EFFECT OF PHYSICAL PRETREATMENT OF OIL PALM FROND ON PARASITE INFESTATION AND BLOOD METABOLITE PROFILE IN BOER GOATS

By

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DECLARATION

I hereby declare that the work embodied in this report is the result of the original research and has not been submitted for a higher degree to any universities or institutions.

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I certify that the report of this final year project entitled "_____

_____"by

_____, matric number _____ has been examined and all the correction recommended by examiners have been done for the degree of Bachelor OF Applied Science (Animal Husbandary) with Honours, Faculty of Agro-Based Industry, University Malaysia Kelantan.

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Effect of Physical Pretreatment of Oil Palm Frond on Parasite Infestation and Blood Metabolite Profile in Boer Kids

ABSTRACT

Oil palm frond (OPF) was widely used as ruminant feed. Local farmers especially those who are in palm oil plantation collected this by-product and fed the animals without pretreating the OPF.Since the crude fibre content of OPF is a bit high, it has lower digestibility to the ruminant. This contributes to the lower feed intake and reduce the animal health status. Hence, this study aimsto evaluate the effect of physical pretreatment of OPF on parasite infestation and blood metabolites. For animal feed trial, twelve goats (12) were separated into three groups; Control Group (CG) fed with napier grass and commercial pellet only, Treatment 1 (T1) and Treatment 2 (T2) fed with napier grass, commercial pellet with freshly chopped OPF and physically pretreated OPF respectively. The blood samples were collected around 4 ml for serum and hematology blood tube.The serum samples were centrifuged at 3 000 rmp at 25 celcius for 15 minutes. Meanwhile,faecal samples were collected through the rectum for McMaster test procedure. Based on hematology analysis,there was no significant difference in all hematology parameters except for Mean Corpuscular Volume and Hematocrit ($P<0.05$) in T2. For fecal egg count data, T2 shows the decrease of egg counts after the feeding trial. Hence, the pressed OPF diet was a suitable feed diet that improves all parameters level of blood metabolite.

Keywords: physical pretreatment, fecal samples, McMaster Test, blood metabolite, hematology.

Kesan Pretreatment Fizikal Pelepah Kelapa Sawit Terhadap Serangan Parasit dan Metabolit Darah dalam Anak Kambing Boer.

ABSTRAK

Pelepah kelapa sawit (OPF) telah digunakan secara meluas sebagai makanan haiwan ruminant. Penternak tempatan terutama yang memiliki ladang kelapa sawit telah mengumpul lebihan pelepah kelapa sawit dan diberi makan kepada haiwan tanpa mempersiapkan OPF. Oleh kerana kandungan serat mentah OPF agak tinggi, ia mempunyai keberkesanan yang rendah terhadap ruminan. Ini menyumbang kepada pengambilan makanan yang lebih rendah dan mengurangkan status kesihatan haiwan. Oleh itu, kajian ini bertujuan untuk menilai kesan pretreatment fizikal OPF terhadap serangan parasit dan metabolit darah. Bagi ujian makanan haiwan, dua belas kambing (12) dipisahkan kepada tiga kumpulan; Kumpulan Kawalan (CG) diberi rumput napier dan pelet komersil sahaja, Rawatan 1 (T1) dan Rawatan 2 (T2) diberi rumput napier, pelet komersi ldengan OPF dicincang segar dan OPF secara fizikal. Sampel darah dikumpulkan sekitar 4 ml untuk tiub darah serum dan hematologi. Sampel serum telah disentrifugasi pada 3 000 rmppada 25 celcius selama 15 minit. Sementara itu, sampel fecal dikumpul melalui rectum untuk prosedur ujian McMaster. Berdasarkan analisis hematologi, tidak terdapat perbezaan yang signifikan dalam semua parameter hematologi kecuali Purata Jumlah Korpuskular (MCV) danhematokrit (HCT) ($P<0.05$) pada T2. Untuk data hitungan telur fecal, T2 menunjukkan penurunan bilangan telur selepas percubaan makan. Oleh itu, diet OPF yang ditekan adalah diet makanan yang sesuai yang meningkatkan tahap paras metabolit darah.

Kata kunci : pretreatment fizikal, sampel fecal, Ujikaji Mac Master, metabolitdarah, hematologi.

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LIST OF ABBREVIATIONS AND SYMBOL

OPF	Oil Palm Frond
EPG	Egg Per Gram
WBC	White Blood Cell
LYM	Lymphocytes
MON	Monocytes
GRA	Granulocyte
RBC	Red Blood Cell
HGB	Haemoglobin
HCT	Hematocrit
MCV	Mean Corpuscular Volume
MCH	Mean Hemoglobin Concentration
MCHC	Mean Corpuscular Hemoglobin Concentration
RDW	Red Blood Cell Distribution Width
PLT	Platelet
MPV	Mean Platelet Volume
PCT	Procalcitonin
PDW	Platelet Distribution Width
ALT	Alanine Aminotransferase

BUN	Blood Urea Nitrogen
CAL	Calcium
CK-NAC	Creatine Kinase
GGT	Gamma-GlutamylTranspeptidase
MG	Magnesium
P	Phosphorus
TP	Total Protein

CHAPTER 1

INTRODUCTION

1.1 Research Background

Elaeis guineensis Jacquin or called as oil palm tree is originate from the West Africa (Nair, 2010). Malaysia has become the major exporter of the palm oil and byproduct to the worldwide market. This plant had been planted in Malaysia due to the tropical environment in Malaysia that is suitable for the oil palm tree growing (Nair, 2010). There are many types of product that can be produce from byproduct of oil palm tree which is can be edible and non-edible to use, for example, the edible products are ice cream, butter and many more (Nair, 2010). In the era 1999, Malaysia had become an important exporter of palm oil and also byproduct which is about 10.5 million tons (51.5 percent) (Nair, 2010).

There are many types of byproduct that can be used as the ruminant feed that from the oil palm tree such as palm kernel cake (PKC), palm oil mill effluent (POME), oil palm decanter cake (OPDC), empty fruit bunches (EFB), palm press fibre (PPF) (Alimon and Wan Zahari, 2010). However, in this research, oil palm frond (OPF) was investigated and upgraded using physical pretreatment. The OPF is the one of oil palm tree part that contains higher crude fibre and consist essential nutrient to the goat. The OPF consists of three main components which are leaflets, rachis and petiole(Wan Zahari, *et al.,* 2003). Each of main components has contained different amount of the crude fibre. OPF contains the important resource that must have in the plant cell which are lignin, cellulose and hemicelluloses and it is also variable in many kinds of shape, size and structure of the cell wall. In the OPF cell wall membrane is consist high lignin content and it is difficult to break down. However, the OPF can be upgraded by pretreatment strategy so that the nutrient composition will be improved.

Assessment of blood parameters level is one of indicators of health status of ruminant. The blood cell is very special cell that can determine many things such as DNA types, disease infection, produce antibodies and many more. There are many cells that helping the body system to work properly, including Red Blood Cell (RBC), White Blood Cell (WCB), Hematocrit (HTC), Mean Corpuscular Volume (MCV), Mean Corpucular Hemoglobin Concentrate (MCHC) and Mean Hemoglobin Concentrate (MCH). These blood samples are collected to analyse the blood by using hematology analyzer.

In the blood serum contain protein, Albumin, Globulin and Creatinine. A researcher recorded that the protein contain in the blood decreased while the feed diet contain higher protein (Alex, 2014). The infection of the disease can be analysed by using the serum of the blood. The blood sampling will be taken at the jugular vein at the goat neck and the blood will be precipitate which is the blood sample will be centrifuged about 10 minutes in order to blood serum appear (Janků *et al*., 2011). The serum protein can detect the disease or infection that had been faced by the goat by using the biochemical analysis machine which is Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The lower protein amount is caused by the higher amount of the globulin fractions (Janků *et al*., 2011). In immunology theory, the higher number of globulin indicates that the higher production of the antibodies when the antibody had detected the presence of a foreign parasite in the body systems.

In the stomach of the ruminant animals have the microorganisms that help to digest the feed. However, the parasite also can grow and reproduce depends on the environment factor. The parasite can get from the water and also at the grass (Villarroel, 2013). When the goats had drank the water and ate the grass, the parasites egg reproduce and live in the gastrointestinal tract. Hence, the parasite eggs can be determined by using the McMaster's technique (Singh*et al*., 2013).

