the particle size of the waste that will be upgraded as feedstock content will vary, and the available surface area will increase.

Methods of physical pre-treatment are drying and mechanical size reduction techniques such as milling and extrusion. Drying or dehydrating a feedstock content is a pre-requisite method that can have a significant impact on the value of the waste material, particularly for thermochemical downstream usability. The moisture content of lignocellulosic biomass waste is typically high. As a result, prior to other pre-treatment processes, drying techniques are a minimum prerequisite for feedstock planning. Air drying (ambient atmosphere), direct oven drying, convection oven drying (fan assisted), and freeze drying are all methods for drying lignocellulosic biomass (vacuum sublimation). (Jönsson et al., 2015).

Besides, in size reduction technique due to the fibrous properties of lignocellulosic biomass waste, determining the optimal feedstock particle size can be challenging. When producing heat energy in a boiler, a large particle size will lead to a decreased conversion efficiency due to reduced heat and mass transfer rates; thus, decreasing the particle size of the residues would improve the efficiency of releasing as much of the calorific material as usable energy. Furthermore, during the enzymatic hydrolysis of biomass wastes, the basic surface area and porosity of the feed stocks influence bio-ethanol processing.

2.5 Pelleting Process and its important parameters

The first step in the pelleting process is what kind of ingredient that use to make the TMR pellet. The TMR pellet is using local ingredients (PKC, rice bran, copra meal, molasses, vitamin/mineral, salt, Napier grass, and soya hull). Before grinding, the feedstuffs would be dried to move a 1-mm panel in a grinding mill. Regarding that, the components would be mixed in the right proportion.

Next, all the ingredients in the formulation will be mixed together in a mixer for a period of time in order to achieve a standardized mixer. The ingredients will be weighed and discharged into an industrial feed mixer according to the formula. After that, the feed will be carefully mixed for several minutes to ensure that all components are evenly distributed. The pellet forming mixture will be sent to the pellet mill's feeder conditioning chamber, where steam will be added to the solution and it will be mixed further. An extruder will be used in the pelletizing process. Lastly, temperature, screw level, and die diameter will all be set at 100°C, 150rpm, and 8mm, respectively, in the extruder to compact the samples. Every pellet will have a length of 3 cm.

The important parameter that important is physical properties of the pellet such as friability, bulk density and hardness of the pellet. In instance the hardness of the pellet can be measure using digital tablet hardness tester. Next, the moisture of the pellet will be measured to increase the quality of the pellet. Then, Pellet Durability Index (PDI) (Holmen) and Kahl tests are used to test the durability of TMR pellet. All steps in making pellets must be in detail to get the perfect pellet.

2.6 Pellet quality

Pellet quality is described as the ability to endure fragmentation and abrasion during handling without breaking up, as well as the ability to hit feeders without producing a significant number of fines. The proportion of pellets that remain intact after being subjected to mechanical forces is measured by the pellet toughness index (PDI), which is one of the most important parameters used to calculate pellet quality. Furthermore, during preparation, transport, and dispatch from the feed mill to the farms, pellets are subjected to friction, impact, and strain, and poor-quality pellets disintegrate, resulting in a feed with a few pellets and fines.

TMR pellets should meet the Quality Control requirements (QC). The important of QC is for checking units and deciding whether they meet the finished product's requirements. The aim of the research is to see whether any corrective steps in the production process are required. In pellet case, the pellet would be evaluated to determine their consistency in terms of physical and chemical characteristics.

CHAPTER 3

METHODOLOGY

3.1 Experimental design and Research Flow

- Determination of chemical properties of pellet in 0, 15, 30, 45 and 60 days. The pellet was stored in zipper bag and placed it in the container to avoid the external effect.

Table 3.1: Shelf life of pellet

Control group (days)	Treatment group (days)
0	15
	30
	45
	60

Research flow of this study was shown in Figure 3.1

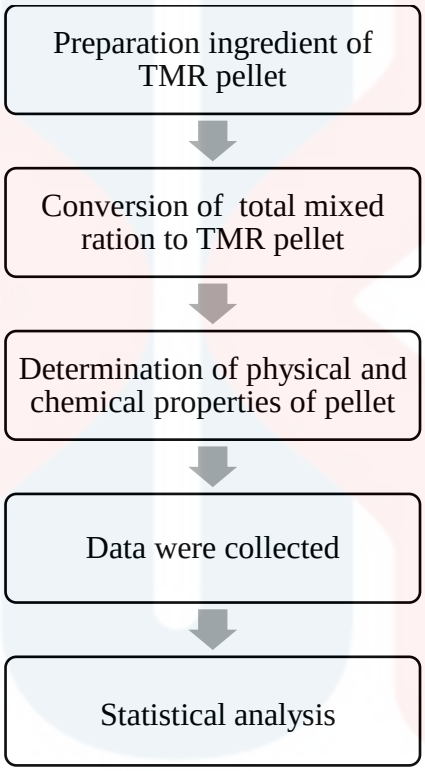


Figure 3.1: Research Flow

3.2 Preparation ingredient of TMR pellet

The formulation of TMR pellet was formulated based on conventional TMR formulation, using local ingredient such as PKC, rice bran, copra meal, molasses, vitamin/mineral, salt, Napier hay, and soya hull and an approved feed formulating program from MARDI. Calcium oxide were used as pellet binder in the TMR pellet to enhance the pellets.

