Vigna radiata Flour as Subsitute Binder for Wheat Flour in *Cyprinus carpio* Feed

A research paper submitted to the faculty of

Philippine Science High School-Western Visayas

Dona Lawa-an H. Lopez Campus

In partial fulfillment of the requirements

in Technology Research

by

Carla Jane F. Genciana

Mary June R. Engada

Doni Fernandez

IV-Tau

ABSTRACT

The study, entitled *Vigna radiata* as substitute binder for wheat flour in *Cyprinus carpio* feed, is aimed at producing carp feeds that are more water stable, yet uses locally available products. Binders are extremely important in producing feed pellets because they determine the feeds' water stability.

Two formulations of 40% protein were made using the Pearson Square method. The first formulation would contain wheat flour, the most commonly used binder in pellet-making. The second formulation would contain mungbean , (*Vigna radiata*), flour.

Using the wheat flour formulation,

APPROVAL SHEET

This research paper entitled, *Vigna radiata* flour as substitute binder for wheat flour in *Cyprinus carpio* feed, prepared and submitted by Carla Jane F. Genciana, Mary June R. Engada, and Doni Fernandez in partial fulfillment of the requirements in Technology Research, has been examined and recommended for acceptance and approval.

July 10, 1998

Date

Mr. Eduardo Ongcol

Adviser

This research paper is accepted and approved in partial fulfillment of the requirements in Technology Research.

Date

Prof. Rebecca Yandog

Director

ACKNOWLEDGEMENT

The researchers who conducted this study would like to express their sincere gratitude to the following persons:

Mr. Eduardo Ongcol, Technology Research adviser, for patiently guiding them in the development of their thesis; Mrs. Ilda Borlongan and the SEAFDEC personnel for their unselfish support and for the intellectual sustenance; the SPICE Force for the emotional support; the TAU people, for their cooperation; Ma'am Joy and Ma'am Lani, for generously giving their time to supervise them in handling laboratory equipment; the school maintenance crew's assistance; the fishes of Pisay's aquariums for testing the feed's digestibility and for entertaining the Pisay people; the Filipino taxpayers and the researchers' parents for the financial aid; and the LORD GOD ALMIGHTY for everything !

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF PLATES

LIST OF FIGURES

Chapter I

INTRODUCTION

A. Background of the Study:

Various kinds of fish differ in shape, color, and size that it is so delightful and enticing to watch them in aquariums. Some fish are nearly flat as pancakes, and others blow up like balloons. They have the colors of the rainbow and some are as bright as those of the brightly colored birds. Their rich hues form hundreds of beautiful patterns, from stripes and lacelike designs to polka dots.

Fish have enormous importance to human beings. They provide food for millions of people around the world. Fishing enthusiasts catch them for sport, and other people keep them as pets.

Fish need food to live. Although there are natural foods available, it is sometimes necessary to provide them with supplemental feeds. Yet, commercially available feeds are too expensive, so sometimes we need to resort to homemade feeds. We also need to choose feed ingredients that are inexpensive, locally available and suitable for the fish.

Factors other than nutrient requirements of fish influence ingredient composition of feeds. One of these factors that must be considered is the water stability of the feed. Pelleted feeds, especially, must be firmly bonded for satisfactory water stability.

In looking for a fish diet to be patterned upon, the researchers chose the common carp (Cyprinus carpio). The common carp diet is not really as complex as other fish diets. Besides that, a diet that is suitable for common carp is usually suitable for most of the freshwater fishes.

The common carp is a bottom feeder and an omnivorous type of fish. They are mostly aquarium fishes. Yet, in other countries, carp are reared in fish farms as a major source of food.

The researchers of this study chose Vigna radiata, locally known as monggo (mungo) or mungbean to be used as substitute for the binding agent, wheat flour, in the common carp diet.

As a leguminous plant, mungbean is often planted as a rotation crop after rice or corn. It is common among the provinces and it can be planted all year round in any kind of soil. It has a short growing period and does not require large quantities of fertilizers. In terms of nutritional value, mungbeans are rich sources of protein and it also yields carbohydrates, minerals, and fats. Mungbean is salable, unlike soybean. It is readily available to the public than wheat flour, which is imported from other countries.

The researchers of this study aim to evaluate mungbean as a substitute binding ingredient for the common carp diet.

B. Statements of the Problem:

1. Is mungbean (*Vigna radiata*) flour more water stable than wheat flour ?

2. Is the formulated feed, containing mungbean flour, better than that containing wheat flour in terms of:

   a. water stability

   b. moisture ?

