DESIGN FORMULATION OF OSTRICH FEED FROM PALM KERNEL CAKE (PKC)

NIK MUHAMMAD RIDHWAN BIN NIK RAZALI

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Universiti Malaysia Pahang

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ABSTRACT

This research is to design formulation of ostrich feed based on palm kernel cake. The palm kernel cake (PKC) are the by-product from the palm kernel production and the excess of these PKC are exported. However, the profit that we gain from the export is small. Thus, this research mainly about how to use this by-product and use as feed input material in the ostrich feed production. So, the objectives is to study the right composition of palm kernel cake, justify the possibility of product using palm kernel cake as protein substitute in ostrich feed and lastly to determine the percentage of the raw material based on standard nutrient for the ostrich. Based on the given information, the composition of the feed was analyzed. There are three samples that has been formulated. These samples contain 25%, 30% and 35% of PKC. Then, these samples are compared with the standard nutrient required by the ostrich. The most suitable formulation is the usage of PKC of 30%. The process involve after the objective achieved is making it into a product. All the raw material will be grinding and then mixing. Then it will be analyze using the Near Infrared Analyzer (NIR) to make analyze that the right nutrient of the compound. Then, it will be mixed other substance as a binding to turn into pellet. The pellet that been produce will be compare with the standard ostrich feed. The product should be the same as the standard or it could be much better. Other raw materials are soybean, corn meal, fishmeal, limestone and oil palm fronds (OPF) were added to get the right nutrient composition. The cost of the manufacturing of ostrich can be reduced due to the usage of the PKC and the profit to the ostrich farming will be increase.

ABSTRAK

Penyelidikan ini adalah untuk memformulasi makanan burung unta dengan menggunakan PKC. PKC adalah bahan buangan daripada produksi kelapa sawit dan biasanya lebihan bahan buangan ini merupakan salah satu bahan yang dieksport. Walaubagaimanpun, keuntungan yang diperolehi daripada eksport ini adalah kecil. Oleh itu, penyelidikan ini adalah untuk menjadikan bahan buangan ini sebagai bahan mentah untuk makanan burung unta untuk meningkatkan nilainya. Maka, matlamat penyelidikan ini adalah untuk mengkaji komposisi nutrisi di dalam PKC, mengesahkan penggunaan PKC untuk menggantikan sumber protein di dalam makanan burung unta, dan akhir sekali untuk menentukan komposisi PKC yang sesuai untuk digunakan sebagai bahan mentah di dalam makanan burung unta. Berdasarkan maklumat yang diperolehi, komposisi nutrisi makanan burung unta telah dianalisis. Terdapat tiga sample telah disediakan iaitu dengan komposisi PKC sebanyak 25%, 30% dan 35 %. Kemudian, nutrisi sampel ini telah dibandingkan dengan nutrisi yang diperlukan oleh burung unta. Formulasi yang paling sesuai adalah penggunaan PKC sebanyak 30%. Proses seterusnya adalah untuk menghasilkan produk. Semua bahan mentah akan dikisar dan dicampur mengikut komposisi yang telah ditetapkan. Kemudian ia akan dianalisis dengan menggunakan near infrared Analyzer (NIR). Ia kemudiannya ditambah dengan bahan-bahan lain untuk menjadikannya dalam bentuk pil. Pil ini akan dibandingkan sekali lagi dengan nutrisi standard bagi makanan burung unta. Untuk mendapatkan nutrisi yang sesuai, kacang soya, jagung , fishmeal, batu kapur dan pelepah kelap[a telah digunakan. Kos pengeluaran makanan burung unta dapat dikurangkan dan jumlah keuntungan dapat dipertingkatkan.

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CHAPTER 1

INTRODUCTION

1.1 Background

The oil palm tree (*Elaeis guineensis jacq.*) originates from West Africa where it grows in the wild and later was developed into an agricultural crop. It was introduced to Malaysia, then Malaya, by the British in early 1870's as an ornamental plant. In 1917, the first commercial planting took place in Tennamaran Estate in Selangor, laying the foundations for the vast oil palm plantations and the palm oil industry in Malaysia. The cultivation of oil palm increased at a fast pace in early 1960s under the government's agricultural diversification programmers, which was introduced to reduce the country's economic dependence on rubber and tin. Later in the 1960s, the government introduced land settlement schemes for planting oil palm as a means to eradicate poverty for the landless farmers and smallholders. The oil palm plantations in Malaysia are largely based on the estate management system and smallholder scheme.