Table 3.2: Ingredient of TMR

Ingredients	Percentage (%)	Amount of ingredient (kg)
Napier grass	60	6
PKC	8.0	0.8
Soybean meal	9.8	0.98
Soy hull	17.7	1.77
Molasses	3.0	0.3
PFAD	1.0	0.1
Mineral premix	0.3	0.03
Calcium oxide	1.5	0.15
Salt	0.2	0.02

3.3 Conversion of total mixed ration into TMR pellet

For a specific duration, all the ingredient in the mixture mixed in a mixer to achieve a standardized blend. The ingredients being weighed and discharged into a commercial feed mixer according to the formulation. Afterwards, the feed carefully mixed using mixer for several minutes to ensure that all components were evenly distributed. Then, the pellet forming mixture send to the pellet mill's feeder conditioning chamber, where steam being added to the solution and it mixed further. Next, an extruder was used in the pelletizing process. Temperature, screw level, and die diameter all be set at 100°C, 150rpm, and 8mm, respectively, in the extruder to compact the sample.

3.4 Determination of chemical properties of TMR pellet

Proximate analysis of ingredient and TMR pellet were conducted in animal science laboratory, University Malaysia Kelantan, Jeli campus.

3.4.1 Determination of moisture content

Sample were analysed by using A&D's Moisture Analyzers MX-50. Percentage of moisture were obtained by using 1 g of sample, the temperature and analysis time were set 160 ℃ and 9.2 min respectively. Heating technique of Moisture Analyzers MX-50 was utilised halogen lamps, infrared lamps, sheathed heaters, or microwave heaters. In order to evaluate the moisture loss, an electric balance weighs the sample before and after heating. the electric balancing requires an insulated load sensor and an innovative design that prevents effects like temperature drift because temperatures can reach 150 ℃ to 200 ℃.

3.4.2 Determination of dry matter content

The sample were placed in Forced-air drying oven at 103 – 105 ºC for twenty-four hours were used to determine the dry matter content. The sample was dried under specific conditions that differ depending on the feed's nature When working with solid feed that has a high moisture content, it's important to do some preliminary drying. Firstly, to analysis the dry matter content in the sample, empty container was weighed using precision balance to get accurate result (W1). Then, 2.0g of sample was weighed approximately (W2). After analysis done, the empty container and final sample was weighed to assess weight loss (W3).

$$\mathrm{DM}(\%) = \frac{(\mathrm{W3} - \mathrm{W1})}{\mathrm{W2}} \times 100$$

Where,

DM (%) = percentage of dry matter

W1= weight of empty container

W2= weight of 2.0 g samples

W3= weight of container and final sample

3.4.3 Determination of ash content

This procedure used to determine the amount of ash in a variety of dry, field forages and feeds. The inorganic residue left after the ignition or full oxidation of organic materials in a food sample is referred to as ash (Ismail et al., 2017). Determination of ash using muffle furnace. Firstly, the empty crucible and approximately 2g of sample were weighed and recorded as W1 and W2 respectively. Next, crucible was being placed in furnace for 12 hours at 550 °C and allowed to cool. Then, placed the crucible with the ash in the desiccator for about 20 minutes and being weighed and recorded as W3.

The formula to determine ash content in sample is:

$$Ash\ (\%) = \frac{W3 - W1}{W2} \times 100$$

Ash (%) = Percentage of ash

W1= weight of empty crucible

W2= weight of samples

W3= weight of crucible with ash

3.4.4 Determination of crude fibre content

Crude fibre content was analysed using Fibertec™ 8000 fully automated fibre analysis. Firstly, the sample being weighed approximately 1g (W1). Then, crucible was placed in hot filtration unit using the holder and locked into position in the front of heater in the Fibertac 8000 to ensure the safety engages. The reflector was then placed in front of the crucibles. Next, acid tank and alkali tank were refilled with 1.25% sulfuric acid and 1.25% KOH respectively. After analysis finished, crucibles were dried in an oven at 130 °C for 2 hours. Then, the crucibles were cooled in the desiccator for 20 minutes and weighed the crucible and residue (W2). Next, ash the sample using furnace at least 3 hours at 525 °C. cooled the crucible in the desiccator and weighed it (W3).

The calculation of crude fibre can be obtained by:

$$Crude\ fibre\ (\%) = \frac{W2 - W3 - C}{W1} \times 100$$

Where:

W1= Sample weight

W2= crucible and residue

W3= crucible and ash residue

C= blank

3.4.5 Determination of crude protein content

Kjeldahl method used to determine crude protein content. The procedure involves three main steps: digestion of the sample in sulfuric acid with a catalyst, which results in nitrogen conversion to ammonia, distillation of the ammonia into a trapping solution and ammonia were measured using a titration of a normal solution. In the presence of a catalyst, the sample being digested by sulphuric acid. Sodium hydroxide solution is used to make the acid solution alkaline. The ammonia was distilled, and a surplus of boric acid solution were extracted, and titrated with a normal sulphuric acid solution.

First step in kjedahl method was digestion. Approximately 1g of sample was weighted and inserted into digestion tube together with 2 pieces of kjedahl tablets and 12ml sulfuric acid. Inserted of the sulfuric acid must be done inside the fume chamber. Before inserting the digestion rack, the Gerhardt Kjeldatherm digestion block was turned on and heated to 400 °C for pre-heating. Before turning the H_2SO_4 aspirator fully off, make sure the fume manifold was securely linked to the top of the digesting tube to prevent the H_2SO_4 vaporised from escaping. After 30 minutes, the pre-heated digesting block is cooled to 250°C. Then, the temperature is lowered to 400 degrees Celsius for another 30 minutes. After an hour, checked the colour changes of the sample. Move away the digestion rack into rack holder that located within the fume chamber for cooling after the colour changes into green.

