

SUPPLEMENTATION OF REJECTED BANANA (*Musa acuminata* X
balbisiana COLLA ABB GROUP 'SABA') MEAL IN BROILER DIET
AND ITS EFFECT ON GROWTH PERFORMANCE

TAN ZHI QIAN

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SAYA: TAN ZHI QIAN

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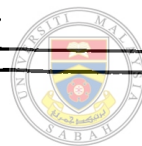
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TAN ZHI QIAN
BR 12110135
11 January 2016



VERIFIED BY

1. Assoc. Prof. Dr. Harpal Singh Saini
SUPERVISOR

H Saini

PROF. Madya DR. HARPAL SINGH SAINI
PENSYARAH
FAKULTI PERTANIAN LESTARI
UMS KAMPUS SANDAKAN

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ABSTRACT

Alternative feedstuffs are one of the potential ways to reduce the feed cost in livestock industry and such alternative feedstuff can be obtained in various agricultural wastes. Banana is ranked fourth in most planted area in Malaysia and generated about 10% of wastes which is made up of rejected bananas. This research was conducted to determine the feasibility of feeding rejected banana in optimum amount to broilers. A total number of five treatments were equally assigned with a total number of fifty-five commercial broiler chicks, which have eleven chicks for each treatment. The treatments included one control treatment (0% of banana supplementation) and four different supplementation level of banana (5%, 7.5% and 10% peeled banana and 10 % unpeeled banana). Chicks were fed with respective treatment diet starting at seventh days old for five weeks duration until they were forty-two days old. Four (4) parameters like feed intake, body weight gain, growth rate, and feed conversion ratio were examined and analyzed to determine the effect of different levels of meals. In terms of feed intake (FI), control group had achieved highest feed intake during the entire experimental period, which is 32.322 kg, followed by T3, T1, T4 and T2 (32.320 kg, 32.311 kg, 32.306 kg and 32.240 kg respectively). Body weight gain of birds in 5 treatments shown a descending trend from control to T4 with 1.78 kg, 1.72 kg, 1.63 kg, 1.56 kg and 1.55 kg respectively and showed no significant differences ($p>0.05$). Similar trend was observed in growth rate of broilers, with 50.92 g/bird/day, 49.25 g/bird/day, 46.72 g/bird/day, 44.75 g/bird/day, and 44.38 g/bird/day respectively for control, T1, T2, T3 and T4. Feed conversion ratio (FCR) of 5 treatments displayed the same descending trend from control to T4, with 1.49, 1.53, 1.57, 1.63, and 1.65 respectively. In conclusion, the H_0 was accepted in this study in which supplementation of Saba Banana had no significant difference on broilers' growth performance. However, 5% of dried banana without peels can compensate for the nutrients needed by broilers and to support the desired growth.

SUPLEMENTASI PISANG 'SABA' (*Musa acuminata* x *balbisiana* Colla ABB Group 'Saba') DALAM MAKANAN AYAM PEDAGING DAN KESANNYA TERHADAP TUMBESARAN