1.2 Problem Statement

Nowadays, OPF was widely used as ruminant feed. Localfarmers, especially those who are in palm oil plantation collected this by-product and fed the animals without pretreating the OPF. Since the crude fibre content of OPF is a bit high, it has a lower digestibility to the ruminant. Plus, the OPF cell wall contains lignin, which is difficult to break down. Lignin is the most recalcitrant component of the plant cell, thus the higher the lignin content, the lower of OPF digestibility. In order to overcome this problem, pretreatment strategy is needed for breaking down the lignin. Physical pretreatment was applied in current study by pressing the OPF using conventional sugarcane machine. The effect of the physical pretreatment on OPF was investigated by assessing the health status of Boer goats.

The unhealthy diet or feed can cause the goat experienced gastrointestinal disease. This is because of the low digestibility due the presence of the nematode egg. Thus, the availability of parasite in the gastrointestinal tract may influence the goat health. Plus, the OPF also consist of the higher lignin content that makes low digestibility in the ruminant. So, the absorption of the nutrient in the body system is low. Thus, it is can cause the gastrointestinal disease and affect the health of the goat.

The gastrointestinal disease also may lead the higher production of the white blood cell in the blood metabolite. However, the 'blood protein will be in the blood can be indicate the protein quality' (Alex, 2014) . In order to overcome these problems occur, this research had tried to find the alternative method to make sure that the animals got enough food with balancing diet for improving the goat health level.

1.3 Objectives

- To evaluate the effect of physical pretreatment of OPF on parasite infestation of the goat.
- To evaluate the effect of physical pretreatment of OPF on blood profile in goat.

1.4 Hypothesis

H^0 = The physical pretreated OPF has no significant on blood profile and parasite infestation.

H^1 = The physical pretreated OPF can increase the digestibility and improve the health status of goats by improving the blood profile as well as controlling the parasite infestation in goats.

1.5 Significance Of Study

The OPF is one of the agriculture by-products that makes up to 70% of the total biomass from palm oil industry. It is readily available daily, therefore OPF is utilized for ruminant feed. Pretreatment strategy should be applied to upgrade OPF and increase the digestibility of OPF. This knowledge will be translated into higher economic returns to the smallholders.

Plus, the farmers will learn new knowledge that related to the animal nutrition and expose to the farmers about upgrading the agriculture waste product. Hence, the farmers can cut the cost of buying feed to the animals.

1.6 Limitation Of Study

The OPF must give feed directly after had pressed. The OPF cannot be storage at long time period because it will decrease the quality of the OPF and decrease palatability. However, storage at long period will lead to development of mould and bacteria to the OPF, which is will make the goat can get infected if they eat in that condition.

1.8 Scope Of Study

This research had focused on the animal nutrition. The feeding trial is the one of the methods to determine the digestibility of the feed. So, the certain amount of the feed will be given to the each goat. Plus, the goats just can be consumed about 30% of OPF. This is important to expose the farmers the alternative to make own food for the ruminant animals.

Plus, this research had focused on the animal health. The animal nutrition has relationship with the animal health status. The status of the goat health can be seen by observing the fecal count and investigate the blood metabolite profile of the goats. The enough feed consumption will give the goats enough nutrient requirement in the goat's body. Hence, it is will enable the absorption of the nutrient. This is important for the animal ruminants especially goats because the health of goats also can influence the human health.

CHAPTER 2

LITERATURE REVIEW

2.1 Current Issues on The Use Of Agriculture By-Products As Animal Feed

Nutrition is a source that contains many important components such as carbohydrate, protein, fat, minerals, vitamins and fibre. These components are very important to the body system in order to give essential nutrient to all body parts and supply energy. There have many aspects that influence the goat's health such as environmental condition and nutrition. However, the nutrition is the most important aspect in order to make sure that the goat can live healthy and resistant diseases.

There is a competition between human food supplies with animal feed based on the agriculture when the demand in food had increased. This had led to the increase of feed cost. The researchers need to find alternative feed that is not consumed by human (Capper, Berger, and Brashears, 2013). The animals and humans have a body system such as digestive system and metabolism that help absorb the nutrient from the food and process of food. However, ruminant animals have ability to digest plant materials due to present of bacteria in the stomach.

The livestock production in Malaysia is not large as the production of poultry. Usually, the product based on ruminant like meat, milk and many more products had imported from the huge and rich country such as England, America and etc. However, there had reportedly that touch about the Malaysian policies that responsibility to increase the production of food which is Ninth Malaysian Plan (9MP) (AbdLatif, *et al.*, 2013). Through this policy, the government finds the way to enlarge the and new modern technologies in order to grow the agriculture sector (Abd Latif *et al.*, 2013).

This is due to high demand in the livestock product such as meat and milk. Through this policy can increase the Malaysian economy with gives advantage to all the farmers or businessman to promote their products in the local and international market (AbdLatif *et al.*, 2013).

There have three types of production system for ruminant animals which are extensive livestock system, systems combining ruminants with arable cropping and lastly, system integrated with tree cropping (Berkat & Tazi, 2006). All the types of production systems indicate the ways to manage the ruminant animals with gives sufficient feed that will reduce the cost especially through the integrated system. Integrated system is mostly farmers usually used to letting the ruminant animals at the place that rich with the plants for example is palm farm. The commercial feeds cost that already sold in market are very expensive. Most of the farmers cannot afford to buy it due to high price.

2.2 Plant Cell Wall Characteristic of Oil Palm Frond (OPF)

Oil palm frond (OPF) consists large quantity of fibre content that contain resources such as cellulose, lignin and also hemicelluloses. These are the components of the cell wall of the palm tree. The waste fibre of the palm will be used as making the fuel, textile, food, enzyme and etc. The OPF fibre has good variability in many aspects such as shape, size and also the structure of the cell wall. All of the aspectsof that experiment must look through the transmission electron microscopy (TEM) (Khalil, Alwani, & Mohd Omar, 2006).

As the plant cell must have vascular bundles, but the different species, it will be a different size of vascular bundles. In the vascular bundles have xylem and phloem, which are complex plant tissues that composed of more than one type of cells. A scientist had described about each bundle in OPF cell were made up of

vessels, fibre, a fibrous tissue, phloem and parenchyma tissues(Khalil *et al.*, 2006). The parenchyma tissue is the simple tissues which only contain one type of tissue. This is because of the parenchyma tissue is a type of permanent tissue. Parenchyma tissue also is the tissues that fill the spaces between the other tissues. There have some research reported that the vessel in the leaves and stem usually separated from parenchyma cells in order to help transfer the oxygen due to exist of barrier (Khalil *et al*., 2006).

2.3 OPF as Animal Feed

Oil palm plantation in Malaysia is just not only produce palm oil and other productsbut alsooffers feed resources from by-product. The previous study reported that all by-products from the production of oil can be reused to become the animal feed for livestock (Dahlan, 2015). There have many parts of oil palm tree that had been used in making by-product for the animal feed such as palm kernel cake (PKC), palm oil sludge (POS), oil palm decanter cake (OPDC), empty fruit bunches (EFB), palm press fibre (PPF) and many more.

The OPF contains three main components which are leaflets, rachis and petiole (Wan Zahari *et al*., 2003). The percentage of the dry matter at the part of petioles is higher and the leaflets are a high percentage of crude protein and ether extract. This will lead to improve the digestibility in the rumen. The rumen degradability is related to the availability of nutrients. The nutrients of the OPF will be different based on the moisture of the OPF and can decrease the cost and suitability to feed the ruminant livestock animals. However, the OPF has lack of nutrient composition because of higher lignin and low protein content. The nutrient composition of the OPF can be upgraded by pretreatment strategy so that the nutrient composition will be improved.

There was investigated on the digestibility of a variety of tissues of the OPF through *in vitro* experiment (Dahlan, 2015). The same researcher also mentioned the good sign and acceptable from the goat and sheep which are the dry matter intake. This will help to increase the body weight of the both ruminant animals. There are many ways to make the OPF as a feed to the ruminant animals such as silage, chopped fresh, and pellet or cube (Tuyen *et al.*, 2013). The silage and pellet or cube can increase the amount of the nutrient content due the addition of the other supplement. The OPF contain a higher percentage of the water content which is easy to become spoiled (Dahlan, 2015).