Next, before started the distillation method, Gerhard vapodest 50S were run twice for clean-up purpose. After 20 minutes of cooling, 80 ml of distilled water and 50 ml of 405% NaOH were added into digestion tube to dilute within the digestible sample. Then, 30ml of receiver solution were added into Erlenmeyer titration flask. 250ml Erlenmeyer flask that containing 30 ml of 4% boric acid along with the indicator were placed on receiving platform in Gerhard vapodest. The digestion tube containing diluted digest were attached to distillation unit and samples were distilled for 5 minutes. After distillation was finished, receiving flask was removed for titration process. The receiver flask was titrate using 0.1 M of HCl. The titration process was over after pink colour were obtained. The volume of HCl that being used for titration were observed and recorded. Determination of crude protein can be obtained using formula:

$$N(\%) = \frac{[T - B] \text{ x } N \text{ x } 14.007}{W(mg)} \; X \; 100$$

$$CP \; (\%) = \%\, N \text{ x } 6.25$$

Where,

T – titration volume for sample (ml)

B- titration volume for blank (ml)

N – Concentration of HCl

W – Weight of sample (mg)

CP (%) – percentage of crude protein

3.4.6 Determination of crude fat content

Crude fat content was determined by using soxtec extraction. The equipment used for this method is FOSS Soxtec 2055 Fat Extraction System. Firstly, aluminium cup was heated for 30 minutes at 105 °C. Then, aluminium cup was cooled in the desiccator for about 20 minutes and being weighed (W1). The sample were weighed approximately 1g using precision balance and recorded as W2. Then, layer of de-fatted cotton was placed on top of each sample. The thimbles then were inserted to the extraction unit by attaching them to the magnets. 80 ml of petroleum ether were filled in the aluminium cups. Then, the samples were undergoing immersion, rinsing and recovery during the extraction process. After all the process finished, aluminium cups were heated in oven at 105 ˚C for 30 minutes. Lastly, cooled the aluminium cup in the desiccator for 20 minutes and recorded weight of final aluminium cup (W3).

The formula to obtain the Ether Extract as bellow

$$EE\ (\%) = \frac{W3 - W1}{W2} \times 100$$

Where

W1 – Weight of empty aluminium cups (g),

W2- Weight of sample (g),

W3- Weight of residue after extraction (g)

3.5 Statistical analysis

The data were analysed using one-way analysis of variance (ANOVA), whereas the Tukey HSD test was used to distinguish the treatment means at the 95% confidence level ($P < 0.05$). The data obtained as mean ± standard deviation (SD).

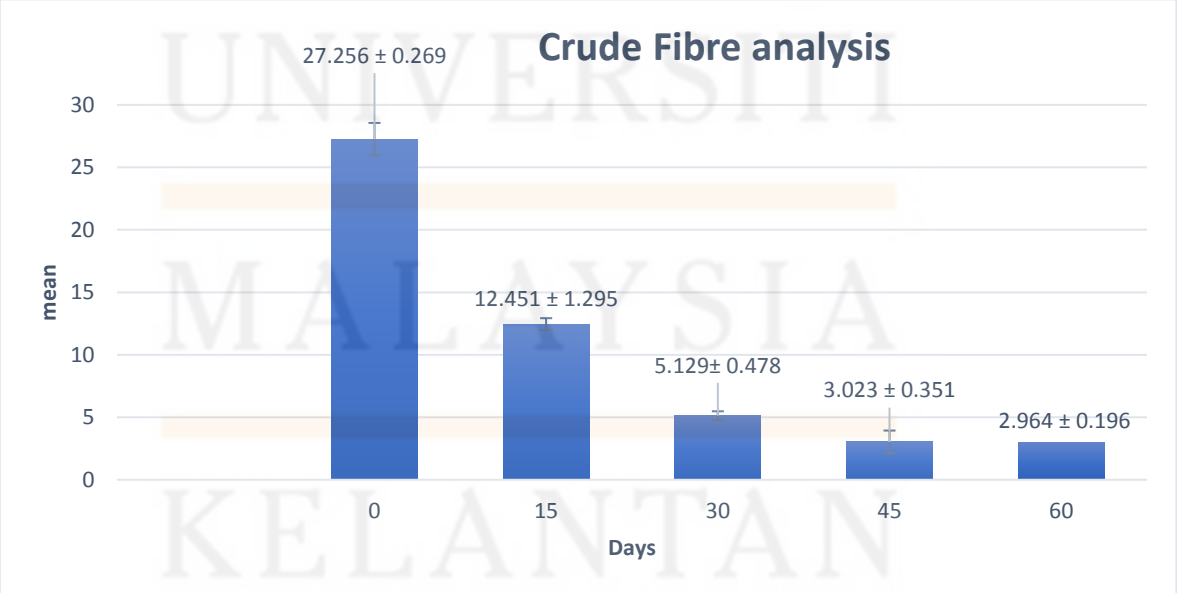
CHAPTER 4

RESULTS AND DISCUSSION

The storage of the pellet begins from days 0, 15, 30, 45 and end in day 60. Proximate analysis was done in each of the days that being state. The results of the analysis were shown below.

The result of crude fibre analysis (Figure 4.1) were gradually decreased within the days. in the day 60, the value of crude fibre in pellet was 2.964%. In day 45, 30, 15 and 0, the value of crude fibre was 3.023, 5.129, 12.451 and 27.256 respectively. In this study, the result of decreasing of the crude fibre may occur because of other nearby compositions such as crude protein, crude lipid, ash, and microbial contamination. (Hossen et al., 2011). Dry matter content decreased also affect the decreasing of crude fibre content in the pellet.