Today, 4.49 million hectares of land in Malaysia is under oil palm cultivation; producing 17.73 million tonnes of palm oil and 2.13 tonnes of palm kernel oil. Malaysia is one the largest producers and exporters of palm oil in the world, accounting for 11% of the world's oils & fats production and 27% of export

trade of oils & fats. The industry provides employment to more than half a million people and livelihood to an estimated one million people.
(Mohd. Basri Wahid, 2004).

Palm oil is an excellent product and useful product. Although oil from the palm tree is an excellent product for the country, residues from oil palm have not been used sufficiently. Until recently, the remaining 90% empty fruit bunches (EFB), fibers, fronds, trunks, kernels, palm oil mill effluent was discarded as waste, and either burned in the open air or left to settle in waste ponds. Although this way, the palm oil processing industry waste contributed significantly to CO_2 and methane emissions.

Arising from the steep enrichment of globalization and metropolitan growth, today oil palm has demonstrated a wide spectrum of implications, almost every part of its plant. With the prices of the crude petroleum and world's demand for oils and fats escalating to an unprecedented height every other day, the amount of biomass produced by an oil palm tree, inclusive of the oil and lingo-cellulosic materials is on an average of 231.5 kg dry weight/year. For each bunch of the fresh palm fruit, approximately 21% of palm oil, 6–7% of palm kernels, 14–15% of palm fibers, 6–7% of palm shells and 23% of empty fruit bunches can be obtained. This has inspired a growing interest in the utilization of oil palm waste as a renewable source of energy or feedstock for a large variety of downstream products. The potentiality is further strengthened and driven by the insight that oil constitutes only 10% of the palm production, while the rest 90% is the biomass. (K.Y.Foo *et al.,* 2009).

The production of aquatic animals, aquaculture, is currently the fastest growing animal production sector in the world. The rapid expansion of the aquaculture industry is most pronounced in Asia, which contributes about 90% of the total global aquaculture production (by weight). This increase in aquaculture production must be supported by a corresponding increase in the production of formulated diets for the cultured aquatic animals. For most aquaculture systems, the cost of feed constitutes 30% to 60% of the operational costs of the farm, with protein being the most expensive dietary component. Even though fish meal continues to be used as a major source of dietary protein in commercial aquafeeds, its escalating cost have stimulated much research into the use of alternative plant protein sources

Among the plant proteins tested, soybean meal has enjoyed the most commercial success. Tropical countries import a large volume of soybean meal for use as a source of protein in the production of animal feeds. In recent years, the cost of imported feed ingredients used in commercial aquafeeds in many developing countries in Asia has continued to rise due to increased global demand and fluctuation in foreign currency exchange. The rising costs of imported ingredients such as fish meal, soybean meal, corn flour and wheat flour greatly cuts into the profit margins of local fish farmers to such an extent that many local aquaculture enterprises are no longer profitable. This is especially true for the culture of lower-value fish species such as catfish, tilapia and carps. There is currently a great interest within the animal feed industry to reduce costs by using locally available feed ingredients. (NG Wing Keong, 2004).

Palm Kernel Cake produced in Malaysia is exported at a low price to Europe for use as cattle feed concentrates in dairy cows. PKC is an established feed ingredient for ruminants, supplying valuable dietary sources of protein, energy and fiber. PKC has also been successfully tested in poultry and swine feeds at low levels of incorporation. The low cost and availability of PKC in many tropical countries where aquaculture is practiced have recently generated much interest in its potential use in fish diets. It was expected to reduce the balance of payment of the country. (Hishamuddin Mohd Aspar, 2001).

The main purpose of this study is to evaluate PKC as a possible substitute for soybean meal, corn meal and etc. in an attempt to reduce the impact of high costs of ostrich feed.