ABSTRAK

Makanan haiwan alternatif merupakan salah satu cara untuk menjimatkan kos makanan dalam industri penternakan dan makanan tersebut boleh didapati daripada sisa-sisa pertanian. Pisang merupakan tanaman yang keempat banyak ditanam di Malaysia mengikut keluasan penanaman dan menghasilkan sebanyak 10% sisa, terutamanya pisang yang ditolak. Kajian ini dijalankan demi pengenalpastian kebolehlaksanaan penggunaan pisang yang ditolak dalam pemakanan ayam pedaging. Sebanyak 5 kumpulan rawatan telah diaturkan secara sama rata dengan lima puluh lima ekor anak ayam pedaging komersial di mana sebelas ekor anak ayam untuk setiap rawatan. Kesemua kumpulan rawatan termasuk rawatan kawalan (0% suplementasi pisang) dan empat jenis rawatan yang melibatkan tahap suplementasi pisang yang berbeza (5%, 7.5% dan 10% pisang tanpa kulit dan 10% pisang berkulit). Semua anak ayam pedaging telah diberi makanan yang berbeza berdasarkan rawatan masing-masing bermula dari umur tujuh hari dan selama lima minggu sehingga mereka mencecah umur empat puluh dua hari. 4 parameter, iaitu kadar pemakanan, penambahan berat badan, kadar pertumbuhan dan nisbah penukaran makanan telah diukur dan dianalisis untuk mengetahui kesan rawatan yang berlainan. Untuk kadar pemakanan, rawatan kawalan mencecah kadar yang tertinggi dengan nilai 32.322 kg, dan diikuti dengan T3, T1, T4 dan T2 (32.320 kg, 32.311 kg, 32.306 kg and 32.240 kg masing-masing). Penambahan berat badan ayam pedaging dalam 5 rawatan pula menunjukkan trend menurun dari rawatan kawalan ke T4, dengan nilai 1.78 kg, 1.72 kg, 1.63 kg, 1.56 kg dan 1.55 kg masing-masing serta tiada perbezaan signifikan antara satu sama lain ($p > 0.05$). Trend yang sama turut didapati dalam kadar pertumbuhan, dengan nilai 50.92 g/ayam/hari, 49.25 g/ayam/hari, 46.72 g/ayam/hari, 44.75 g/ayam/hari, and 44.38 g/ayam/hari untuk kawalan, T1, T2, T3 and T4. Nisbah penukaran makanan (FCR) untuk 5 rawatan menunjukkan trend menurun yang sama dari kawalan ke T4, dengan nilai 1.49, 1.53, 1.57, 1.63, and 1.65 masing-masing. Kesimpulannya, H_0 telah diterima dalam kajian ini kerana $p > 0.05$. dan pemberian pisang Saba tanpa kulit sebanyak 5% boleh menampung keperluan ayam.

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LIST OF SYMBOLS, UNITS AND ABBREVIATIONS

%CF	Percentage of Crude Fiber
%CP	Percentage of Protein
%EE	Percentage of Ether Extract
%MC	Percentage of Moisture Content
%N	Percentage of Nitrogen
%NFE	Percentage of Nitrogen Free Extract
BC	Before Christ
BWG	Body Weight Gain
CGIAR	Consultative Group for International Agricultural Research
DOS	Department of Statistic
DVS	Department of Veterinary Services
et al.	and others
FAO	Food and Agriculture Organization of the United Nations
FCR	Feed Conversion Ratio
FI	Feed Intake
FSA	Faculty of Sustainable Agriculture
GDP	Gross Domestic Product
GR	Growth Rate
IU	International Unit
Kcal	Kilocalories
kg	Kilogram
mg	Milligram
mm	Millimeter
spp.	species
T1	Treatment 1
T2	Treatment 2
T3	Treatment 3
T4	Treatment 4
USA	United States of America
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Introduction

Agriculture sector is one of the important sectors in Malaysia as it provides food to the people and raw material to the country for development and economic growth. In 2013, Malaysia had achieved the Gross Domestic Product (GDP) which has a total amount of RM787.6 billion (DOS, 2014). Among the total amount, agriculture sector contributed 7.1% (DOS, 2014) and the contribution of livestock subsector to GDP for agriculture was 12.4% in year 2013. This subsector showed a gradual increase in percentage share of GDP for agriculture from the year 2009 (9.7%) until 2013 (12.4%). Besides, the trend in the consumption of livestock products, especially the meat and meat products also showed a gradual increase from year 2004 (365,537.39 metric tons) to 2013 (571,784 metric tons) (DVS, 2013). It is quite evident that, the importance and contribution of livestock subsector to the country's economy cannot be overlooked and underestimated.