Figure 4.1 Crude fibre content of pellet in 0, 15, 30, 45 and 60 days

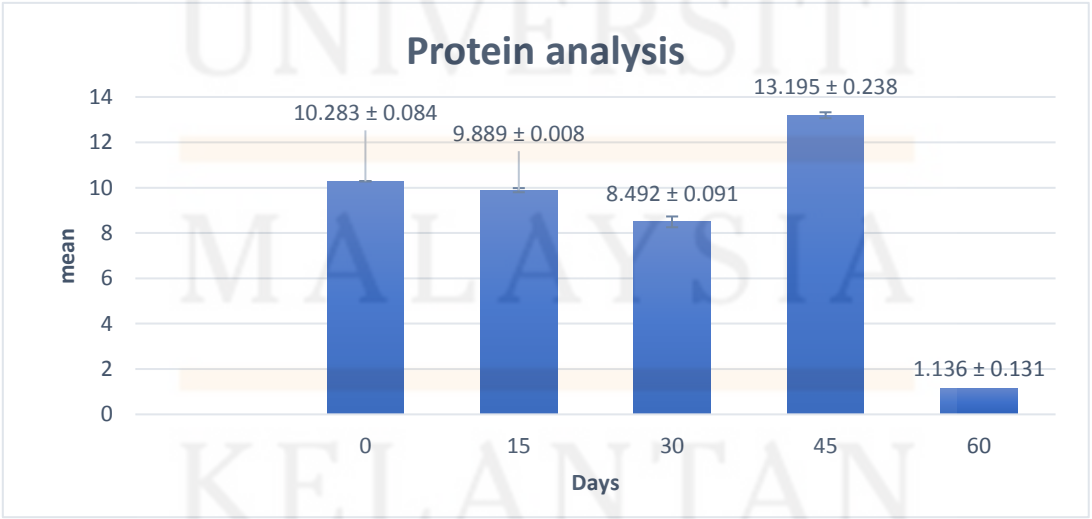


Next, the value of crude protein in Figure 4.2 was decreased gradually from day 0, day 15 and day 30 which were from 10.283, 9.889 and 8.492 respectively. However, the increasing of crude protein happens in day 45 which was 13.195 but then decreased drastically in day 60 which was 1.136.

Protein become the most important components of the ruminant. It is because the inadequate level of protein in ruminant diet can affect the milk production, growth rate, reproduction and disease resistance in animal body. (Rashid., et al 2008)

The leaching out of some extractable soluble protein fractions and hydrolysis of some lipid fractions may be to blame for the observed decline in crude protein and lipid content during storage (Daramola et al., 2007). However, in days 45 the crude protein value suddenly increased and drastically decreased at the end of storage time which was days 60. The extremely changes in these timelines may because of the error that occur during the analysis. In instance, overshoot HCl during titration affecting the calculation and also the results of crude protein.

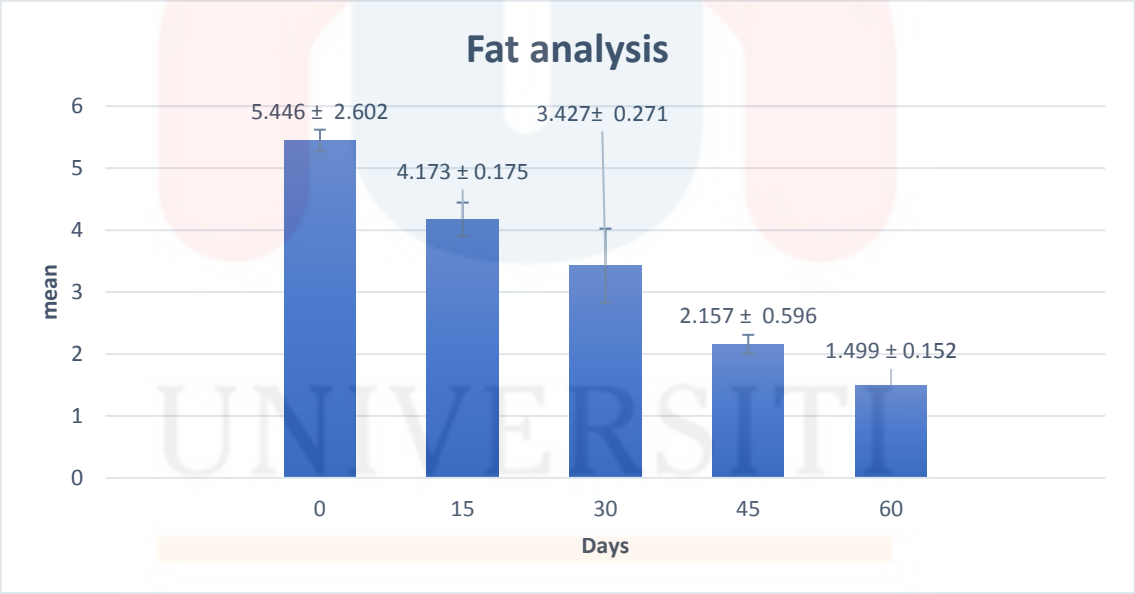
Figure 4.2 Crude protein content of pellet in days 0, 15, 30, 45 and 60.



Then, in days 0 until days 60, the result of fat analysis was decreased gradually that started with 5.446 in day 0, 4.173 in day 15, 3.427 in day 30, 2.157 in day 45 and 1.499 in day 60 (Figure 4.3).

The result of crude fat analysis shows in the Figure 4.3 were decreased continuously. The reason may occur because of auto oxidation. Auto-oxidation is the primary cause of oxidative alterations in the lipid phase, which accounts to produce the carbonyl molecules that cause rancid off tastes in most vegetable oils. (Prabath pathirana et al., 2013). Furthermore, the decreasing of crude fat was because of decreasing of dry matter content in the pellet.