However, there are many additive feed and methods that can improve the nutritional value in the roughage feed such as molasses, EM and many more. The additive feed acts as a supplement to make sure the animals consume enough nutrient requirement of the body. So, the OPF has big potential to be the feed for the ruminant animals (Dahlan, 2015). Some of the commercial pellet can be as the supplementary feed to the animals. Plus, Malaysia also had exploited about '35 million tonnes of OPF as the ruminant feed' (Wan Zahari *et al*., 2003). Nowadays, many farmers already used the fresh OPF to give feed to the ruminant animals and this reason had been attracted many organizations to make the new feed technology and also research and development on the using of OPF (Wan Zahari *et al*., 2003).

2.4 Pretreatment Strategies of OPF

Pretreatment is very important in doing the experiment or research to make sure that the feed can be digested properly in the rumen. There are three types of pretreatments which are physical, chemical and biological pretreatment. A study mentioned that the process in the production of ethanol from lignocelluloses must

come through the all pretreatment in order to make sure that the hydrolysis process work efficiently (Kristiani, *et al.,* 2013).

2.4.1 Physical pretreatment

In the previous research, the OPF must be choped into small size around 3 cm and then it must be dried in 24 hours at medium temperature (Kristiani *et al*., 2013). After that, used of the milling-grinding machine to mill it (Kristiani *et al.*, 2013). Physical pretreatment is related to the process of grinding, pelleting and steaming which are can increase the digestibility. The previous study reported that the feeding value can be improved by using the different type of the technologies in order to produce the different type of the feed (Tuyen *et al.*, 2013). The other study had reported about the size that reacted with the acid enable to increase the hydrolysis rate of the hemicelluloses (Kristiani *et al.*, 2013). In other words, the smaller size of the materials will lead large surface area which has enabled and eases the process of degradation.

Besides, there is also a research about the glucose in the OPF can effective recovery by using hot compressed water (Goh, Tan, & Lee, 2012). This can also increase the ability of digestibility lignocellulosic biomass (Goh *et al*., 2012). This show that the higher temperature or hydrothermal can break down the lignin that very difficult to break it. The used OPF and rinse with distilled water. After that, the sample will dried in a day at temperature 80 degree Celsius (Goh *et al.*, 2012). Then, the 0.1 mg of sample had added into the water extraction and 200mL distilled water (Goh *et al.*, 2012). In contrast, another sample had into the Soxhlet extraction containing 200mL of 95% ethanol in a day in order to remove all the pigments of the cell in the sample (Goh *et al.,* 2012). So, the result of this test had shown that through high temperature can remove the hemicelluloses and lignin surface in the OPF.

Besides, it will activate the enzymatic reaction in the OPF due to the absence of the hemicellulose and lignin (Kristiani *et al.*, 2013). Besides temperature, there are certain factors that can consider as a parameter in this experiment such as time. The time had given effect on the biomass loss was uniformly which was 5 to 12 minutes. However, longer than 15 minutes biomass will break down into small components (Long-Wee Lai and Ani, 2013). The exceed than 20 minutes with using high temperature will remove the hemicelluloses but it will inhibit the enzymatic reaction in the sample (Goh *et al.*, 2012).

2.4.2 Chemical pretreatment

As in OPF contain lignin which is the component that really difficult to break the bonding between lignin and hemicelluloses, Acid pretreatment is one of pretreatment methods that enable to use by using the chemical material such as sodium hydroxide, chloride acid, nitric acid and sodium chloride (Tuyen *et al.*, 2013). The previous study had reported that the chemical pretreatment by using acid can be operated by using different type of temperature and concentration of acid, but it must inversely amount or example, the low temperature of acid and high concentration of acid used or vice versa (Kristiani *et al*., 2013). However, she had reported that enzymatic hydrolysis can work very efficiently by using high temperature of chemical (Kristiani *et al*., 2013). By using limited temperature and low acid concentration, this will lead the increasing reaction rate and hydrolysis of cellulose in OPF. Kristiani (2013) had reported that diluted acid pretreatment can be used and efficiently to diminish the hemicelluloses is almost succeed, but it cannot react to dissolve completely the lignin, it just disturbs the lignin in order to increase the cellulose activity of enzymes working on in OPF.

2.4.3 Biological pretreatment

There have some pretreatments based on biological that can improve the OPF nutrient content. Based on the other research, the white rot fungi have ability to increase the digestibility of the ruminant animals due to white rot fungi composed of lignin, cellulose and also hemicelluloses (Namoolnoy, Phoolphundh, & Wongwicharn, 2011). The white rot fungi can secreta variable typepe of enzyme such as lignin peroxidase (LiP), manganese peroxide and also laccase (Namoolnoy *et al.*, 2011). There are sme researchers stated that by using biological pretreatment enable to break down the hemicelluloses bonding which is made lignocelluloses difficult to chemical and biological process into the simple sugar (Kristiani *et al*., 2013). However, the bio-digestibility in ethanol production with using waste product such as OPF can increase the enzyme process.

2.5 Parasite Infestation In Goats

Goat's immune system are not as strong as in sheep especially in fighting against gastrointestinal disease (Hoste, Torres-Acosta, & Aguilar-Caballero, 2008). There are many types of parasite such as a parasite that life in the organ (internal) or at the skin (external). The internal parasite is can make the goat become unhealthy. There are specific species of parasite that live in the internal organ like lung worm (*Dictycaulus spp.* Or*Muelleriuscapillaris*), stomach worm (*Haemonchuscontortus*), liver flukes (*Fasciola hepatica*) and intestinal parasites (*Eimeria)* (Villarroel, 2013). The environment is very important to take care of it in order to make sure that the parasite will not grow rapidly. The different type of parasite can get and live in the surrounding of the goats life if the poor management of the goat herd. When the goat had an infection of the parasite, there are many signs that the goat suffers from the parasite such as diarrhoea, weight loss, depression and many

more. A research reported that there have some standard methods that can be used due to check the parasite egg that contain in the goat faces by using the microscope (Villarroel, 2013).

The parasites that contain in the feed or grass have the ability to live on the goat's organ and also enable to grow or reproduce egg in the internal body when the feed had eaten by goats. However, this can be investigated the physical pretreatment of the faeces. There are two types of testing strategies that can investigate the faeces contain through the microscope, which are grouped testing and individual testing (Villarroel, 2013). Group testing is not specific than individual testing, where is the faeces of a group of goats will be collected and put together in the ziplock bag. However, the individual testing is very specific and rigid which are faeces must collect for each goat sample in order look the faeces sample for every goat.

2.6 Blood metabolite profiles in Goats

In the blood, contain many cells that helping the body system to work properly, such Red Blood Cell (RBC), White Blood Cell (WCB), Hematocrit (HTC), Mean Corpuscular Volume (MCV),Mean Cospuscular Hemoglobin Concentration (MCHC) and Mean Hemoglobin Concentration (MCH). The presence of these component cells in the body will regulate of the body systems. In the blood, there are contain light yellowish colour liquid called serum. In the blood serum contain protein, Albumin, Globulin and Creatinine. A research recorded that the protein content in feed dietwill affect the protein in animal blood (Alex, 2014). The authors had tested the goats with eating the balanced diet in daily life to look the changes of the goat health and the changes that influence the blood cell (Chaturvedi, Singh, & Dutta, 2013). However, the result in the research had not given effect on hematological of the goat's blood.

There is the research that investigates the blood sample of goat by using the blood serum protein (Ahmed *et al*., 2015). This research study on different period of parturition to see the progress and the effect of the serum protein on healthy goats (Janků *et al*., 2011). The lower protein amount is caused by the higher amount of the globulin fractions (Janků *et al.*, 2011). The higher amount of globulin indicates that the higher production of the antibodies to against the parasite or infectious disease. The infected goat not just can be determined by using the blood serum to expose the disease. The deficiency sign of the goat also can be indicates that the goat had a gut infection from the bacteria or parasites such as diarrhea (Janků *et al*., 2011).