C. Objectives of the Study:

The researchers of the study aim:

1. To be able to make two formulated feeds, one containing mungbean flour and the other containing wheat flour, for the common carp.

2. To be able to incorporate in the formulated feeds the desired protein requirement of the common carp.

3. To be able to compare the formulated feeds in terms of:

   a. water stability

   b. moisture

D. Scope and Limitation:

This study uses common carp (*Cyprinus carpio*) as the basis for formulating the diet of 40% protein using the Pearson Square Method. The improvised fish food contains mungbean (*Vigna radiata*) flour as one of the ingredients. The feed would be assessed according to its moisture content and water stability.

The level of protein would be kept constant on both formulated feeds. The essential amino acid (EAA) composition of the proteins would not be considered due to the lack of instruments in determining them. There would be two formulated feeds, one would contain mungbean flour and the other would contain wheat flour. These feeds would be assessed according to their price, water stability, moisture content.

Feeding experiments and proximate analysis would not be performed due to time constraints and limited equipment. The manufacturing of the product would be done at the Research Center of Southeast Asian Fisheries and Development Center (SEAFDEC), Tigbauan, Iloilo and at the laboratory rooms of Philippine Science High School-Western Visayas Campus.

E. Significance of the Study:

This research involves the use of mungbean flour as a substitute binder for wheat flour in the common carp feed.

Legumes, such as mungbean, grow abundantly in the Philippines all year round and are sold cheaply. Wheat flour, on the other hand, is one of our major exports according to Espiritu et al (1993).

Binders are dietary components that should be considered in formulating fish feeds. They improve the water stability of feeds and efficiency of feed manufacture. They also prevent disintegration of pellets during transport and storage (Borlongan, 1997).

Given all these facts to consider, the researchers of this study considered utilizing mungbean flour as a binder in the common carp feed.

According to Shang (1981), the cost of feeds in aquaculture can often exceed 50 percent of the total variable costs of production, rising as high as 75 percent. Pillay (1979) also agreed, hence, the need for optimization of feeding fish both in terms of nutritional value and cost aspects is a promising area of research.

We should definitely utilize our available resources as much as possible. Prices of basic commodities are rising, and still we are being too dependent on our imports.

This study aims to make use of the locally available legume, mungbean, as a substitute binder for imported wheat flour in the common carp diet.

F. DEFINITION OF TERMS :

Mungbean (*Vigna radiata*)

It is a legume locally known as mongo or munggo.

Mungbean Flour

This is made by grinding mungbean seeds.

Mungbean Flour Formulation

It is a feed formulation used in the methodology of this study composed of 32.68% fish meal, 16.34% shrimp meal, 31.98% rice bran, 1% soybean oil, 1% vitamin mix, 1% mineral mix, and 16% mungbean flour.

Mungbean Flour Feed Pellets

These are the result of mixing together the compositions of the mungbean flour formulation and extruding them in a garlic press or an electric pelletizer.

Wheat Flour

It is usually used as a binder in various fish feeds.

Wheat Flour Formulation

It is a feed formulation used in the methodology of this study composed of 34.58% fish meal, 17.30% shrimp meal, 22.56% rice bran, 1% soybean oil, 1% vitamin mix, 1% mineral mix, and 22.56% wheat flour.

Wheat Flour Feed Pellets

These are the result of mixing together the compositions of the wheat flour formulation and extruding them in a garlic press or an electric pelletizer.

Binder

They improve the water stability and efficiency of feed manufacture, and prevent disintegration of pellets during transport and storage.

Common Carp *(Cyprinus carpio)*

Common carps are bottom-feeding aquarium fishes. They feed on worms, insects, shrimps, shells, *kangkong* leaves, bread crumbs, and rice bran.

Carp Feed

This usually includes 36-40% protein, and is rich in energy (Steffens,1966; Kaneko. 1969; Sin, 1973; Shiloh and Viola, 1973).

Moisture Determination Test

It is frequently used as an index of stability and quality, as well as a measure of yield and quantity.

Water Stability

It is a test used to determine whether fish feeds would remain intact in water long enough for the fish to consume them.

Garlic Press

It is a kitchen aid used for pressing garlic. In the methodology of this study, it is used as an alternative for the electric pelletizer.

G. Hypothesis of the Study:

It is hypothesized that:

1. wheat flour is a much better binder than mungbean flour in the common carp feed.
2. the carp feed pellets containing mungbean flour is not as water stable as that containing wheat flour. Thus, it would contain less moisture.