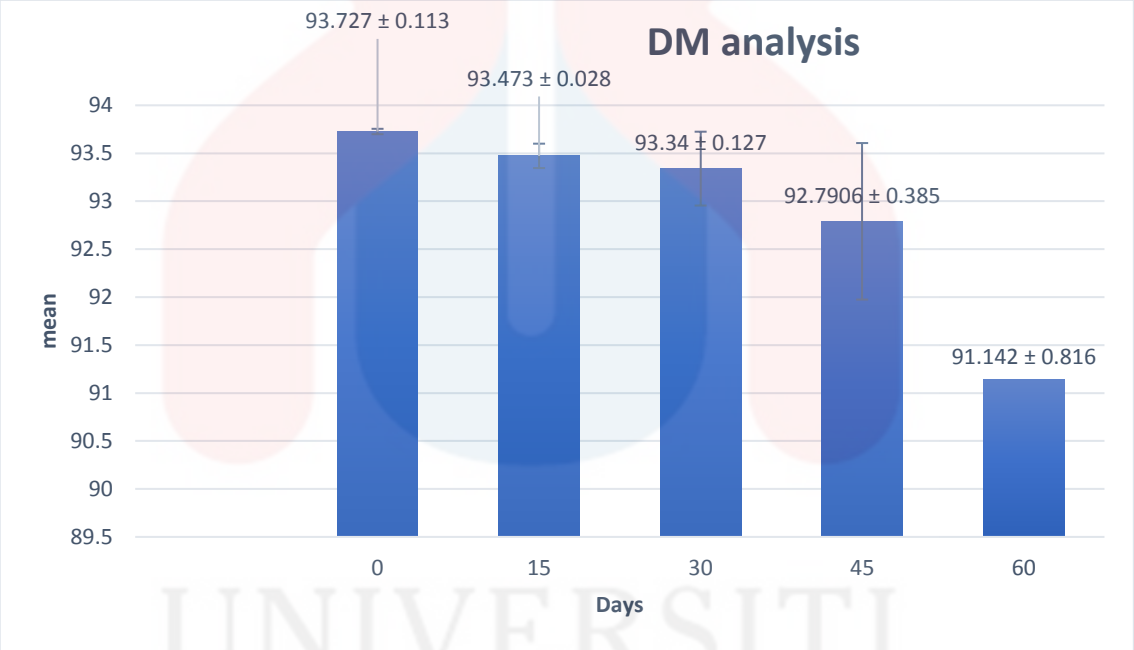
Figure 4.3 Crude fat content of pellet in days 0, 15, 30, 45 and 60.



Dry matter analysis in Figure 4.4, the result start with 93.727 in day 0 and decreased gradually from day 15, 30, 45 and 60 which were 93.473, 93.34, 92.791 and 91.142 respectively.

In this study, the gradually decreased in dry matter of pellet start from day 0 until days 60 decreased because of moisture content that increased day by day.

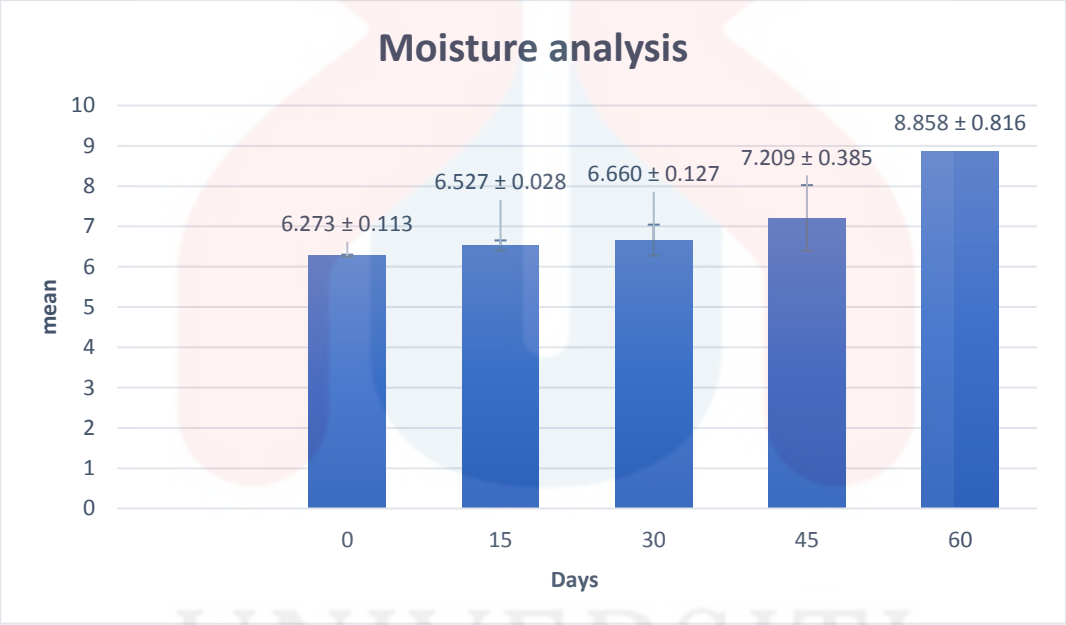
Figure 4.4 Dry matter content of pellet in days 0, 15, 30, 45 and 60.



Next, moisture value was increasing day by day in Figure 4.5. In day 0, 15, 30, 45 and 60 the moisture content in the pellet were 6.273, 6.627, 6.660, 7.209, 8.858 respectively.

One of the reasons why the content of moisture was increasing was Hossen et al., 2011 reported that by using Polypropylene and polythene-based bag, the moisture content had risen slightly.

Figure 4.5 Moisture content of pellet in days 0, 15, 30, 45 and 60.