Hematology is the knowledge that related with the number of blood and morphology of metabolite in the blood (Etim, Williams, Akpabio, & Offiong, 2014). It is very important to detect other substance, foreign material or disease in the blood. However, there are several type of factors that may affect the changes of blood metabolite profile which are age, breed, nutrition, animal health and management system of farm (Etim *et al*., 2014). The RBC level can be influenced by feeding that contain essential nutrient to the goat (Chaturvedi et al., 2013). So, this will help to determine the goat health status.

CHAPTER 3

METHODOLOGY

3.1 Collection Of Sample

The samples of the OPF and Napier were collected from Tanah Merah, Kelantan, Malaysia. The OPF were brought to the UMK AgroTechnopark and cleaned prior to physical pretreatment method. The whole parts of the OPF including the petiole was used. The commercial goat pellet who was known as “pellet kambing hitam” was brought from TernakTani, Bukit Bunga, Tanah Merah, Kelantan.

3.2 Physical Pretreatment Method

The OPF samples were collected and cleaned. The OPF were pressed using the sugar cane press machine and after that it was chopped into smaller size. Chopping also considers a physical pretreatment who commonly being used prior to OPF feeding. Following the pressing method,we obtained pressed fibre of OPF, also known as physical pretreated OPF.

3.3 Experimental Design

The individual allocation of goat was based on randomized complete block design (RCBD). The experimental design of different dietary treatments is shown in Table 1.

Table 3.1: The experimental design of different dietary treatments.

Groups (4 goats/group)	Dietary treatment			
	Napier grass (50%)	Goat pellet (30%)	Oil palm frond (20%)	Total feed (kg)
Control	1.75kg	0.75kg	None	2.5kg
Treatment 1	1.25kg	0.75kg	Fresh OPF/0.5kg	2.5kg
Treatment 2	1.25kg	0.75kg	Physical pretreated OPF/0.5kg	2.5kg

3.4 Animal Feed Trial

A total of twelve (12) male Boer goats aged 5 months were used for 120-day animal feeding trial at Agro Technopark, Universiti Malaysia Kelantan (UMK), Jeli Campus. The goats were individually separated into three groups; Control group and another 2 treatment groups. Each group of goats consists of 4 goats who were fed with different nitrogenous treatment diets. All groups were fed with napier grass, commercial pellet and OPF except the control group (Table 1). Treatment 1(T1) was fed with fresh OPF, meanwhile Treatment 2 (T2) was given physical pretreated OPF. The goat pellet was given every morning around 7.00 a.m. and napier grass and OPF was given at 12.00 p.m..

Table 3.2 : The type of feed for each group of goat

Group	**Feed material**
Control Group (CG)	Napier + Pellet
Treatment 1 (T1)	Fresh chopped OPF + Napier + Pellet
Treatment 2 (T2)	Pressed OPF fibre + Napier + Pellet

3.5 Blood Sampling

The serum and hematology samples were taken for each goat for looking the serological analysis and hematology test. The blood sample were collected at the jugular vein in the neck of the goats using blood tube, vacutainer and needles size 21 G. This blood sample had collected three times, which were 2 weeks before feed trial, week 6 and 2 weeks after feeding trial. Each goat had collected the blood around 4 to 6 ml by using the serum blood tube and haematology blood tube (Jatau *et al.*, 2011). The blood sample of serum had precipitated and 'centrifuged at 3 000 rmp at 25 celcius for 15 minutes' (Janků *et al.,* 2011). Then, the serum sample and haematology sample had analyzed the data using the machine.

3.6 Fecal Egg Count

The faecal egg count was examined by using Mac Master Test. First, the faeces collected at all goats rectum by using the glove. These tests were very specific test and rigid that faeces collected for each goat sample in order look the faeces sample for every goat. 20 pellets of fecalwas stook and placed it in the ziplock bags(Villarroel, 2013). Since this fecal collects from each goat, the ziplock bags had labelled with their ID number(Villarroel, 2013). Then, stored the sample in the refrigerator at – 20 ºC.

Then, weighed the faeces in the cup about 3 grams on the scale and putted in the cup that had been labelled. After that, the faeces mixed with the saturated salt solution to 60 ml and stirred it well. The mixture had been filtered by using the tea strainer. Then, took the dropper to fill the chamber of Mac Master Slide with mixture. Lastly, observed it under microscope with 10 x objectives lens.

These test had done three times, which were 10 days before feed trial, week 6 and after week 12.

3.7 Data Analysis

The data had used One- Way ANOVA Test and analysed with the IBM SPSS Statistics 23 software to calculate the data based on the effect of physical pretreatment of OPF in the blood metabolite and parasite infection in boer kid goats.Then, the data had used Duncan Multiple Range Test to compare the data. All the data were analysed with triplicate and the significant difference ($P<0.05$).

CHAPTER 4

RESULT

4.1 Hematological Parameters

Based on the result from Table 4.1, all parameters before feeding trial were lower than the normal reference value due to the goats not adapt to new environments. Then, the number of white blood cell before starting the feeding trial was increased for all treatments. However, the result of white blood cell as well as platelet level was decreased for all treatment during the feeding trial.

Most of the parameters such as white blood cell (WBC), monocytes (MON), red blood cell (RBC), lymphocytes (LYM), granulocytes (GRA), mean platelet volume (MPV), hematocrit (HCT), mean corpuscular volume (MCV) and red blood cell distribution width (RDW) were not significantly difference ($P > 0.05$). Moreover, the results of mean corpuscular volume (MCV) and haemoglobin (HCT) during feeding trial were significantly difference between goat from Control Group (CG) and Treatment 1 (T1). During the feeding trial, the hemoglobin level in the blood of CG goats significantly higher ($P < 0.05$) than goats from T2. However, most of the parameters were significantly decreased after the feeding trial finished. Meanwhile, the value of RDW was still in range started from before feeding trial until after feeding trial.

Table 4.1 a : Hematological parameters of Boer goat fed with different types of feed for three months.

Measurement	Before Feeding Trial			During Feeding Trial			After Feeding Trial		
	CG	T1	T2	CG	T1	T2	CG	T1	T2
WBC	24.43 ± 4.39[à]	33.70 ± 11.63[à]	40.23 ± 9.65[à]	21.50 ± 3.91[à]	28.93 ± 7.03[à]	28.50 ± 1.80[à]	13.80 ± 1.00[à]	23.45 ± 2.65[à]	24.05 ± 1.73[à]
LYM	23.58 ±5.41[à]	29.05 ±1.43[à]	24.58 ±2.79[à]	10.00 ±2.23[à]	14.23 ±4.03[à]	16.68 ±0.40[à]	6.60± 0.35[à]	11.00 ±2.95[à]	11.48 ±2.93[à]
MON	1.63 ±0.12[à]	1.70 ±0.35[à]	1.50 ±0.19[à]	1.47 ±0.43[à]	2.18 ±0.5[à]	1.78 ±0.54[à]	0.97 ±0.03[à]	1.55 ±0.35[à]	1.33 ±0.35[à]
GRA	17.20 ±0.06[à]	20.20 ±2.71[à]	18.70 ±1.4[à]	12.33 ±1.44[à]	11.55 ±0.1[à]	14.15 ±0.84[à]	11.67 ±0.67[à]	11.15 ±0.33[à]	12.23 ±0.98[à]
RBC	16.94 ±4.21[à]	19.13 ±1.07[à]	20.32 ±0.12[à]	11.83 ±1.88[à]	14.30 ±0.43[à]	13.15 ±1.12[à]	11.40 ±1.35[à]	13.45 ±1.79[à]	11.22 ±0.54[à]
HGB	8.43 ±0.96[à]	8.95 ±0.15[à]	8.88 ±0.47[à]	12.43 ±0.52[ƀ]	11.73 ±0.07[à ƀ]	10.58 ±0.88[à]	14.10 ±0.99[à]	13.15 ±0.64[à]	12.33 ±0.67[à]
HCT	30.83 ±7.69[à]	34.63 ±2.07[à]	37.00 0.79[à]	41.00 ±3.97[à]	34.68 ±0.43[à]	39.08 ±1.29[à]	47.40 ±4.80[ƀ]	38.03 ±0.15[à]	36.88 ±4.29[à]

Table 4.1 b : Hematological parameters of Boer goat fed with different types of feed for three months.