Malaysia livestock subsector comprises of several animal industries such as dairy and beef cattle, goat, sheep, buffaloes, swine and poultry. Poultry industry, of which the broiler and layer chicken have the most share, is of great importance and contributing to the increasing trends. Poultry industry contributed 7.8% out of 12.4%, followed by other livestock (3.1%) and cattle (1.5%) in the percentage share of GDP for agriculture sector of 2013. The domestic consumption of poultry meat in Malaysia reached 1,459,039 metric tons for the year 2014 from 1,394,598 metric tons in year 2012 (USDA , 2014). According to Department of Veterinary Service Malaysia (DVS, 2013), Malaysia consumption per capita of poultry meat is recorded to be 43.36kg in



year 2011. In order to accommodate the local consumption and demand for poultry meat, the poultry industry is expected to be expanded into a larger scale industry.

As the poultry industry expands over times, animal feed industry should be developed at the same pace to ensure the livestock animals especially poultry have access to quality feed. Feed is the major component in animal husbandry sector. Feed occupies a major proportion of livestock industry which often represents 50% or more of total production cost in ruminants and 80% or more of the total production cost in non-ruminants (Pond *et al.*, 2005). Therefore, feed millers in Malaysia have to import a number of feedstuffs and feed ingredients from foreign countries especially United States of America (USA) and Argentina. Feedstuffs such as cereal grains, oilseeds and legume grains are often imported into our country to be processed into animal feeds. This is because of the local production of feedstuffs is insufficient to fulfill the demand of local feed industry. Therefore, the better way to lift the current status is to search for the alternative feedstuffs produced locally. Opportunity exists in exploring unconventional feeds that are locally produced. Unconventional feed can come from various sources such as agriculture wastes, industrial and milling by-products and some foods produced in excessive for human consumption.

Banana is a general term which comprises of a number of varieties in the *Musa* genus of Musaceae family (Morton, 1987). Banana is one of the staple foods for human consumption especially in Africa. According to McGrath, reporter of BBC News (2012), the banana could be replacing potatoes in the world market which is currently being affected by global warming process. This will leads to an increase in planting area and production of banana. In Malaysia, there are approximately 27,454 hectares of land are planted with banana and it is the fourth ranking of most planted area after oil palm, rubber and rice. In terms of fruit crop sector, it is the second ranking fruit crop in terms of planted area. The annual production of banana in Malaysia is 530,000 tonnes per year and for every tonne (1000kg) of banana is picked; 100 kg of fruit is rejected. Rejected banana fruits mostly comprises of over ripe and rotten fruits. It is considered a great loss for banana producers as the rejected fruits cannot be sold to the consumers and utilized in any other way.

However, rejected banana can be used for processing into livestock feed especially for swine and poultry. In the Philippines, it has been found that meal made from dehydrated reject bananas can contribute 14% of total broiler rations without

adverse effects (Morton, 1987). In addition, dried banana or plantain fruits or pulp with higher energy densities could meet appetite limitations if well supplemented with protein, vitamins and minerals (Babatunde, 2003). Due to high energy content of banana fruit, theoretically it can be included in livestock feeding to replace or reduce other energy ingredients. The poultry feed comprises mostly the cereal grains such as corn. However, production of corn in Malaysia is not sufficient to meet the needs and thus the Malaysia feed industry has to rely up on import of corn, and this has resulted in the increased cost of poultry feeds. For reducing the cost of poultry feed in Malaysia, one of the ways is to provide locally produced ingredients which can supply sufficient nutrients so that the dependency on imported ingredients can be reduced. In this case, rejected banana provide an opportunity in replacing some amount of corn in the broiler diet as it cannot be sold to customers and it would be a waste if not utilized. Therefore, it is necessary to carry out research to exploit the potential of rejected bananas in broiler feeding. This research proposes to determine the optimum level of inclusion of rejected banana of *Musa acuminata x balbisiana* Colla ABB Group 'Saba' variety in broiler diet, as controversy exist among researches regarding the inclusion rates of rejected banana in broiler diets.