Chapter II

REVIEW OF RELATED LITERATURE

Common carp (*Cyprinus carpio*) is one of the very large family of freshwater fishes has many relatives throughout the world except in Australia, New Zealand, South America, and Madagascar. This powerful fish can grow up to a weight of 13.6 kg (Cacutt, 1993). The common carp, in particular, has prospered , as a cultured fish because of its omnivorous foraging feeding habit.

Though there are a large body of literature about the common carp, this research is more on the its nutrition. One important consideration is the digestion physiology of common carp, which changes with their age. The digestive canal of fish larvae is less elaborate than those of adult fishes. At hatching, the canal is simple; straight tube which is closed at the mouth and anus. Prior to complex adsorption, the mouth and anus opens and the tube becomes segmented into several regions: Buccopharynx, fore-, mind- and hind gut. Usually, larvae lack a functional stomach. Instead, the foregut and midgut expands to store food. As the larvae grows, taste buds increase reflective of changes in the diet of the larvae. For protein, larvae, do not possess all the enzymes necessary to fully digest protein into constituent amino acids. Instead, protein macromolecules are pinocytotically absorbed at the hindgut region. Complete protein digestion is accomplished intracellularly. This compensates for their inability to fully digest protein. With the development of gastric glands, however, the mechanism of protein digestion changes from pinocytosis and intracellular digestion to extracellular digestion and membrane transport. As for carbohydrates, these are digested into simpler sugars by carbohydrases present in the digestive tract. However, the exact mechanism of carbohydrate adsorption is unknown (Borlangan, 1997).

The common carp is best regarded as a benthic omnivore. It has no stomach, like other carps, tends to feed for long periods of time (Printers, 1985). The known optimum growth temperature of common carp is 23-30°C. Most experimental studies on the common and Chinese carps have been made towards the lower end of this range, and it should be remembered that feeding habits, feed conversion, and nutritional requirements (particularly energy substrates) will be different at higher, tropical temperatures(Printers, 1985).

A very important consideration in carp nutrition is the activity of the intestinal bacteria which assist digestion and can provide nutrients supplemental to the ingested material. Their role has not been fully investigated. This is a complicating factor in working out the dietary requirements of carp (Printers, 1985). However, sufficient data for the common carp now exist to have a broad picture of its protein, amino acid, lipid (including essential fatty acids), carbohydrate, mineral vitamin and trace element requirement (Jauncey, 1982).

Diet formulation is the process in which feed ingredients and various vitamin and mineral supplements are blended to produce a diet with the required quantities of essential nutrients. The main objective of the formulation is to develop nutritionally balanced mixture of feedstuffs which will be eaten in sufficient amounts to provide optimum production at an acceptable cost. Knowledge of nutrient requirements, locally available feed ingredients and digestive capacity of fish are required to produce efficient diets. Fish production can be efficiently increased by taking into account both nutrition and feed cost. Supplying adequate nutrition for various species involves not only the formulation of diets containing desired essential nutrients, but also the proper management of numerous factors relating to diet quality and intake. The bioavailability of nutrients, diet palatability or acceptability, feed manufacture, storage methods, and chemical contamination may have significant effects on fish performance (Borlangan, 1997).

Feed ingredients are selected on the basis of their nutrient composition and available energy content as determined by chemical analyses. No single feedstuff contains all nutrients that are needed in the correct proportion, so the nutrients in a balanced feed formula is supplied by various feedstuffs (Borlangan, 1997).

Nutrient requirements for fishes are also affected by growth rate, age, size, and stage of reproductive cycle of the fish, interrelationships among nutrients, and environmental factors such as water temperature, salinity, pH, crowding, and disease. The quantitative effects of most of these factors, however, have not been sufficiently measured (Poston, 1986).

The formulation of complete feeds for intensive culture is more difficult than that of supplemental feeds. Complete feeds usually contain generous amounts of high quality protein, such as fish meal, and are, therefore expensive (Printers, 1985).

Feed ingredients, particularly proteins and carbohydrates, must be digestible as well as sufficient in chemical composition. Common carp are well able to digest plant proteins, and most fish can digest animal and microbial protein and a wide range of carbohydrates. In general, carp use dietary proteins and lipids for energy in preference to carbohydrate (Printers, 1985).

Proteins are large, complex, organic compounds which perform an essential role in the structure and function of all living things. Unlike plants, fish and other animals cannot synthesize them from simple inorganic materials and must rely on dietary sources of protein (Borlangan, 1997).

Among the major dietary nutrients required, protein is considered first protein is considered first because it is the most costly among the macronutrients and cannot be substituted by other nutrients. Protein is used very efficiently as a source of energy, but for economic reason should be kept to a minimum.