Measurement	Before Feeding Trial			During Feeding Trial			After Feeding Trial		
	CG	T1	T2	CG	T1	T2	CG	T1	T2
MCV	18.20 ±0.06[à]	18.08 ±0.13[à]	18.18 ±0.33[à]	29.70 ±5.1[àb]	40.50 ±1.77[b]	25.93 ±4.68[à]	59.33 ±8.46[à]	59.28 ±4.33[à]	58.58 ±2.81[à]
MCH	5.43 ±0.95[à]	4.70 ±0.33[à]	4.35 ±0.26[à]	22.13 ±5.92[à]	21.58 ±5.6[à]	18.80 ±4.80[à]	26.53 ±3.96[à]	27.73 ±3.07[à]	22.05 ±0.70[à]
MCHC	29.83 ±5.13[à]	25.98 ±1.84[à]	24.05 ±1.44[à]	23.63 ±4.40[à]	27.23 ±5.37[à]	23.80 ±4.55[à]	29.47 ±2.52[à]	31.05 ±5.35[à]	32.63 ±2.83[à]
RDW	16.90 ±1.39[à]	15.95 ±0.47[à]	15.48 ±0.69[à]	13.10 ±0.95[à]	15.75 ±0.67[à]	15.05 ±0.07[à]	15.20 ±0.46[à]	14.28 ±1.62[à]	15.53 ±0.4[à]
PLT	569.67±256.34[à]	582.25 ±10.44[à]	428.50 ±111.76[à]	399.00 ±74.93[à]	451.00 ±64.67[à]	384.25 ± 53.16[à]	320 ±14.47[à]	391.25 ± 39.67[à]	421.25 ± 44[à]
MPV	5.27 ±0.07[à]	4.90 ±0.23[à]	5.05 ±0.18[à]	6.57 ±0.24[à]	6.93 ±0.33[à]	6.38 ±0.23[à]	7.77 ± 0.35[à]	7.70 ±0.22[à]	7.25 ±0.26[à]
PCT	0.297 ±0.13[à]	0.286 ±0.02[à]	0.219 ±0.06[à]	0.207 ±0.08[à]	0..280 ±0.04[à]	0.223 ±0.06[à]	0.260 ±0.04[à]	0.241 ±0.03[à]	0.284 ±0.04[à]
PDW	54.97 ±7.73[à]	62.65 ±6.80[à]	64.75 ±7.04[à]	25.03 ±5.27[à]	27.10 ±4.23[à]	43.30 ±14.21[à]	17.87 ±0.97[à]	22.28 ±2.71[à]	22.63 ±9.53[à]

à-b Indicates the means that with significant different (P >0.05).CG : control group (napier + pellet), T1 : treatment 1 (napier + pellet + chopped OPF), T2 : treatment 2 (napier + pellet + pressed OPF).

WBC white blood cell (4.0-12.0), LYM lymphocytes (1.0-5.5), MON monocytes (0.1-1.0), GRA granulocyte (2.0-8.0), RBC red blood cell (4.0-6.2), HGB haemoglobin (11-17), HCT hematocrit (35-55), MCV mean corpuscular volume (80.0-100.0), MCH mean hemoglobin concentration (26-34), MCHC mean corpuscular hemoglobin concentration (31-35.5), RDW red blood cell distribution width (10-16), PLT platelet (150-400), MPV mean platelet volume (7.0-11.0), PCT procalcitonin (0.200-0.500), PDW platelet distribution width (10.0-18.0).

4.2 Biochemical Parameters

Table 4.2 shows the biochemical parameters such as alanine aminotransferase (ALT), blood urea nitrogen (BUN), calcium (CAL), creatine kinase (CK-NAC), gamma-glutamyltranspeptidase (GGT), magnesium (Mg), phosphorus (P) and total protein (TP) in serum blood. According to the result in Table 4.2, most of the parameters were increased before the feeding trial started for all treatments, but during feeding trial, these started to be decreased except Mg level. The Mg level in the serum, kept on increased before feeding trial until during field trial had held. All the parameters did not have significant difference (P > 0.05).

Table 4.2 : Biochemical parameters of Boer goat fed with different types of feed for three months.

Measurement	Treatment					
	Before Feeding Trial			During Feeding Trial		
	CG	T1	T2	CG	T1	T2
ALT	20.78±0.8[à]	18.63±1.31[à]	18.96±4.17[à]	17.96±2.07[à]	18.38 ±1.23[à]	18.83 ±2.19[à]
BUN	6.40±0.44[à]	7.43±0.82[à]	7.50±0.7[à]	6.94±0.06[à]	6.95±0.67[à]	7.51±0.61[à]
CAL	1.87±0.06[à]	1.83±0.01[à]	2.16±0.33[à]	1.80±0.12[à]	1.64±0.17[à]	1.58±0.45[à]
CK-NAC	99.97±15.90[à]	106.05±23.91[à]	176.50±78.1[à]	90.43±33.23[à]	57.80±7.40[à]	69.50±16.96[à]
GGT	45.11±19.93[à]	79.14±33.24[à]	58.01±16.07[à]	39.24±2.95[à]	32.31±6.28[à]	43.11±4.35[à]
Glucose	5.39±0.33[à]	5.16±0.19[à]	4.82±0.21[à]	2.19±0.55[à]	2.61±0.02[à]	2.80±0.35[à]
Mg	1.11±0.06[à]	1.07±0.02[à]	1.37±0.61[à]	1.33±0.11[à]	1.22±0.11[à]	1.32±0.40[à]
P	3.45±0.23[à]	3.77±0.43[à]	3.93±0.52[à]	2.73±0.31[à]	2.57±0.74[à]	3.14±0.15[à]
TP	82.62±0.92[à]	87.79±1.17[b]	81.64±2.01[à]	63.12±6.43[à]	50.77±4.41[à]	54.1±3.23[à]

[à]Indicates the means that with significant different (P >0.05). CG : control group (napier + pellet), T1 : treatment 1 (napier + pellet + chopped OPF), T2 : treatment 2 (napier + pellet + pressed OPF). ALT alanine aminotransferase (6-19), BUN blood urea nitrogen (3.6-7.1), CAL calcium (2.23-2.93), CK-NAC creatine kinase (28-130),

GGT gamma-glutamyltranspeptidase (2.78-4.16), MG magnesium (0.31-1.48), P phosphorus (1.40-2.90) and TP total protein (64.70).

4.3 Faecal Egg Counts

Based on Table 4.3, most of goats consist of high level of parasite before feeding trial, while there were few goats that low amount of the nematode eggs, which were 152 and 146 for the Treatment 1 and 143 from Treatment 2. These three goats had increased the level of the egg during the feeding trial, while the others, the goat egg level had decreased rapidly within 45 days period interval.However, the egg level of the most goats had decreased rapidly after the feeding trial had ended except few goats from Control Group (156) and Treatment 1 (150 and 030).

Based on the table below, the mean of Control Group during feeding trial significantly higher ($P<0.05$) than post feeding trial. At the same time, there was no significant difference between the Control Group before feeding trial and during the feeding trial ($P > 0.05$). At the Treatment 1 goats, the value of mean egg per gram slightly decreased and there was no significant difference ($P >0.05$). For the Treatment 2, the mean of egg per gram during feeding trial significantly higher ($P <0.05$) thanbefore feeding trial. However, mean value of egg per gram and during feeding trial had no significant figure ($P>0.05$).

Table 4.3 : Mean of the egg per gram according the different treatment of Boer goats.

Measurement	Treatment		
	Before Feeding Trial	During Feeding Trial	After Feeding Trial
CG	4166.67 ± 277.39 ᵇ	2783.33 ± 684.55 ᵃ	2016.67 ± 405.52 ᵃ
T1	2237.50 ± 461.60 ᵃ	2112.50 ±369.33 ᵃ	2050.00 ± 406.20 ᵃ
T2	2750 ± 677.31 ᵃᵇ	3137.50 ± 388.57 ᵃ	1312.50 ± 219.26 ᵃ

ᵃ-ᵇ Indicates the means that with significant different (P >0.05). CG : control group (napier + pellet), T1 : treatment 1 (napier + pellet + chopped OPF), T2 : treatment 2 (napier + pellet + pressed OPF).