1.2 Justification

- 1) Alternative feed sources for poultry industry, specifically in broiler chicken sector: Rejected banana which contain high carbohydrate content, especially starch could supply good amount of daily energy needs of broiler chickens.
- 2) High wastages in local banana industry: Banana industry in Malaysia produces 100kg of rejected banana for every tone of banana produced. This indicates a 10% of wastage in fruits if no other measure is taken to utilize the wastes.
- 3) High feed cost due to importing feedstuffs such as cereal grains, oilseed and legume grains from foreign country: As we know that, broiler feed is made up of several ingredients and most of the ingredients such as corn and soybeans are imported. By utilizing the locally produced rejected bananas, certain portion of imported feedstuffs can be replaced. Hence, feed industry can reduce the dependency on imported ingredients and thus, reducing the feed costs.
- 4) A new model for broiler chicken farming in Malaysia: This research will be carried out to determine the feasibility of utilizing rejected bananas in feeding broiler. If it is feasible, broiler farmers will be advised to plant bananas at empty and unused area in their broiler farms so that they can diversify their farm products and at the same time

include rejected and unused bananas, in the broiler diets to reduce the dependence on basic imported feed.

1.3 Objectives

- 1) To assess the nutritive value of *Musa acuminata* x *balbisiana* Colla ABB Group 'Saba' as an alternative feedstuff for broiler.
- 2) To determine the effect of supplementation of different levels of *Musa acuminata* x *balbisiana* Colla ABB Group 'Saba' on the growth performance of broiler chickens.

1.4 Hypothesis

H_0 : There is no significant effect of different levels of *Musa acuminata* x *balbisiana* Colla ABB Group 'Saba' supplementation on growth performance of broiler.

H_A : There is significant effect of different levels of *Musa acuminata* x *balbisiana* Colla ABB Group 'Saba' supplementation on growth performance of broiler.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Cultivated bananas or plantains are edible fruit which belongs to genus *Musa*. There had been archaeological studies regarding the origin and domestication of cultivated banana in different contexts such as Chinese, Hindu and Roman. The earliest reference to banana dates back to about 500 BC (Pillay *et al.*, 2007). According to Denham *et al.* (2003), the earliest archaeological evidence of domesticated bananas is from Papua New Guinea and has been dated to at least 7,000 years before present. Besides, evidences from archaeology studies indicate that some of the regions in Southeast Asia could be possibly the origin of banana. Cultivated bananas are then brought into other regions of the world through travelers or migrants.

Banana (*Musa spp.*) is a term which refers to several varieties of plant that belong to Musaceae family. Banana is being classified into 2 main groups, which are dessert or sweet banana and cooking banana including plantain on the basis of culinary uses (Champion, 1963; Lescot, 1990; Marchal, 1993; Marriott and Lancaster, 1983; Nakasone and Paull, 1999; Turner, 1994). Dessert banana is often being consumed in uncooked but ripen state while for cooking banana, it is consumed in cooked state, either ripen or raw. Fresh banana fruit further can be processed into great variety of local products such as cooked banana (fried, boiled, crisps); purée or mash; alcoholic products and desserts.

Banana is native to Indo-Malaysian, Asian and Australian tropics and is now found throughout the tropics and subtropics (Nelson *et al.*, 2006). According to Nelson *et al.* (2006), the size of banana plant ranged from 2 to 9 meters at maturity and can



grow in wide range of soils, preferably well drained. Bananas and plantains are widely adapted and are growing at habitat which elevations of 0–920 m or more, depending on latitude; having mean annual temperatures of 26–30°C and annual rainfall of 2000 mm or higher for commercial production (Nelson *et al.*, 2006).