Another consideration is on protein requirements including essential amino acids. Most experimental studies have shown that carp grow beat on high protein diets. Carp, like other fish species so far investigated, require ten amino acids: arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, trytophan, and valine (Printers, 1985). These are termed as essential amino acids or EAA. Since proteins constitute the single most expansive item in fish diets, the choice of protein source must therefore be done with care. Deficiencies in one or more of these can cause growth depression and possibly deficiency syndromes which look like disease conditions, for example, skeletal deformities. The proteins taken in by carps, must, therefore, be sufficiently digestible and also supply sufficient amounts of all these compounds. Although carp intestinal bacteria can synthesize both essential and non-essential amino acids to some extent, this should not be relied on in formulating complete diets (Printers, 1985).

The food supplied must contain fats and carbohydrates for energy as well as all their protein and fats which are essential for the replacement of cell materials for normal growth and in maintaining general metabolism besides small amounts of vitamins and minerals (Hunnam, 1994).

The carbohydrates, which include starches, sugars, cellulose, and gums are cheapest source of energy. They contribute significantly to the water stability of pellets. For most animals, carbohydrates are the principal dietary components for energy. For common carp, questions such as whether cellulases can be produced in sufficient quantities by intestinal bacteria to enable significant digestion of cellulose remain unresolved. Most of the available information suggests that amino acids and lipids are better energy sources for common carp than carbohydrates (Printers, 1985).

The word *lipid* is a general term which covers sterols, waxes, fatty acid esters, phospholipids, and sphingomyelins. Dietary lipids are important sources of energy and fatty acids that are essential for the survival and normal growth of warmwater fish. In addition, the presence of lipids in the diet enhance the adsorption of fat-soluble vitamins. Lipids play a vital role in the structure of biological membranes as well as in many other aspects of metabolism. Lastly, lipids influence the flavor and textural properties of the feeds (Borlangan, 1997).

Common carp requires not only high protein diets, but also high quality animal or bacterial protein for optimum growth. Fortunately, the protein requirements of carp can be modified by raising the levels of other dietary components. This is called sparing the dietary protein component. The most important sparing compounds for common carp are lipids. These supply energy which would otherwise be used by metabolizing proteins and amino acids. Moreover, as common carp are generally accepted to be fatty fish, with carcass lipid levels as high as 20% from pond culture, there is great scope for increasing dietary lipid content even if this results in some elevation of tissue lipid levels. Levels as high as 18% can be used with no growth retardation, no acceptable carcass lipid buildup and improved protein utilization (Printers, 1985).

The vitamin requirements of carps are best supplied with a complete vitamin premix. Carps appear to be less sensitive to mineral-deficient diets than other fish, but, as in the case of vitamins, the inclusion of mineral premix in supplemental and complete feeds is advisable (Printers, 1985).

Since the common carp is an omnivore, the feeds that would be used is a mixture of plant and animal source. And according to a SEAFDEC literature:

Laboratory experiments in Southeast Asian Fisheries and Development Center (SEAFDEC) have shown that a combination of two or more protein sources either of plant or animal source or both animal sources, is better than one source in terms of weight gain (Garcia, Garcia, 1986).

Wheat is a common name for cereal grasses of a genus of the grass family, cultivated for food since prehistoric times by the peoples of the temperate zones and now the most important grain crop of those regions. It is a tall, annual plant attaining an average height of 1.2 m (4 ft). The leaves, which resemble those of other grasses, appear early and are followed by slender stalks terminating in spikes, or so-called ears, of grain. The main use of wheat is in the manufacture of flour for bread and pastries. In general, hard varieties are used for bread flour and soft varieties for pastry flour (Microsoft Encarta Encyclopedia, 1997).

Mungbean (*Vigna radiata*) locally known as *mungo*, is widely grown in the Philippines and is a major source of protein in Filipino diet. It also contains vitamins and minerals which are often lacking in seed diets. Being a legume, mungbean does not require large quantities of fertilizer. It has a short growing period, the first harvest often done 60 days after planting. The crop is cultivated mainly for its seeds (or sprouts) which are cooked into a vegetable dish sautéed with meat and shrimps, to make *hopia, butse-butse, sotanghon,* and *halo-halo*. Experiments conducted at the Betitan Research Station indicate that mungbean can be grown in any soil in the province (PCARR, 1981).

Legumes are similar to cereals in terms of nutritive value except that they have higher protein content. They grow abundantly in the Philippines whole year round and are sold cheaply. Wheat flour on the other hand, is one of our major exports.