Lastly, the result of ash analysis in Figure 4.6 was decreased continuously from days 15 to days 60. From day 15 the mean is 7.738 and continue to decrease in day 30, 45 and 60 which were 6.487, 3.906 and 3.563 respectively.

The ash content in the pellet were also decreased continuously (Figure 4.6). The gradual loss of protein and fat with storage days may explain the ash level the pellet. moreover, the decreasing of ash content in the analysis also because of the moisture content. (Hossen et al., 2011).

Figure 4.6 Ash content of pellet in days 0, 15, 30, 45 and 60.

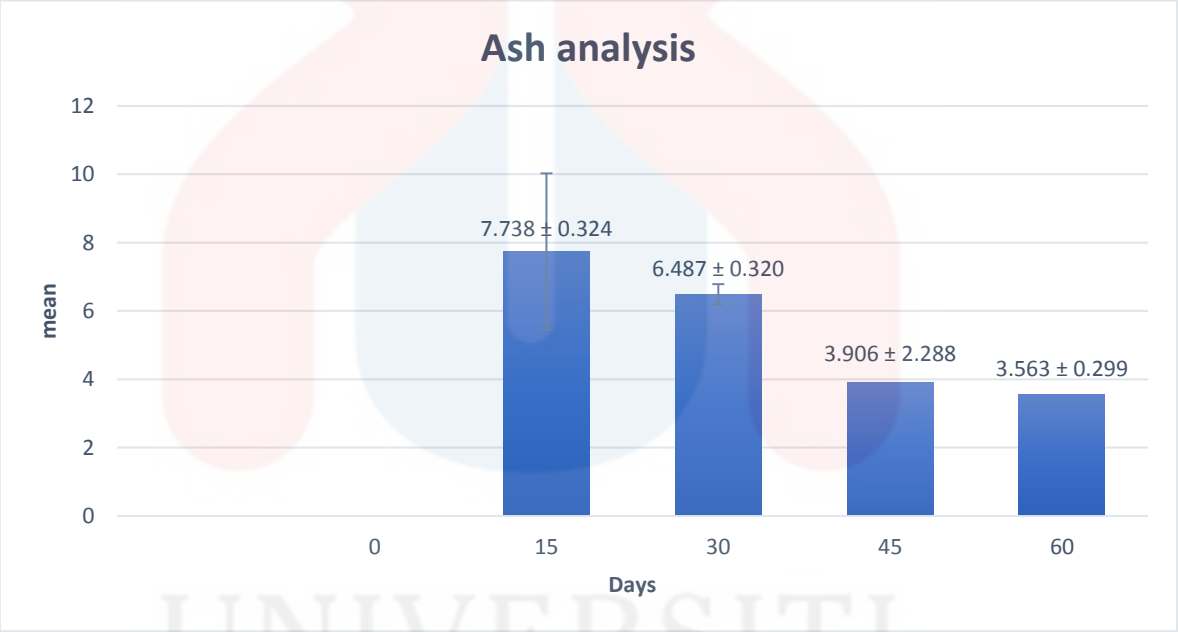


Table 4.1: Nutrient content of TMR pellet in days 0,15,30,45 and 60 based on Mean ± STD with p-value (P < 0.05)

Nutrient content (%)	Day 0	Day 15	Day 30	Day 45	Day 60	p-value
Dry matter (%)	93.727 ± 0.113[b]	93.473 ± 0.028[b]	93.340 ± 0.127[b]	92.791 ± 0.385[ab]	91.142 ± 0.816[a]	0.008
Moisture (%)	6.273 ± 0.113[a]	6.527 ± 0.028[a]	6.660 ± 0.127[a]	7.209 ± 0.385[ab]	8.858 ± 0.816[b]	0.008
Crude protein (%)	10.283 ± 0.084[c]	9.889 ± 0.008[c]	8.492 ± 0.091[b]	13.195 ± 0.238[d]	1.136 ± 0.131[a]	0
Crude fibre (%)	27.256 ± 0.269[c]	12.451 ± 1.295[b]	5.129± 0.478[a]	3.023 ± 0.351[a]	2.964 ± 0.196[a]	0
Crude fat (%)	5.446 ± 2.602[a]	4.173 ± 0.175[a]	3.427± 0.271[a]	2.157 ± 0.596[a]	1.499 ± 0.152[a]	0.206
Ash (%)	-	7.738 ± 0.324[a]	6.487 ± 0.320[a]	3.906 ± 2.288[a]	3.563 ± 0.299[a]	0.098

The overall result for proximate analysis in Table 4.1, all the proximate analysis was having significant value ($P < 0.05$) except for crude fat and ash analysis.

In dry matter content, day 0, 15 and days 30 were not significant ($P > 0.05$) to each other but have significant different ($P < 0.05$) with days 60 meanwhile in days 45, the DM content was not having significant different to day 0, 15, 30 and 60.

Next, in moisture content, day 0,15 and days 30 were not significant ($P > 0.05$) to each other but have significant different ($P < 0.05$) with days 60 meanwhile in days 45, the moisture content was not having significant different to day 0, 15, 30 and 60.

In crude protein analysis, both day 0 and 15 not have significant different ($P > 0.05$) to each other but have significant different ($P < 0.05$) to days 30, 45 and 60. The same result also applied to days 30, 15 and 45 which were have significant different ($P < 0.05$) to each other.

Then, in crude fibre analysis, the only timeline that were not have significant different ($P > 0.05$) to each other were days 15, 30 and 60 meanwhile both days 15 and day 0 were have significant different ($P < 0.05$) to each other.