1.2 Problem Statement

In recent years, the cost of imported feed ingredients used in commercial aquafeeds in many developing countries in Asia has continued to rise due to increased global demand and fluctuation in foreign currency exchange. The rising costs of imported ingredients such as fishmeal, soybean meal, corn meal and wheat greatly cuts into the profit margins of local fishfarmers to such an extent that many local enterprises are no longer profitable. There is currently a great interest within the animal feed industry to reduce costs by using locally available feed ingredients. (NG Wing Keong, 2004).

The production of the palm oil has help the economy of the country. For every one tonne of palm oil that been produced, one tons of waste are also been produced. The waste from the palm tree are 90% was discarded as waste and either burned in the open air or waste pond. The burning has contribute significantly to carbon dioxide and ethane emission. Among these waste are the palm kernel cake. Each year 80 % of the Palm kernel cake has been export. The palm kernel cake has a huge potential to serve as the raw material for the animal feed and this research as the ostrich feed.

1.3 Objective

The proposed research was studied to achieve the following objectives:

1) To study the composition of the Palm kernel cake
2) To use PKC as protein substitute in ostrich feed.
3) To determine the appropriate percentage of PKC and other raw material for the standard formulation of the Ostrich feed.

1.4 Scope of Study

The scopes of the study are:

1) To determine the nutrient composition inside PKC
2) To determine the appropriate amount of other nutrient that must be added together with PKC.
3) To identify the nutrient composition of final design feed based on protein, fat, fiber and content.
4) To compare the composition of final design feed with the commercial pallet feed.
5) To study the cost saving in the design formulation using PKC.

1.5 Research Contribution

The research contributions of the study are:

1) Provide alternative for ostrich diet with lower cost of imported feed ingredient
2) To turn the waste of the palm oil into profit and income for our country
3) Opportunities for the exporting of livestock production and facilities competitive outsource of raw material.
4) Increase the income for the ostrich farmer

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

Knowledge about ostrich feeding has recently improved (Angel, 1996). However, the relationship between feeding regimes and meat quality has not yet been studied in depth. For Mediterranean ostrich breeders, feeding costs are often very high because many Ostrich breeding has recently been developing in European countries due to consumer interest towards this kind of red meat, thanks to its healthy image which is justified by its low fat content and favorable fatty acid profile as compared to beef, with an emphasis on high PUFA content (Cooper &Horba~ nczuk, 2002; Sales, 2002).

In Malaysia, one of the problems that arise to the farming breeder of the ostrich is the cost of feed that keep arising throughout the year. This was cost by the raw material that was originated from the oversea. Due to this problem, the low cost and the large quantity of the PKC that available has shown a great deal of potential as the substitute of raw material in the ostrich diet. This research will benefit the farmer breeder of the ostrich greatly as this will increase their income and this research will surely contribute to the society.

2.2 Type of ostrich

Ostriches (Srruthiocamelus) are the largest living flightless birds in the world. Adult males weigh 100-l 30 kg, and adult females weigh 90- 110 kg (Dunning, 1993). Formerly they were found in Syria and Arabia as well as in Africa, generally south of the Sahara to the Cape Province of the Republic of South Africa. At least six races or subspecies have been described, but one of these is extinct and a second appears to have merged with one of the remaining four races. Now wild ostriches are found primarily in restricted regions of eastern and southern Africa (Brown et al., 1982).

2.3 Palm Kernel Cake

The palm kernels are crushed to yield palm kernel oil and PKC. The yield of PKC is 50%. Since 1996, Malaysia has been producing more than 1.3 million tonnes of PKC annually. Most of the PKC produced is exported, especially to Europe for use as an ingredient in animal feed formulations. The European Union (EU) countries absorb more than 85% of Malaysian PKC annually and the Netherlands is the biggest importer of Malaysian PKC among the EU countries (Table 2). Asian countries which import Malaysian PKC are South Korea and Japan. In 2000, approximately 1.1 million tonnes or 90% of Malaysian PKC exports to the EU were taken by the Netherlands

Table 2.1. Malaysia Annualy Prodution of Palm Kernel and PKC (t)