Certain components are added to fish feeds for physiological or economic reasons. They include pellet binders, synthetic antioxidants, mold inhibitors, feeding stimulants, hormones, antibiotics, etc. Binders improve the water stability of feeds and efficiency of feed manufacture. They also prevent disintegration of pellets during transport and storage. Examples of binders are agar, alginates, and carageenan; cassava, corn, sago palm, and potato starch; bread or wheat flour; gum arabic and guar gum; wheat and corn gluten; gelatin and chitin; and carboxymethylcellulose (CMC, a synthetic binder). Binders usually contain high levels of carbohydrates (Borlongan, 1997).

According to Borlongan (1997) mungbean contains 67.0 % nitrogen-free extracts, and wheat flour contains 52.09 % carbohydrates according to Espiritu et al.(Bato Balani Senior Vol. 14 No.6).

Commercially prepared fish feeds are dried into pellets, flakes, and powders. Convenient and widely available they are blended to serve the nutritional requirements of fishes, and most aquatic animals will thrive on them.

Flaked feeds provide a particularly wide variety of recipes, to be used for herbivores, the pre-spawning period, rapidly growing young, and so on. Flakes will float while dry, and sink slowly when saturated with water. Pellets are produced as "mouth-sized particles" for large fishes. Some pellets float for surface feeders, while others sink for midwater and bottom feeders. Powdered feeds are useful for young fry, and suspension-feeding invertebrates (Hunnam, 1981).

The formulated feed would be in a pelletized form which would sink, since the common carp is a bottom feeder.

The sample selected for analysis must be truly representative of the entire lot of feed to be analyzed, the portion weighed out for examination must be accurate sample of the product available for analysis. Accuracy in analytical details is of little value if sampling is not done carefully. The preparation of a sample for analysis generally involves reduction in amount and simultaneous reduction in particle size. The product is thoroughly mixed so that the portion used represents the average composition of the entire mixture.

The determination of moisture is one of the most important and most widely used analytical measurements. Moisture content is frequently used as an index of stability and quality, as well as a measure of yield and quantity.

Fish feeds should remain intact in water long enough for the fish to consume them. Catfish feeds, for example, should remain stable for at least ten minutes in water. (Proximate Analysis, SEAFDEC literature)

Carp pellets and crumb are mostly manufactured in United Kingdom (Micheals, 1988). Thus, this is one of the reason why the researchers must develop a carp feed that is water stable and utilizes local ingredients.

Chapter III

METHODOLOGY

The methodology of this research is divided into three phases. The first phase contains the calculations for the formulation of two carp feeds with different binders, one containing mungbean flour and the other containing wheat flour. The second phase is the making of carp feed pellets. The third phase would be the proximate analysis of each feed in terms of moisture and water stability.

PHASE 1: FORMULATING THE CARP FEEDS

Procedure:

The two formulated feeds, the mungbean flour formulation and the wheat flour formulation, contained approximately 40% protein and used the following ingredients: fish meal with 63.8% protein, shrimp meal with 68.4% protein, rice bran with 10% protein. The proportion of fish meal to shrimp meal was 1:1, that of rice bran to the mungbean was 1:2, and rice bran to wheat flour was 1:1.

Steps for each feed formulation:

A square was drawn and the desired protein level of the diets, 40%, was placed at the middle of the square. Then, the ingredients were grouped on the basis of their protein content. The ingredients with higher protein content was placed under PROTEIN SOURCES, and those with lower protein content under ENERGY SOURCES. The weighted average protein content of each group was calculated by multiplying the number of parts of an ingredient in their given proportion and their given protein content. At the left corners of the square, the corresponding weighted average for percent protein of each group of ingredients were placed. The percent protein of each ingredient was subtracted from the 40% desired protein level of the feed, the absolute value was taken. The difference was placed on the corners of the square diagonally opposite the ingredient. The numbers appearing on the right corners of the square were added and each number on the right side was expressed in percentage using the sum. The contribution of each ingredient within a group was calculated by multiplying the percentage obtained and each ingredient's corresponding given proportion expressed as a fraction.

Note that the vitamin mix, mineral mix, and soybean oil are protein-free and they would constitute 1 % each in both feed formulations.

Here is the table of the final feed formulations whose binders are different, but have similar protein content of 40%, and their equivalent in grams per 200 g:

Formulation	Mungbean Flour		Wheat Flour	
Ingredient	% in diet	Per 200 g	% in diet	per 200g
Fish meal	32.68	65.36	34.58	69.16
Shrimp meal	16.34	32.68	17.30	34.60
Rice bran	31.98	63.96	22.56	45.12
Soybean oil	1	2	1	2
Vitamin mix	1	2	1	2
Mineral mix	1	2	1	2
Mungbean flour	16.00	32.00	****	****
Wheat flour	****	****	22.56	45.12
TOTAL	100%	200 g	100%	200 g

Table A Each ingredient's contribution in both feeds are shown above in percentages and in grams per 200 grams of feed.