Lastly, in crude fat, all these timelines were not having significant different to each other. The result practically the same with ash analysis which were all the results were not have significant ($P > 0.05$) to each other.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In conclusion, pellet storage was very important in order to keep the quality of the pellet. The storage of pellet in zipper bag and placed it in the container was not so effective. It is because the moisture content of pellet in the plastic bag slightly being raise and as reported by Hossen et al., 2011, by using Polypropylene and polythene-based bag, the moisture content had increased slightly.

Next, the error that occur during experiment must be emphasise. It is because the error that occur during experiment affect the result and also calculation. In instance, crude protein result suddenly increased and drastically decreased. One of the reasons that happen were maybe because of error that caused during experiment especially in titration step during crude protein analysis which HCl may overshoot during the titration step.

Lastly, the factor that effecting the storage of pellet such as hygiene must not be one of the reasons that effecting the pellet quality. It is because the reason was to lame, and hygiene was the most important which needs to be emphasized before implementing. Furthermore, further study for pellet shelf life was necessary in order to produce the pellet with great quality that can be store for a long time.

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APPENDIX

PROXIMATE ANALYSIS

Protein analysis

Descriptives

protein

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	3	10.2826	.14498	.08370	9.9225	10.6427	10.12	10.37
15	3	9.8890	.01329	.00767	9.8560	9.9220	9.88	9.90
30	3	8.4915	.15707	.09069	8.1013	8.8817	8.34	8.65
45	3	13.1950	.41267	.23825	12.1699	14.2202	12.76	13.58
60	3	1.1359	.22716	.13115	.5716	1.7002	.99	1.40
Total	15	8.5988	4.17927	1.07908	6.2844	10.9132	.99	13.58

ANOVA

protein

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	243.993	4	60.998	1139.046	.000
Within Groups	.536	10	.054		
Total	244.529	14			

Moisture analysis

Descriptives

moisture

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	3	6.2733	.19655	.11348	5.7851	6.7616	6.05	6.42
15	3	6.5267	.04933	.02848	6.4041	6.6492	6.47	6.56
30	3	6.6600	.21932	.12662	6.1152	7.2048	6.42	6.85
45	3	7.2100	.66731	.38527	5.5523	8.8677	6.45	7.70
60	3	8.8567	1.41384	.81628	5.3445	12.3688	7.23	9.79
Total	15	7.1053	1.13318	.29259	6.4778	7.7329	6.05	9.79

ANOVA

moisture

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.911	4	3.228	6.370	.008
Within Groups	5.067	10	.507		
Total	17.977	14			

Tukey HSD[a]

days	N	Subset for alpha = 0.05	
		1	2
0	3	6.2733	
15	3	6.5267	
30	3	6.6600	
45	3	7.2100	7.2100
60	3		8.8567
Sig.		.523	.101

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Crude fibre analysis

Descriptives

fibre

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	3	27.2556	.46627	.26920	26.0973	28.4138	26.79	27.72
15	3	12.4515	2.24231	1.29460	6.8813	18.0217	10.27	14.75
30	3	5.1289	.82712	.47754	3.0742	7.1836	4.26	5.91
45	3	3.0226	.60812	.35110	1.5119	4.5332	2.32	3.44
60	3	2.9639	.34017	.19640	2.1188	3.8089	2.64	3.32
Total	15	10.1645	9.59716	2.47798	4.8497	15.4792	2.32	27.72

ANOVA

fibre

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1276.646	4	319.161	248.761	.000
Within Groups	12.830	10	1.283		
Total	1289.476	14			

fibre

Tukey HSD[a]

days	N	Subset for alpha = 0.05		
		1	2	3
60	3	2.9639		
45	3	3.0226		
30	3	5.1289		
15	3		12.4515	
0	3			27.2556
Sig.		.209	1.000	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Fat analysis

Descriptives

fat

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	3	1.4990	.26292	.15180	.8459	2.1521	1.20	1.69
15	3	2.1571	.10320	.05958	1.9007	2.4134	2.04	2.25
30	3	3.4268	.46925	.27092	2.2611	4.5925	3.11	3.97
45	3	5.4455	4.50652	2.60184	-5.7493	16.6403	1.50	10.36
60	3	4.1729	.30280	.17482	3.4207	4.9251	3.83	4.42
Total	15	3.3402	2.25466	.58215	2.0916	4.5888	1.20	10.36

ANOVA

fat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.768	4	7.442	1.798	.206
Within Groups	41.401	10	4.140		
Total	71.169	14			

fat

Tukey HSD[a]

days	N	Subset for alpha = 0.05
		1
0	3	1.4990
15	3	2.1571
30	3	3.4268
60	3	4.1729
45	3	5.4455
Sig.		.199

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Dry matter analysis

Descriptives

DM

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
0	3	93.7267	.19655	.11348	93.2384	94.2149	93.58	93.95
15	3	93.4733	.04933	.02848	93.3508	93.5959	93.44	93.53
30	3	93.3400	.21932	.12662	92.7952	93.8848	93.15	93.58
45	3	92.7906	.66694	.38506	91.1338	94.4474	92.30	93.55
60	3	91.1423	1.41268	.81561	87.6330	94.6516	90.21	92.77
Total	15	92.8946	1.13326	.29261	92.2670	93.5222	90.21	93.95

ANOVA

DM

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12.921	4	3.230	6.385	.008
Within Groups	5.059	10	.506		
Total	17.980	14			

DM

Tukey HSD[a]

days	N	Subset for alpha = 0.05	
		1	2
60	3	91.1423	
45	3	92.7906	92.7906
30	3		93.3400
15	3		93.4733
0	3		93.7267
Sig.		.100	.522