Year	Palm kernel	PKC
1975	232 821	n.a
1980	557 066	278 559
1985	1 211 887	633 316
1990	1 844 737	1 038 221
1995	2 395 588	1 293 144
1996	2 488 750	1 383 034
1997	2 636 000	1 435 104
1998	2 429 468	1 345 277
1999	3 025 690	1 624 134
2000	3 162 760	1 639 227
2001*	1 366 360	729 197

2.3.1 PKC COMPOSITION

There are two types of PKC depending on the process to get it, i.e. either through mechanical or solvent process.In Malaysia, mechanical extraction by screw press is the most widely used. The solvent extraction process is generally not used currently due to its higher cost.

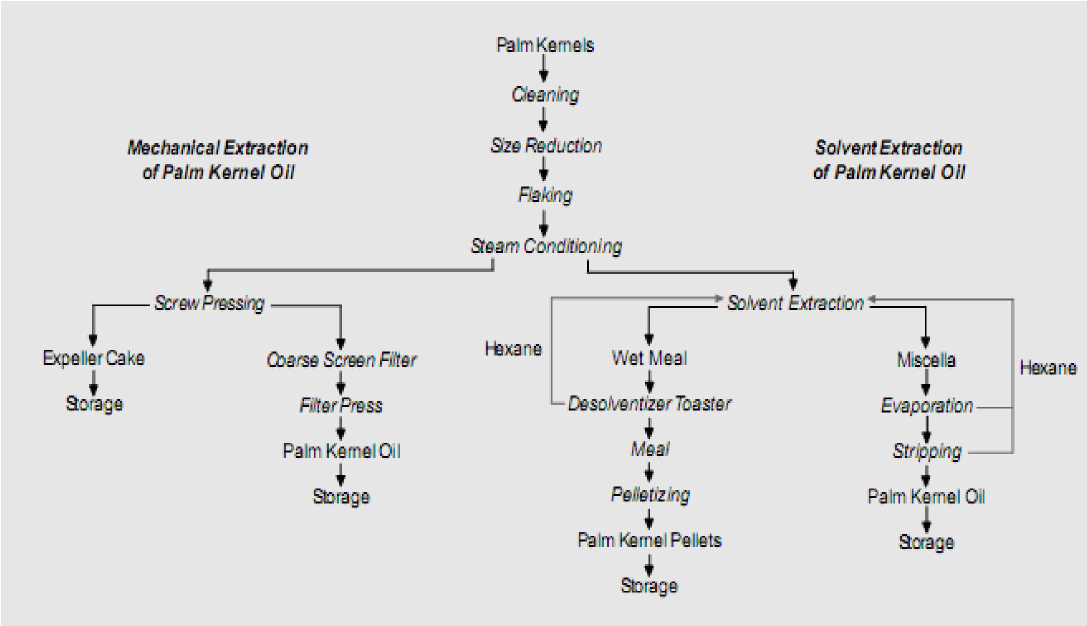

Figure 2.1: Extraction of Palm Kernel Oil.

Table 2.2: Nutrient Composition of solvent extracted and expeller pressed PKC. Source: Mustaffaet al. (1987), Chin (1991)

	Solvent extracted			Expeller pressed		
	1	2	3	1	2	3
Dry matter (%)	89.0	91.0	91.0	92.7	93.0	89.1
Crude protein (%)	15.3	15.2	15.0	14.6	14.8	16.0
Crude fibre (%)	14.3	16.0	15.6	12.1	15.7	16.8
Acid detergent fibre (%)	46.1	46.0	40.0	41.8	44.0	39.6
Neutral detergent fibre (%)	66.7	-	-	66.4	-	-
Ether extract (%)	2.9	1.8	0.9	9.1	9.8	10.6
Ash (%)	4.1	3.8	3.5	4.3	4.2	4.1
Nitrogen free extract	63.4	63.2	65.0	59.9	55.5	52.5