Banana plant comprises of leaves, apparent trunk, suckers and underground stems. When it is fruiting, there is presence of male and female flowers in a bunch. Leaves of banana are large and closely rolled up one over the other (FAO, 1977). The leaves look like a trunk when rolled up together but they only formed up the apparent trunk or pseudo-stem instead of true trunk (FAO, 1977). Banana fruits possess peels which are yellow in colour. The flesh of banana is light in colour, sweet and soft (FAO, 1977). In the middle of banana fruit, little black specks are present. These are the seeds of banana but they will not germinate (FAO, 1977). The morphology of a banana plant and cross section of banana fruit are shown in Figure 2.1 and 2.2 below respectively.

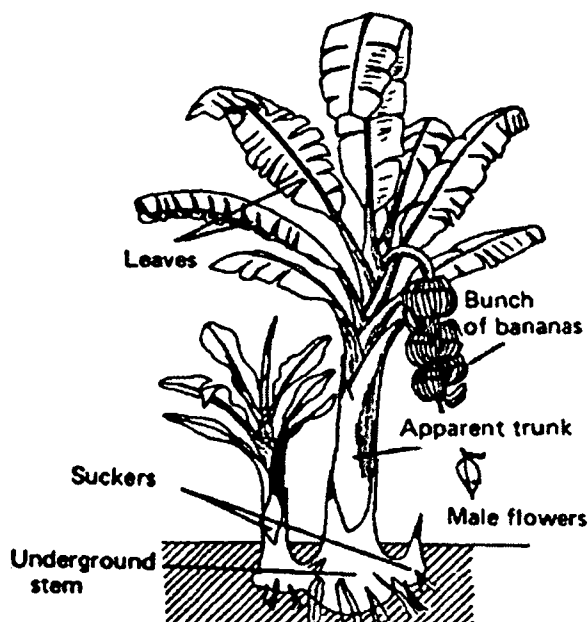


Figure 2.1 Morphology of a banana plant.

Source: <http://www.fao.org/docrep/006/t0308e/t0308e03.htm>

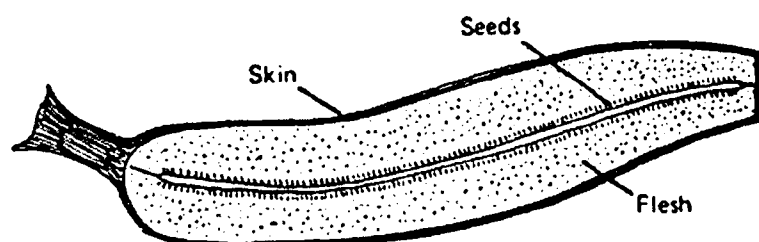


Figure 2.2 Cross section of a banana fruit.

2.1.1 Banana Cultivars

Banana species comprises of several cultivars resulted from the crosses between 2 wild varieties, which are *Musa acuminata* Colla and *Musa balbisiana* Colla. *Musa acuminata* Colla (AA) is a wild diploid which is highly polymorphous and with spindly plants that grow in clumps while *Musa balbisiana* Colla (BB) is a homogenous hardy plant with a massive pseudo-trunk (Aurore *et al.*, 2008). The cultivars which resulted from these 2 wild varieties can be grouped according to their genome groups. There are diploid, triploid and tetraploid genome groups (Aurore *et al.*, 2008). However, the main genome groups are AA, AB, AAA, AAB and ABB (Bakry *et al.*, 1997; Stover and Simmonds, 1987).

2.1.1.1 *Musa acuminata* x *balbisiana* Colla ABB Group 'Saba'

Musa acuminata x *balbisiana* Colla ABB Group 'Saba' is known as Saba banana or sweet plantain by its English common name, is a triploid hybrid banana cultivar resulted from crossing between *Musa acuminata* and *Musa balbisiana*. Saba banana is originated from Philippines and can be found throughout the Southeast Asia. In Malaysia, it is known as 'Pisang Nepah' and particularly known as 'Pisang Saba' in Sabah states. Saba banana can grow in warm and moist area with average annual rainfall of 2500 mm evenly distributed throughout the year and temperature ranging from 18°C to 35°C (Lim, 2012). According to Lim (2012), it grows best in full sun in well-drained, deep, moist, fertile soils rich in organic matter and soil pH between 5.5 and 6.5. The average weight of a bunch of Saba banana is around 14-22 kg with 7-12 hands per bunch and 12-20 fingers per hand (Lim, 2012).