PHASE 2: MANUFACTURING OF CARP FEED PELLETS

Procedure:

The mungbean seeds were washed three times with tap water and were then dried under the sun. The seeds were grinded and sifted in a $1mm^2$ mesh, while approximately 50 ml of water was boiled. All the dry ingredients, 65.36 g of fish meal, 32.68 g of shrimp meal, 63.96 g of rice bran, and 32.0 g of mungbean flour were combined in a large container. The mixture was blended with an electric mixer. Then, 2 .0 g each of vitamin mix, mineral mix, and soybean oil were added and the mixture was reblended. The 50 ml of hot water was added and the mixture was mixed vigorously until well blended or when it formed a soft dough. The dough was extruded in a pelletizer twice and cut into short pieces. The pellets were dried in the oven at 60° C for six hours. The pellets were set aside to cool.

Another feed was made using wheat flour instead of mungbean flour. About 45.12 g of wheat flour was sifted in 1 mm^2 mesh, while approximately 50 ml of water was boiled. Then, all the dry ingredients, 69.16 g of fish meal, 34.60 g of shrimp meal, 45.12 g of rice bran, and 45.12 g of wheat flour were combined in a large container. The mixture was blended with an electric mixer. Then, 2.0 g each of vitamin mix, mineral mix, and soybean oil were added and the mixture was reblended. The 50 ml of hot water was added and the mixture was mixed vigorously until well blended or when it formed a soft dough. The dough was extruded in a pelletizer twice and cut into short pieces. The pellets were dried in the oven at 60° C for six hours. Then, the pellets were set aside to cool. It was stored in an airtight container to prevent the feeds from spoilage.

PHASE 3: PROXIMATE ANALYSIS OF THE TWO FEEDS

Procedure:

A. Sampling

The feed sample was grinded into small particle size and stored in a dry, well-covered container. After thorough mixing of the feed sample, a small part was taken and formed into a cone. The cone was flattened into a circle and divided into quarters. The two opposite quarters were taken, that is, quadrants 1and 3 . The procedure was repeated until a small sample enough for use for analysis was secured.

B. Moisture

Three 2-gram samples of each feed were obtained. They were dried in the oven at 105-110° C for six hours. The final weight of the samples were recorded. The % moisture was calculated using the formula:

$$\% \text{ Moisture} = \frac{\text{Wt. of original sample - Wt. of dried sample}}{\text{Wt. of original sample}} \times 100$$

C. Water Stability

Two wire baskets made from 3 mm^2 wire mesh with an area of $5mm^2$ and with a depth of 1 cm were constructed. The baskets were dried in a 100°C oven for 30 minutes. They were allowed to cool in a dessicator and were weighed. Then 3.5 g of each pelleted feed was placed in separate baskets. The baskets were separately and carefully submerged into a beaker of water and were allowed to stay in water for exactly 10 minutes. The baskets were gently removed from the water and were allowed to stand for 15 minutes. They were placed in an oven at 100°C for four hours. They were then cooled in a dessicator and were weighed. The % dry weight lost was calculated using the formula:

$$\% \text{ Dry Weight} = \frac{\text{Original weight - Final weight}}{\text{Original weight}} \times 100$$

Chapter V

RESULTS AND DISCUSSIONS

The results of the moisture determination test are shown in Table B. The average final weight of the grinded pellets containing wheat flour as binder and the grinded pellets containing mungbean flour are almost similar in value.

	Original Weight	Final Weight
WHEAT FLOUR		
Sample A	2 g	1.79 g
Sample B	2 g	1.78 g
Sample C	2 g	1.79 g
MUNGBEAN FLOUR		
Sample A	2 g	1.80 g
Sample B	2 g	1.79 g
Sample C	2 g	1.79 g

TABLE B Moisture content of two different pellets, one containing wheat flour, and the other mungbean flour.

The weight lost by the samples indicate their moisture content. The results show that all the samples in both feeds have negligible differences.

Since moisture content is frequently used as an index of stability, then the results of the moisture determination test should correspond to the results of the water stability test.

The results of the water stability test are shown in Table C below. The average final weight of the pellets containing the binder wheat flour and the pellets containing the binder mungbean flour are almost similar in value.