CHAPTER 5

DISCUSSION

5.1 Hematological Parameters

According to the result of hematology at the Table 4.1, the level of the WBC for all treatments was decreased gradually at the different period time. The WBC level affected because of in the blood there are several types of the subgroups such as Neutrophil, Monocytes, Ecsinophils, Lymphocytes and Basophils. These components in blood had made the WBC level decreased and made the goat suffer leucopenia. The level of the MON for goat from CG and T2 before feeding trial start until after feeding trial had started are slightly decreased due to low level of the WBC. However, the MON level of the goat from T1 during the feeding trial increased because of the stress due to environment factor and disease condition on the goats (Alabi *et al*., 2013). This happened because of the several factors that have relations between the nutrient intake and health factor. The MON component is important to fight fighting the foreign materials that infected in the blood stream.

The RBC level for the three month period of research are eventually decreased for all treatment due to increase the maturity of the goats' age. The younger goats consists high number of the RBC in the blood stream (Etim *et al*., 2014). The RBC level after feeding trial at CG goats is the highest and this is indicate that CG preference due to lower dietary protein intake (Alabi et al., 2013). The HGB level of all goats at different pretreatments are increased gradually, especially goat from CG. The higher amount of the hemoglobin and red blood cell will indicating higher nutrient supply in the body system of the goats (Alabi *et al*., 2013).

The MCV and MCHC were related with the result RBC, HGB and PCV (Egbe-Nwiyi, Nwaosu and Salami, 2000). The function of the MCV was to know the average size of the RBCs and based on the result above, the MCV values for all treatment are significantly higher which was because of RBC regeneration had been marked. The MCHC is the sum of the concentration of haemoglobin in the blood. MCHC level after the feeding trial at T2 is the highest which indicatesthe hemolysis of blood and lipaemia. Lipaemia is the abnormality that presence in blood because of the high concentration of fat. Based on Table 4.1, the PLT level become decreased to all pretreatment when after the feeding trial especially T2. If the PLT level higher, there will caused thrombocytosis which is caused by iron deficiency and loss of blood (Shaikat *et al.*, 2013). The HCT level is like PVC level which is important to absorb nutrient in the blood (Etim *et al*., 2014).

5.2 Biochemical Parameters

Based on the Table 4.2, the levels of ALT, CAL, MG, TP, Glucose, CK-NAC, BUN and GGT are very important to the goat body. All these components are called as electrolytes. The biochemical analysis is very important to test the substance that contains in the living organisms. Through this test, the level of goat's health can be assessed especially the performance of internal organs in the goat. Based on the result in Table 4.2, the level of ALT starting from before feeding trial until during feeding trial is becoming decrease to all treatments. However, the results of the ALT are still in the range about 6-19 U/L. ALT is the metabolite of nitrogen, which is really important to the body due related to the liver. Moreover, the difference between the values of ALT of different period among the treatments is very normal physiological range (Mondal, 2015).

The values of BUN of all treatments are significant difference (P>0.05). Based on the Table 4.2, the Bun value of CG and T2 goats are significantly higher during the feeding trial, but the goat from T2 is the higher level and exceed from the reference value which is 3.6 until 7.1mmol/l. However, the value from the T1 is slightly lower. This value of BUN is represented as the Creatinine level that presence in the liver. Through this value can indicate the performance of the liver. The higher BUN level in the blood indicate the toxicity of urea occur. Hence, the T1 and T2 feed do not may cause the urea toxicity in the body system of the goats (Mondal, 2015).

The CAL is very important element that mostly takes part in the synthesis of the hormones in the body system (Yatoo*et al.*, 2013). Plus, the CAL level in the blood actually delicate together with the P level in the blood. In the Table 4.2, the level of the CAL is very low until during the feeding trial to all treatments group which are below than reference value (2.23-2.93 mmol/l). In the same time, the level of P are still in the range of the reference value (1.40-2.90 mmol/l). This process was happened due to hormone parathyroid hormone (PTH) which is thelevel of P will affect the level of CAL in the blood and it is will reacts in the positive and negative ways. However, the reduction of the CAL level in the blood for all treatments especially T2 will avoid the goats got kidney problem (Muralidharan *et al*, 2015).

Based on Table 4.2, the value of CK-NAC for all treatments drop rapidly, especially T2, which is the value of CK-NAC of before feeding trial start is increase and exceed from 28 until 130 U/L. CK-NAC is a type of protein that responsible to produce enzyme in the muscle cell and brain. The higher level of CK-NAC may lead the disease that related to the important organs such as heart (Newby, 2010). As well as GGT is indicate to measure the amount of the enzyme in the blood as chemical reaction (Marcin, 2017). The higher amount of T2 during the feeding trial is indicate that the enzyme in the body increase to degrade the pressed OPF due high contain in fibre and lignin in OPF (Alimon and Wan Zahari, n.d.). The total protein in the table

shown (Table 4.2) the TP level for all treatments are in high level before the feeding trial start. However, after the feeding trial had started, the TP level for all treatments are decrease and below from the range of the reference value (64-70 g/l). This happened because the amount of the Napier and the OPF given is not enough which must exceed than 3 kilograms. However, the changes of total protein happen due to many factors and the prediction and synchronize all the factors during the feeding trial is very difficult (H. Kioumarsi, 2009).

Mg is the a electrolytes that helps to regulate the nervous system and heart maintainance. There are some research that state the Mg level related with the potassium level in the blood serum (Odufowora, Adelakun, & Egbeyale, 2008). The high level of potassium will shift the Mg into and out the cell. This will lead to hypomagnesium, which is an imbalance of the magnesium by lower level of magnesium. Table 4.2 for CG and T1 are gradually increasing, however, the Mg value in T2 is slightly decreasing. However, the value of Mg for all treatments is still in the range between 0.31mmol/l until 1.48 mmol/l due to improvement of the feed formulation.

5.3 FaecalEgg Counts

Based on the Table 4.3, the result of the fecal egg count of CG before feeding trial are high at first. However, the amount of egg per gram (EPG) after the feeding trial for CG which are goats 151 and 158 were slightly decreased. For goat 156, the EPG level was slightly decreased during the feeding trial, but, it was starting to increaseafter feeding trial. That was happened due to stress factor during the feeding trial. For T1 which was goat 146 was rapidly increased during the feeding trial, but slightly decreased after the feeding trial. Same with the goat 150 which was decreased rapidly after the feeding trial. This was happened due to health problems.

For T2, most of the goats increased during feeding trial. However, the epg level drops rapidly because the health problems.

The amount of the EPG when exceed than 1000 epg, it may have many oocytes that type of coccidia(Villarroel, 2013). The coccidian infection will detected by the symptoms of diarrhea and weight loss (Villarroel, 2013). Plus, the higher level of the egg counts affected by the poor immune system (Gwaze, Chimonyo, & Dzama, 2012). Based on the Table 4.3, the mean of epg after feeding trial at T2 was the most lower than CG and T1. These can be shown that the feed from T2 was suitable and consists enough nutrient requirement and avoid the malnutrition problem.

CHAPTER 6

CONCLUSION

In conclusion, the hematology and biochemical analysesof the T2 had no significant difference except Mean Corpuscular Volume and Hematocrit. The biochemical analysis is very important to test the substance that contains in the living organisms. This indicates the level of health of the goats, especially the performance of internal organs in the goat body. For parasite infestation, the value of epg of T2 was the decreased after the feeding trial. Hence, the Pressed OPF diet was a suitable feed diet that improves all parameters level of blood metabolite.

RECOMMENDATION

The facilities of the housing system must be proper in order to enable the feeding trial. Then, the feed formulation must be improve every two weeks when doing the feeding trial. This is very important to make sure that the animals get enough nutrients. Next, the blood samples that had collected must be put into the ice box to avoid the contamination happen. Lastly, the pen fence must high to avoid the goats enable moving to another pen.

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APPENDIX A

Table 1A : The post hoc test of every component.