(%)						
Total digestible nutrient, TDN (calculated, %)	75.0	70.0	75.0	72.0	67.0	70.0
Metabolisable energy (cattle, MJ/kg)	13.1	12.2	13.1	12.5	11.7	12.2
Calcium (%)	0.20	0.25	-	0.21	0.20	-
Phosphorus (%)	0.54	0.52	-	0.52	0.32	-
Magnesium (%)	-	0.16	-	-	-	-
Copper (ppm)	34.0	28.5	-	18.0	-	-
Ferrous (mg/kg)	-	4.05	-	-	-	-
Manganese (mg/kg)	-	225.0	-	-	-	-
Zinc (mg/kg)	-	77.0	-	-	-	-

2.4 Basic Nutritional Concept

Feeding has three main purpose: to maintain life, to ensure proper growth and allow for maximum egg production and reproduction of breeding bird. The3 feed consume by ostrich must contain the following essential classes of nutrient to satisfy their need.

- Water
- Protein
- Carbohydrate
- Lipid

- Minerals
- Vitamins

Dietary habits in the wild and gastrointestinal anatomy and function have established that the ostrich is an herbivore. Ostriches are not turkeys, but turkeys may be the best avian model we have from which to predict the ostrich's nutrient needs. To minimize leg abnormalities in ostrich chicks, it may be helpful to restrict weight gain by limiting dietary protein concentrations below those recommended for starting turkeys and by using higher fiber diets. (Duane E. Ullrey, 1996)

Inadequate fed ostriches will rapidly reflect deficiencies through decline in growth rate, production of eggs, fertility and general performance. The bird will normally exhibit sign of classical nutritional deficiency disease. When a dietary deficiency is marginal, symptom will first appear in most rapidly growing or high egg-producing birds because their nutritional requirement normally exceeds those of average bird. (M. M Shanawany, 1999)

2.4.1 Water

The newly hatched ostrich chick is about 75-80 percent water. As it ages,, this percentage change but the bird need for water remains. No other nutrient is as important as water for its many vital roles in the body, particularly in metabolism, thermoregulation and transfer of other nutrient and chemical in the blood. Without ample amount of water production performance will suffer. All feed ingredient contain some water, but this may be not adequate to meet the need of the bird. Although water is the one least expensive ingredient available; it is often supply in adequate quantities. It should be provided continuously and be easily accessible to all bird. It should be free of excess minerals and salt, free of high bacteria contamination, low in nitrate and generally of a quality for human consumption. Furthermore water troughs must be constructed so that minimal contamination can occur from bird faces, litter and other foreign material. (M. M Shanawany, 1999)

The water economy of the ostrich is similar to that of other large savannah and desert animals such as antelope and camel, although the partitioning of water loss differs. The ostrich has a lower evaporative water loss and a higher faecal and urinary loss than mammals of similar bodyweight. The ratio of water intake to dry matter intake is relatively constant at about 2.3. (Degen, 1991)

2.4.2 Protein

There are many different protein but all are composed chiefly of comparatively simple compound known as alpha-amino acids, or simpler as amino acids. Amino acids are the ‘building block’ for tissue growth. It quality generally based on two major factors:

- Amino acid composition of the foodstuff
- Availability of the amino acid in foodstuff trough digestion in the gut of the bird.

Some of these amino acid are called ‘essential’ because ostrich are monogastric (single-stomach animal) and therefore unable to manufacture them in the body. For this reason, it is important that they should be supplied in the diet at the right concentrations. (M. M Shanawany, 1999)

Major source of animal protein are meat and blood meal, fishmeal and milk products. Major source of plant protein are soybean. Sesame, cottonseed, and sun-flower seed meal. (M. M Shanawany, 1999)

2.4.3 Energy

Energy is considered to be most important requirement from the standpoint of total cost and quantity of ostrich feed. As a general rule, the ostrich eats to satisfy its energy requirement. To that end, the energy content of the diet determines within the limit, the amount of the feed consumed, this include the protein, mineral and vitamin which contain in the feed. Food stuff high in carbohydrate constitutes the major percentage of ostrich diet. Carbohydrates are the primary source energy for the birds. Major carbohydrate source are grain, primarily maize, wheat, barley and oats. (M. M Shanawany, 1999)