WHEAT FLOUR	**Original weight**	**Final Weight**
Trial 1	3.5 g	2.61 g
Trial 2	3.5 g	2.59 g
MUNGBEAN FLOUR		
Trial 1	3.5 g	2.59 g
Trial 2	3.5 g	2.59 g

TABLE C Water stability of two different pellets, one containing wheat flour and the other mungbean flour.

Chapter VI

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, based on the results of the moisture determination and water stability tests, the mungbean flour feed pellets are as water stable as the wheat flour feed pellets. Therefore, mungbean flour is a good binder as wheat flour.

The mungbean flour feed formulation contained 32.68% fish meal, 16.34% shrimp meal, 31.98% rice bran, 1% soybean oil, 1% vitamin mix, 1% mineral mix , and 16% mungbean flour.

The researchers of this study would like to recommend the following for the enhancement of this study:

1. For the results to be more accurate, more trials should be performed.
2. Experimantal feeding should be done in order to test the digestibility and other direct effects of the feeds on the carp. The testing period should be 3 months or more.
3. To save more time and effort, an electric pelletizer is preferred.
4. Proximate analysis should be done so as to produce quality feeds.

The main basis for a good binding agent is to contain large amounts of carbohydrates.

The results indicate that there is no significant difference between the water stability of the two pellets. This is due to both flours' high carbohydrate contents. Borlongan (1997) stated that the higher carbohydrate content of a feedstuff, the more it would make a better binder.

The researchers of this study also reccomends that mungbean flour should be used at minimum levels. The seed coat of mungbean seeds should be removed, if possible in making the mungbean flour. It contains harmful elements according to Borlongan (1997).

BIBLIOGRAPHY

Borlongan, I. 1979. Nutrition of Finfish Larvae (Lecture Notes). SEAFDEC, Tigbauan, Iloilo.

Espiritu, A., *et al.* "Different Kinds of Legumes as Substitute for Flour in Different Food Products and Their Qualitative and Quantitative Analyses". Bato Balani (Senior). Vol. 19 No.6, p.16 -18.

Furuichi, M. Fish Nutrition and Mariculture. Japan. p. 74-75.

Garcia, W. and Garcia, R. August,1986. A Practical Way of Using Prawn Pellets Under Philippine Condition, 2nd Ed.

Gracia, D. and Bersamin, P. What You Should Know About Carp Cultures. Philippines. p. 1.

Halver, J. E. ed. 1972. Fish Nutrition. Academic Press, New York. p.652.

Hunnam P. 1994. The Living Aquarium. London. p. 1.

Hepher, B. and Parugihin,Y. 1981. Commercial Fish Farming. John Wiley and Sons. Canada. p. 195-196.

Lakshamanan, M.A.V. *et al.* 1969. On a New Artificial Feed for Carp Fry. Cuttack, India. p. 385-386.

Microsoft Encarta Encyclopedia, 1993-1996, Microsoft Corporation.

"Monggo Flour". Bato Balani (Sophomore). Vol. 13 No. 6.

Santos, J.S. and Grafia, A. April-June 1991. " A Mungbean Primer". Philippine Technology Journal. Vol. XVI No. 2. Philippines. p. 4-18.

Tjormana, M. Observations on the Applications of Artificial Feeds on Carp Production. Indonesia. p.2.

UNDP, FAO of US. 1983. Fish Feeds and Feeding in Developing Countries. Rome. p. 1-3.

APPENDICES

APPENDIX A

USING THE PEARSON SQUARE METHOD

Mungbean Flour Formulation:

This first formulation contains mungbean flour. Mungbean contains about 20% protein.