White Blood Cell

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	24.4333
Treatment 1 (Napier + Pellet + Chopped OPF)	4	33.7000
Treatment 3 (Napier + Pellet + Pressed OPF)	4	40.2250
Sig.		.193

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 203.987.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Lymphocyte

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	23.7333
Treatment 3 (Napier + Pellet + Pressed OPF)	4	24.5750
Treatment 1 (Napier + Pellet + Chopped OPF)	4	29.0500
Sig.		.260

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 31.851.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Granulocyte

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	17.2000
Treatment 3 (Napier + Pellet + Pressed OPF)	4	18.7000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	20.2000
Sig.		.223

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 8.538.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Monocyte

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	1.5000
Control Group (Napier + Pellet)	3	1.6333
Treatment 1 (Napier + Pellet + Chopped OPF)	4	1.7000
Sig.		.523

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .148.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Red Blood Cell

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	16.9367
Treatment 1 (Napier + Pellet + Chopped OPF)	4	19.1275
Treatment 3 (Napier + Pellet + Pressed OPF)	4	20.3175
Sig.		.288

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 14.614.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Hemoglobin

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	8.4333
Treatment 3 (Napier + Pellet + Pressed OPF)	4	8.8750
Treatment 1 (Napier + Pellet + Chopped OPF)	4	8.9500
Sig.		.503

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .898.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Hematocrit

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	30.8333
Treatment 1 (Napier + Pellet + Chopped OPF)	4	34.6250
Treatment 3 (Napier + Pellet + Pressed OPF)	4	37.0000
Sig.		.295

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 50.157.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mean Corpuscular Volume

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	18.0750
Treatment 3 (Napier + Pellet + Pressed OPF)	4	18.1750
Control Group (Napier + Pellet)	3	18.2000
Sig.		.650

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .117.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mean Hemoglobin Concentration

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	4.3500
Treatment 1 (Napier + Pellet + Chopped OPF)	4	4.7000
Control Group (Napier + Pellet)	3	5.4333
Sig.		.162

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .820.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Red Blood Cell Distribution Width

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	15.4750
Treatment 1 (Napier + Pellet + Chopped OPF)	4	15.9500
Control Group (Napier + Pellet)	3	16.9000
Sig.		.258

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.270.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Platelet Count

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	428.5000
Control Group (Napier + Pellet)	3	569.6667
Treatment 1 (Napier + Pellet + Chopped OPF)	4	582.2500
Sig.		.444

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 60445.302.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Procalcitonin

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	.21900
Treatment 1 (Napier + Pellet + Chopped OPF)	4	.28600
Control Group (Napier + Pellet)	3	.29733
Sig.		.457

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .017.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Platelet Distribution Width

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	54.9667
Treatment 1 (Napier + Pellet + Chopped OPF)	4	62.6500
Treatment 3 (Napier + Pellet + Pressed OPF)	4	64.7500
Sig.		.282

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 119.091.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mean Corpuscular Hemoglobin Concentrate

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 3 (Napier + Pellet + Pressed OPF)	4	24.0500
Treatment 1 (Napier + Pellet + Chopped OPF)	4	25.9750
Control Group (Napier + Pellet)	3	29.8333
Sig.		.169

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 24.191.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Mean Platelet Volume

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	4.9000
Treatment 3 (Napier + Pellet + Pressed OPF)	4	5.0500
Control Group (Napier + Pellet)	3	5.2667
Sig.		.111

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .070.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 2A :Pos hoc of each component hematology during feeding trial.

WBC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	21.5000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	28.5000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	28.9250
Sig.		.330

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 84.881.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

LYM

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	10.0000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	14.2250
Treatment 2 (Napier + Pellet + Pressed OPF)	4	16.6750
Sig.		.069

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 16.779.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MON

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	1.4667
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1.7750
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2.1750
Sig.		.352

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .850.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

RBC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	11.8333
Treatment 2 (Napier + Pellet + Pressed OPF)	4	13.1500
Treatment 1 (Napier + Pellet + Chopped OPF)	4	14.3000
Sig.		.161

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 4.222.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

GRA

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	11.5500
Control Group (Napier + Pellet)	3	12.3333
Treatment 2 (Napier + Pellet + Pressed OPF)	4	14.1500
Sig.		.262

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 7.676.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

HGB

Duncan[a,b,c]

Treatment	N	Subset 1	Subset 2
Treatment 2 (Napier + Pellet + Pressed OPF)	4	10.5750	
Treatment 1 (Napier + Pellet + Chopped OPF)	4	11.7250	11.7250
Control Group (Napier + Pellet)	3		12.4333
Sig.		.133	.334

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .853.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

HCT

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	34.6750
Treatment 2 (Napier + Pellet + Pressed OPF)	4	39.0750
Control Group (Napier + Pellet)	3	41.0000
Sig.		.079

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 16.314.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCV

Duncan[a,b,c]

Treatment	N	Subset 1	Subset 2
Treatment 2 (Napier + Pellet + Pressed OPF)	4	25.9250	
Control Group (Napier + Pellet)	3	29.7000	29.7000
Treatment 1 (Napier + Pellet + Chopped OPF)	4		40.5000
Sig.		.482	.068

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 47.088.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCH

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	18.8000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	21.5750
Control Group (Napier + Pellet)	3	22.1333
Sig.		.652

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 84.029.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCHC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	23.6333
Treatment 2 (Napier + Pellet + Pressed OPF)	4	23.8000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	27.2250
Sig.		.552

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 55.549.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

RDW

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	13.1000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	15.0500
Treatment 1 (Napier + Pellet + Chopped OPF)	4	15.7500
Sig.		.064

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.530.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PLT

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	384.2500
Control Group (Napier + Pellet)	3	399.0000
Treatment 1 (Napier + Pellet + Chopped OPF)	4	451.0000
Sig.		.435

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 10956.844.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MPV

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	6.3750
Control Group (Napier + Pellet)	3	6.5667
Treatment 1 (Napier + Pellet + Chopped OPF)	4	6.9250
Sig.		.316

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .438.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PCT

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	.20667
Treatment 2 (Napier + Pellet + Pressed OPF)	4	.22250
Treatment 1 (Napier + Pellet + Chopped OPF)	4	.27950
Sig.		.367

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .010.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PDW

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	25.0333
Treatment 1 (Napier + Pellet + Chopped OPF)	4	27.1000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	43.3000
Sig.		.185

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 262.271.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 3 A : The post hoc of each components after feeding trial.

WBC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	13.8000
Treatment 1 (Napier + Pellet + Chooped OPF)	4	23.4500
Treatment 2 (Napier + Pellet + Pressed OPF)	4	24.0500
Sig.		.060

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 36.345.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MON

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	.9667
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1.3250
Treatment 1 (Napier + Pellet + Chooped OPF)	4	1.5500
Sig.		.189

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .273.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

LYM

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	6.6000
Treatment 1 (Napier + Pellet + Chooped OPF)	4	11.0000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	11.4750
Sig.		.181

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 18.298.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

GRA

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chooped OPF)	4	11.1500
Control Group (Napier + Pellet)	3	11.6667
Treatment 2 (Napier + Pellet + Pressed OPF)	4	12.2250
Sig.		.677

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 10.261.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

RBC

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	11.2150
Control Group (Napier + Pellet)	3	11.4000
Treatment 1 (Napier + Pellet + Chooped OPF)	4	13.4500
Sig.		.334

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 7.835.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

HCT

Duncan[a,b,c]

Treatment	N	Subset 1	Subset 2
Treatment 2 (Napier + Pellet + Pressed OPF)	4	36.8750	
Treatment 1 (Napier + Pellet + Chooped OPF)	4	38.0250	
Control Group (Napier + Pellet)	3		47.4000
Sig.		.736	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 19.574.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCV

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	58.5750
Treatment 1 (Napier + Pellet + Chooped OPF)	4	59.2750
Control Group (Napier + Pellet)	3	59.3333
Sig.		.931

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 119.970.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

HGB

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	12.3250
Treatment 1 (Napier + Pellet + Chooped OPF)	4	13.1500
Control Group (Napier + Pellet)	3	14.1000
Sig.		.111

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1.625.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCH

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	22.0500
Control Group (Napier + Pellet)	3	26.5333
Treatment 1 (Napier + Pellet + Chooped OPF)	4	27.7250
Sig.		.201

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 27.436.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MCHC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	29.4667
Treatment 1 (Napier + Pellet + Chooped OPF)	4	31.0500
Treatment 2 (Napier + Pellet + Pressed OPF)	4	32.6250
Sig.		.468

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 28.496.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

RDW

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chooped OPF)	4	14.2750
Control Group (Napier + Pellet)	3	15.2000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	15.5250
Sig.		.384

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 3.049.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PLT

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	320.0000
Treatment 1 (Napier + Pellet + Chooped OPF)	4	391.2500
Treatment 2 (Napier + Pellet + Pressed OPF)	4	421.2500
Sig.		.111

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 5275.688.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

MPV

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	7.2500
Treatment 1 (Napier + Pellet + Chooped OPF)	4	7.7000
Control Group (Napier + Pellet)	3	7.7667
Sig.		.672

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 2.290.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PCT

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chooped OPF)	4	.24075
Control Group (Napier + Pellet)	3	.26000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	.28400
Sig.		.432

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .005.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

PDW

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	17.8667
Treatment 1 (Napier + Pellet + Chooped OPF)	4	22.2750
Treatment 2 (Napier + Pellet + Pressed OPF)	4	22.6250
Sig.		.180

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 17.375.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 4A :The post hoc of biochemical analysis before feeding trial.