2.2 Uses of Banana

2.2.1 Banana as Staple Food

Banana is an important food crop which accommodates demands from huge population of mankind from all over the world, especially in tropical humid regions. Banana is regarded as the fourth important food crop, which is after rice, wheat and maize. Banana is consumed as staple food mostly in poorest regions among Asia, Africa and Latin America. Banana is important staple food which accommodates for nearly 400 million people in many developing countries, especially in Africa (CGIAR, 2015). Based on CGIAR (2015), in the East African highlands, consumption may be as high as 1 kilogram per person per day. Ripe banana which provides 116 Kcal of energy for every 100 grams is the reasons why it becomes a supplementary staple food (Sampath Kumar *et al.*, 2012).

Due to its wide adaptability, it can be planted in many tropics and subtropics regions such as Asia and Africa and thus became an important source of food for population in poor regions. According to CGIAR (2015), only 15% of global banana and plantain production is involved in international trade – most production is consumed domestically. This indicates that banana and plantain produced comprises large proportion of food consumed for human population especially in those poor regions. Banana and plantain ensure the food security for small scale farmers and family of low income as it can be produced in year-round and this provides a continuous supply of food along the year. Small scale farmers and poor villagers of tropical regions usually planted banana around the empty spaces of their farm and house to get easier access to the fruits during fruiting period.

2.2.2 Banana as Medicinal Food

Banana fruit has several medicinal properties for human. First of all, banana can help in reducing risk of high blood pressure. This is due to its high potassium content, where a medium-sized of banana can provide 350 mg of potassium. Potassium acts as an essential mineral for maintaining normal blood pressure and heart function (Sampath Kumar *et al.*, 2012). According to Sampath Kumar *et al.* (2012), scientists reported that natural compounds in bananas act in a manner similar to antihypertensive drugs. Researchers have reported that blood pressure fell by 10% in people who ate two bananas daily for a week. There is also report on 10% of falling in

blood pressure in people who ate 2 bananas daily for a week by researchers. Moreover, there is also a study in 1997 that suggested consumption of 5 bananas daily would have half the effect of blood pressure controlling pills.

Moreover, banana can help to restore normal bowel activity due to its high content of non-digestible fibre. Non-digestible fibre such as hemicellulose and cellulose are believed to help in restoring normal bowel activities. Besides, banana can also help with constipation and diarrhoea (Sampath Kumar *et al.*, 2012). Banana which is rich in fructooligosaccharides that is used for nourishing probiotics in our colon helps to improve the absorption of nutrients and also provide protection from unbeneficial microbes. Probiotics fermented fructooligosaccharides and increasing its own population along with improving adsorption of nutrients (Sampath Kumar *et al.*, 2012).

Besides, banana is an energy booster and can help with anaemia. Banana comprises of 3 types of sugars (glucose, fructose and sucrose) along with fibre. These sugars act as sources of energy which are readily utilized by human body. Banana is also high in iron content (1mg of iron in a medium-sized banana). Iron is an important mineral for production of haemoglobin in red blood cells. High iron content of banana could enhance the production of haemoglobin and this could aid in the anaemia.

2.2.3 Banana as Source of Mineral and Vitamin

Mineral and vitamins are important for body normal function and metabolism. Ripe banana is an excellent sources of several mineral and vitamins that required by human body. Banana is rich in potassium, magnesium, and iron mineral. According to Sampath Kumar *et al.* (2012), a single banana provides us with 23% of the potassium that we need on a daily basis. Moreover, 100g of banana consists of 27mg of magnesium. Besides, banana consists of high iron content which one medium-sized banana contains 1mg of iron.