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

Ash analysis

Descriptives

ash

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
15	3	7.7376	.56113	.32397	6.3437	9.1315	7.09	8.06
30	3	6.4869	.55371	.31968	5.1114	7.8624	5.85	6.89
45	3	3.9063	3.96214	2.28754	-5.9362	13.7488	.19	8.08
60	3	3.5633	.51801	.29907	2.2765	4.8501	3.01	4.04
Total	12	5.4235	2.52121	.72781	3.8216	7.0254	.19	8.08

ANOVA

ash

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36.745	3	12.248	2.953	.098
Within Groups	33.177	8	4.147		
Total	69.921	11			

ash

Tukey HSD[a]

days	N	Subset for alpha = 0.05
		1
60	3	3.5633
45	3	3.9063
30	3	6.4869
15	3	7.7376
Sig.		.132

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

INGREDIENT'S PROXIMATE ANALYSIS

Dry matter

Descriptives

DM

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
sodium	3	82.1123	10.30152	5.94759	56.5219	107.7027	74.42	93.82
salt	3	88.5421	3.40704	1.96706	80.0786	97.0057	85.65	92.30
PFAD	3	92.5708	4.91706	2.83887	80.3562	104.7855	88.58	98.06
soybean meal	3	75.2329	10.33348	5.96604	49.5631	100.9027	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	80.6232	2.59688	1.49931	74.1722	87.0742	78.66	83.57
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	36	84.4406	11.30187	1.88364	80.6166	88.2646	44.64	99.52

ANOVA

DM

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2998.724	11	272.611	4.445	.001
Within Groups	1471.903	24	61.329		
Total	4470.627	35			

Fat analysis

Descriptives

fat

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
soybean meal	3	.803667	.3620465	.2090277	-.095707	1.703040	.4090	1.1204
sodium	3	.000000	.0000000	.0000000	.000000	.000000	.0000	.0000
salt	3	.000000	.0000000	.0000000	.000000	.000000	.0000	.0000
PFAD	3	3.104530	.2544160	.1468872	2.472526	3.736534	2.8287	3.3300
copra meal	3	4.835567	2.5837778	1.4917448	-1.582893	11.254026	2.5955	7.6622
soya hull	3	4.691000	.9659892	.5577141	2.291350	7.090650	3.6965	5.6257
mineral premix	3	.455047	.1163124	.0671530	.166111	.743983	.3338	.5657
PKC	3	16.001533	3.0407580	1.7555824	8.447872	23.555195	13.1279	19.1856
rice bran	3	10.262633	1.3343856	.7704079	6.947836	13.577431	8.7459	11.2560
molasses	3	4.953333	2.2346663	1.2901852	-.597885	10.504552	3.3200	7.5000
Napier	3	3.727933	1.6084390	.9286327	-.267651	7.723517	2.0912	5.3065
corn meal	3	1.416333	2.4531613	1.4163333	-4.677657	7.510324	.0000	4.2490
Total	36	4.187631	4.8007427	.8001238	2.563294	5.811969	.0000	19.1856

ANOVA

fat

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	741.762	11	67.433	24.941	.000
Within Groups	64.888	24	2.704		
Total	806.650	35			

Moisture analysis

Descriptives								
Moisture								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
sodium	3	3.5833	.65760	.37966	1.9498	5.2169	3.15	4.34
salt	3	.5267	.02517	.01453	.4642	.5892	.50	.55
pfad	3	3.5033	.11015	.06360	3.2297	3.7770	3.39	3.61
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
soyhull	3	10.1300	.49508	.28583	8.9002	11.3598	9.64	10.63
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
corn meal	3	9.9233	.05132	.02963	9.7959	10.0508	9.88	9.98
Total	36	10.6964	12.34155	2.05693	6.5206	14.8722	.50	49.98

ANOVA					
Moisture					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5325.296	11	484.118	2041.543	.000
Within Groups	5.691	24	.237		
Total	5330.988	35			

Protein analysis

Descriptives								
Protein analysis								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
sodium	3	.0000	.00000	.00000	.0000	.0000	.00	.00
salt	3	.0000	.00000	.00000	.0000	.0000	.00	.00
PFAD	3	.1569	.13524	.07808	-.1790	.4929	.08	.31
soybean meal	3	20.7050	1.26728	.73166	17.5569	23.8531	19.93	22.17
copra meal	3	10.1379	.72354	.41773	8.3405	11.9353	9.60	10.96
soyhull	3	10.3584	.54615	.31532	9.0017	11.7151	9.93	10.97
mineral premix	3	.0000	.00000	.00000	.0000	.0000	.00	.00
PKC	3	10.6052	.13510	.07800	10.2696	10.9408	10.46	10.72
rice bran	3	5.9684	.69554	.40157	4.2406	7.6963	5.17	6.39
molasses	3	1.6247	.40558	.23416	.6172	2.6322	1.31	2.08
Napier	3	5.9689	.37474	.21635	5.0380	6.8998	5.54	6.22
corn meal	3	1.0571	.30324	.17508	.3038	1.8104	.81	1.40
Total	36	5.5486	6.27284	1.04547	3.4261	7.6710	.00	22.17

ANOVA					
Protein					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1370.510	11	124.592	446.969	.000
Within Groups	6.690	24	.279		
Total	1377.200	35			

Fibre analysis

Descriptives

Fibre

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Sodium	3	37.4574	12.00104	6.92880	7.6451	67.2696	29.36	51.25
salt	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			

Ash analysis

Ash analysis								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Soybean Meal	3	7.1308	3.38969	1.95704	-1.2896	15.5513	3.75	10.53
Sodium	3	91.4228	16.52208	9.53903	50.3796	132.4659	72.53	103.18
salt	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			