ALT

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	18.6300
Treatment 2 (Napier + Pellet + Pressed OPF)	4	18.9600
Control Group (Napier + Pellet)	3	20.7767
Sig.		.539

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 18.520.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

BUN

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	6.3967
Treatment 1 (Napier + Pellet + Chopped OPF)	4	7.4325
Treatment 2 (Napier + Pellet + Pressed OPF)	4	7.5025
Sig.		.249

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1.310.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

CAL

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	1.8325
Control Group (Napier + Pellet)	3	1.8700
Treatment 2 (Napier + Pellet + Pressed OPF)	4	2.1550
Sig.		.305

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .143.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

CK_NAC

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	99.9667
Treatment 1 (Napier + Pellet + Chopped OPF)	4	106.0500
Treatment 2 (Napier + Pellet + Pressed OPF)	4	176.5000
Sig.		.272

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 6957.292.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

GLUCOSE

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	4.8150
Treatment 1 (Napier + Pellet + Chopped OPF)	4	5.1600
Control Group (Napier + Pellet)	3	5.3933
Sig.		.168

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .241.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Magnesium

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	1.0650
Control Group (Napier + Pellet)	3	1.1067
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1.3650
Sig.		.504

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .305.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Phosphorus

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	3.4500
Treatment 1 (Napier + Pellet + Chopped OPF)	4	3.7650
Treatment 2 (Napier + Pellet + Pressed OPF)	4	3.9275
Sig.		.417

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .515.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

TP

Duncan[a,b,c]

Treatment	N	Subset 1	Subset 2
Treatment 2 (Napier + Pellet + Pressed OPF)	4	81.6425	
Control Group (Napier + Pellet)	3	82.6233	
Treatment 1 (Napier + Pellet + Chopped OPF)	4		87.7850
Sig.		.657	1.000

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 8.130.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

GGT

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	45.1100
Treatment 2 (Napier + Pellet + Pressed OPF)	4	58.0125
Treatment 1 (Napier + Pellet + Chopped OPF)	4	79.1400
Sig.		.300

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1561.576.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 5A : The post hoc of each component of biochemical analysis during feeding trial.

ALT

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	17.9567
Treatment 1 (Napier + Pellet + Chopped OPF)	4	18.3825
Treatment 2 (Napier + Pellet + Pressed OPF)	4	18.8250
Sig.		.711

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 8.496.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

BUN

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	6.9400
Treatment 1 (Napier + Pellet + Chopped OPF)	4	6.9500
Treatment 2 (Napier + Pellet + Pressed OPF)	4	7.5125
Sig.		.542

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1.340.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Cacium

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1.5775
Treatment 1 (Napier + Pellet + Chopped OPF)	4	1.6425
Control Group (Napier + Pellet)	3	1.8000
Sig.		.175

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .037.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

CK_NAC

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	57.8000
Treatment 2 (Napier + Pellet + Pressed OPF)	4	69.5000
Control Group (Napier + Pellet)	3	90.4333
Sig.		.201

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 909.146.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Glucose

Duncan[a,b,c]

Treatment	N	Subset 1
Control Group (Napier + Pellet)	3	2.1933
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2.6050
Treatment 2 (Napier + Pellet + Pressed OPF)	4	2.7975
Sig.		.253

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .398.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

GGT

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	32.3100
Control Group (Napier + Pellet)	3	39.2433
Treatment 2 (Napier + Pellet + Pressed OPF)	4	43.1050
Sig.		.119

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 63.358.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Magnesium

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	1.2200
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1.3225
Control Group (Napier + Pellet)	3	1.3267
Sig.		.732

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .150.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Phosphorus

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2.5700
Control Group (Napier + Pellet)	3	2.7267
Treatment 2 (Napier + Pellet + Pressed OPF)	4	3.1375
Sig.		.064

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .116.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Total Protein

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	50.7650
Treatment 2 (Napier + Pellet + Pressed OPF)	4	54.1225
Control Group (Napier + Pellet)	3	63.1167
Sig.		.075

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 60.311.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 6A : The post hoc of parasite infestation before feeding trial.

Egg_Per_Gram

Duncan[a,b,c]

Treatment	N	Subset 1	Subset 2
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2237.5000	
Treatment 2 (Napier + Pellet + Pressed OPF)	4	2750.0000	2750.0000
Control Group (Napier + Pellet)	3		4166.6667
Sig.		.524	.103

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 1065442.708.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used.

Type I error levels are not guaranteed.

c. Alpha = .05.

Table 7A : The post hoc of parasite infestation during feeding trial.

EPG

Duncan[a,b,c]

Treatment	N	Subset 1
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2112.5000
Control Group (Napier + Pellet)'	3	2783.3333
Treatment 3 (Napier + Pellet + Pressed OPF)	4	3137.5000
Sig.		.174

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 782552.083.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 8A : The post hoc of parasite infestation after feeding trial.

EPG

Duncan[a,b,c]

T	N	Subset 1
Treatment 2 (Napier + Pellet + Pressed OPF)	4	1312.5000
Control Group (Napier + Pellet)	3	2016.6667
Treatment 1 (Napier + Pellet + Chopped OPF)	4	2050.0000
Sig.		.164

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 382942.708.

a. Uses Harmonic Mean Sample Size = 3.600.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

Table 9 A : The reference value of hematological analysis.

Haemogram		**Ref.**
WBC	10^3/µl	**4.0-12.0**
LYM	10^3/µl	**1.0-5.5**
MON	10^3/µl	**0.1-1.0**
GRA	10^3/µl	**2.0-8.0**
RBC	10^6/µl	**4.00-6.20**
HGB	g/dl	**11.0-17.0**
HCT	%	**35.0-55.0**
MCV	µm^3	**80.0-100.0**
MCH	pg	**26.0-34.0**
MCHC	g/dl	**31.0-35.5**
RDW	%	**10.0-16.0**
PLT	10^3/µl	**150-400**
MPV	µm^3	**7.0-11.0**
PCT	%	**0.200-0.500**
PDW	%	**10.0-18.0**

Table 10 A : Reference value of biochemical analysis.

Haemogram	**Ref.**
ALT U/L	**6.0-19.0**
BUN mmol/l	**3.6-7.1**
CAL mmol/l	**2.23-2.93**
CK-NAC U/L	**28-130**
GGT U/L	**20-56**
GLUCOSE mmol/l	**2.78-4.16**
MAGNESIUM mmol/l	**0.31-1.48**
PHOS mmol/l	**1.40-2.90**
TP g/l	**64-70**

Table 11 A :The egg per gram result of parasite infestation of each Boer goat.

Group	Goat ID	Before Feeding Trial	During Feeding Trial	After Feeding Trial
GC	151	3650	2600	1550
GC	156	4250	1700	2550
GC	158	4600	4050	1950
T1	152	1500	2150	850
T1	146	1700	3050	2650
T1	150	2200	1250	2350
T1	030	3550	2000	2350
T2	143	1300	3350	950
T2	148	2800	3450	1200
T2	149	2350	3750	1150
T2	160	4550	2000	1950

CG : control group (napier + pellet), T1 : treatment 1 (napier + pellet + chopped OPF), T2 : treatment 2 (napier + pellet + pressed OPF).