Lipid (fat and oils) are in a single category of nutrient since they are utilized for a specific purpose. They have high energy value, but should only be use at relatively low level since the feed will begin to lose its optimum flow characteristic at about 5 percent added level. Animal tallow is a major fat source, although vegetable oil are commonly be used. Lipids are added to diet to reduce dust in the feed and increase palatability. (Duane E. Ullrey, 1996)

Ostriches had significantly (P £ 0.01) higher ME values than both pigs and ruminants for all three types of diets (low fibre, medium fibre as well as high fibre). There was no significant difference between the ME values for ostriches and poultry with the low fibre diet (high concentrate diet). ME values for ostriches, however, were higher than for poultry for both the medium and high fibre diets. This is related to the ability of ostrich to digest fibre.Swart (1988) also showed that ostriches effectively digest plant fibre, and more specifically hemicellulose (66%) and cellulose (38%). (T. S Brand, 2000)

2.4.4 Mineral And Vitamins

Mineral are inorganic chemical element that have numerous function in the body. Compound of these element are found in all tissue and in absence of certain minerals or vitamins, that various organ and tissue of the bird are unable to perform their function with the result that good health, growth and reproduction cannot be maintain. (M. M Shanawany, 1999)

The entire mineral are important to the ostrich especially calcium and phosphorus since they are used in egg and eggshell formation. Vitamin are classified as fat soluble (A, D,, E and K) and water soluble. (B- Complex and C). (M. M Shanawany, 1999)

2.4.5 Fiber

Fiber can be found in most plant and animal product except fats and oil. It is essential to provide a certain amount of bulk in the diet for efficient digestion and physical consistency and movement of food through the digestive tract. Unlike ruminant the digestive system of larger animal it cannot hold a large amount of the fiber.There are many source of fiber which can be added to the diet such as grain hulls, wood shavings, corn cobs and other high cellulose products. Chopped alfalfa can also be added. Dietary fiber is particularly effective in controlling cannibalism and feather packing among the imported ostriches in quarantine confinement. (M. M Shanawany, 1999)

Energy metabolism and digestion of dietary fibre in growing ostrich chicks were studied at different live masses (5-50kg) by means of a total excreta collection method and a radioactive indicator method by Swart *et al.* (1993b). They found that passage rate within live mass groups varied considerably (from 21 to 76h). Overall mean passage rate was 40.1 h and it was independent of live mass. Digestibility coefficients for cell wall (NDF), hemicellulose and cellulose were 47, 66 and 38% respectively, and were not influenced by live mass, they found that of the total metabolizable energy in the diet, 12% disappeared in the hindgut Swart *et al.* (1993c) found that energy loss as methane was negligible and was influenced by dietary energy or crude fibre concentration. They found that maintenance energy (ME) requirement was 0.44 MJ/metabolic size/day and the efficiency of ME utilization tended todeteriorate with decreasing energy or increasing crude fibre concentration in the diet. (A. A. Aganga, 2003)

The ostrich to utilize a considerable amount of fibre for the production of volatile fatty acids as energy sources. These acids are the primary energy sources to the bird, providing as much as 60% of the animal's energy need (Scheideler 1996). In many ostrich-producing countries, such as South Africa and Zimbabwe, nutritive fibre is supplied mainly by alfalfa (lucerne) or grass meal. In Malaysia, ostriches are fed chopped fresh grass plus poultry feed or compound ostrich feeds, which contain grass meal or alfalfa as the main fibre source. An experiment has been done which indicated that at 22% level of inclusion, OPF could replace alfalfa leaf meal in a compound feed to yield comparable growth performance. Inclusions of 4% and 14% OPF in compound feeds in other experiment resulted in significantly better gains in the animal's body weight than the inclusion at 25% level. The animals in the 14% group showed better growth than those in the 4% group. In the choice-feeding experiment, growing ostriches were observed to select significantly more feed from the 4% and 14% OPF feeds than the feed which contained 25% OPF meal. It is concluded that OPF could be included in the feeds of growing ostriches to replace imported leaf or alfalfa leaf meal. A medium level of 14% OPF inclusion in the feed, which was equivalent to a crude fiber level of 12%, is suggested. (Azahan, 2004)