Other than that, banana itself is an excellent source of vitamins including A, B₆ C and D (Sampath Kumar *et al.*, 2012). In every 100g of banana, there is 64 IU of vitamin A; 0.4mg of vitamin B₆; and 8.7mg of vitamin C respectively. The nutrition facts for mineral and vitamin content of 100g of banana is shown as below.

Table 2.1 Mineral and Vitamin Content in 100g of banana

Vitamins

Amounts Per Selected Serving		%DV
Vitamin A	64.0 IU	1%
Vitamin C	8.7 mg	15%
Vitamin D	-	-
Vitamin E (Alpha Tocopherol)	0.1 mg	1%
Vitamin K	0.5 mcg	1%
Thiamin	0.0 mg	2%
Riboflavin	0.1 mg	4%
Niacin	0.7 mg	3%
Vitamin B6	0.4 mg	18%
Folate	20.0 mcg	5%
Vitamin B12	0.0 mcg	0%
Pantothenic Acid	0.3 mg	3%
Choline	9.8 mg	
Betaine	0.1 mg	

Minerals

Amounts Per Selected Serving		%DV
Calcium	5.0 mg	1%
Iron	0.3 mg	1%
Magnesium	27.0 mg	7%
Phosphorus	22.0 mg	2%
Potassium	358 mg	10%
Sodium	1.0 mg	0%
Zinc	0.2 mg	1%
Copper	0.1 mg	4%
Manganese	0.3 mg	13%
Selenium	1.0 mcg	1%
Fluoride	2.2 mcg	

Source: <http://nutritiondata.self.com/facts/fruits-and-fruit-juices/1846/2>

2.2.4 Banana as Raw Material for Further Processing

Banana fruit can either be eaten fresh or further processed into other food products. Banana fruit can be processed into a great variety of food products including whole, peeled and dried banana; cooked banana (boiled, fried, crisps, mashed); domestic preparation (fritters, jams, wines, beer); domestic and artisanal flour; green banana starch; puree; alcohol; regional beers; wine; vinegar; nectar; chunks and purees as ingredients in culinary preparations (pastries, desserts, ice-creams, sorbets and cream products) (Aurore *et al.*, 2008).

2.2.5 Banana as Animal Feed

Whole banana plant can be utilized as animal feed as they are cheap and easily accessible. Banana especially the fruit can be used for feeding livestock such as pigs, cattle and broiler. Bananas fruits have high water content, which is around 75% to 80%. According to FAO (1978), In the green state in which they are generally picked and packed, the dry matter consists mainly of starch (72 percent), which on ripening changes into simple sugars (saccharose, glucose and fructose). Banana which consists of high fermentable sugar can be made into silage for supplying feed in scarcity. Silage made from banana can be fed to ruminants such as cattle and goat and also monogastric. Ripe banana fruit either rejected or not are often fed to pigs along with supplementation of protein, vitamin and mineral. Fresh bananas can be fed to pigs in whole peeled form or chopped into thin slices. However, Le Dividich and Canope (1970) proposed that adding bananas to a pig ration reduces the digestibility of the total nitrogen content of the ration.

Besides, cattle can be fed with banana fruit too together with supplementation of protein in urea form. This is due to the low protein content of banana fruit. Sukri *et al.* (1999) proposed that farm-rejected banana fruit could be used as energy feed for fattening of beef cattle. In Sukri's work, they found that inclusion of banana fruit (var Cavendish) in the diet around 50% and 75% has resulted in good animal body weight gain in the case of beef cattle.

In case of broiler, there is meal that made from dehydrated rejected bananas. According to Morton (1987), it has been found that meal made from dehydrated reject bananas can form 14% of total broiler rations without adverse effects in the Philippines.

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