PROTEIN SOURCES

Fish Meal – 63.8 % x 1 parts = 63.8

Shrimp Meal – 68.4% x 1 part = 68.4

Sum = 132.2

weighted average protein content: 132.2/2 = 66.10%

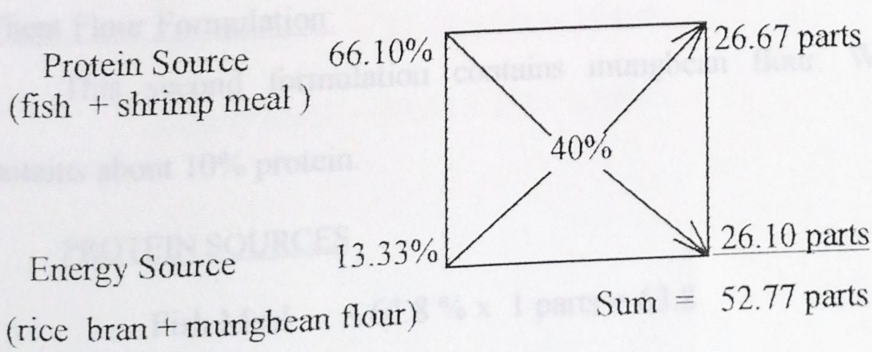
ENERGY SOURCES

Rice Bran – 10.0% x 2 parts = 20.0

Mungbean Flour– 20.0% x 1 part = 20.0

Sum = 40.0

weighted average protein content: 40/3= 13.33%



Weighted average of the protein sources: 26.67/52.77 x 100 = 50.54%

% PROTEIN SOURCES

Fish Meal = 50.54 x 2/3 = 33.69%

Shrimp Meal = 50.54 x 1/3 = 16.85%

Weighted average of the energy sources : 26.1/52.77 x 100 = 49.46%

% ENERGY SOURCES

Rice Bran = 49.46 x 2/3 = 32.97%

Mungbean Flour = 49.46 x 1/3 = 16.49%

Note that soybean oil, vitamin mix, and mineral mix are protein-free and each constitutes 1% of the formulation. So, 97% of the feed contains the protein and energy sources.

So the following ingredients have the following percentage: fish meal, 32.68%; shrimp meal, 16.34%; rice bran, 31.98%; mungbean flour, 16.00%; and soybean oil, vitamin mix, and mineral mix make up 1% each.

Wheat Flour Formulation:

This second formulation contains mungbean flour. Wheat flour contains about 10% protein.

PROTEIN SOURCES

Fish Meal – 63.8 % x 1 parts = 63.8

Shrimp Meal – 68.4% x 1 part = 68.4

Sum = 132.2

weighted average protein content: 132.2/2 = 66.10%

ENERGY SOURCES

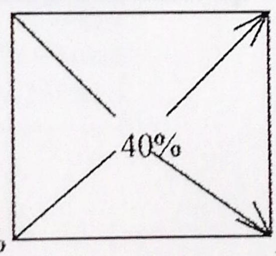
Rice Bran – 10.0% x 1 part = 10.0

Wheat Flour – 10.0% x 1 parts = 10.0

Sum = 20.0

weighted average protein content: 20/2= 10.0%

Protein Source (fish + shrimp meal) 66.10% — 30.00 parts



Energy Source (rice bran + wheat flour) 10.00% — 26.10 parts

Sum = 56.10 parts

Weighted average of the protein sources: 30.00/56.10 x 100 = 53.48%

% PROTEIN SOURCES

Fish Meal = 53.48 x 2/3 = 35.65%

Shrimp Meal = 53.48 x 1/3 = 17.83%

Weighted average of the energy sources : 26.1/56.10 x 100 = 46.52%

% ENERGY SOURCES

Rice Bran = 46.52 x 1/2 = 23.26%

Wheat flour = 46.52 x 1/2 = 23.26%

Note that soybean oil, vitamin mix, and mineral mix are protein-free and each constitutes 1% of the formulation. So, 97% of the feed contains the protein and energy sources.

So the following ingredients have the following percentage: fish meal, 34.58%; shrimp meal, 17.30%; rice bran, 22.56%; wheat flour, 22.56% ; and soybean oil, vitamin mix, and mineral mix make up 1% each.

APPENDIX B

CALCULATIONS FOR PHASE 3.b: Moisture Determination

$$\%\ \textbf{Moisture}_{\text{Wheat Flour}} = \frac{\textbf{ave Original Wt} - \textbf{ave Final Wt}}{\textbf{ave Original Wt}} \times 100$$

$$= \frac{(2.0\ g) - (1.787\ g)}{(2.0\ g)} \times 100$$

$$\boxed{= 10.665\ \%}$$

$$\%\textbf{Moisture}_{\text{Mungbean flour}} = \frac{\textbf{ave Original Wt} - \textbf{ave Final Wt}}{\textbf{ave Original Wt}} \times 100$$

$$= \frac{(2.0\ g) - (1.793\ g)}{(2.0\ g)} \times 100$$

$$\boxed{= 10.35\ \%}$$

APPENDIX C

CALCULATIONS FOR Phase 3.c: Water Stability Test

$$\textbf{\%Dry Weight Lost}_{\text{Wheat flour}} = \frac{\textbf{ave Original Wt - ave Final Wt}}{\textbf{ave Original Wt}} \times 100$$

$$= \frac{(3.5\ g) - (2.60\ g)}{(3.5\ g)} \times 100$$

$$\boxed{= 25.71\%}$$

$$\textbf{\%Dry Weight Lost}_{\text{Mungbean flour}} = \frac{\textbf{ave Original Wt - ave Final Wt}}{\textbf{ave Original Wt}} \times 100$$

$$= (3.5\ g)$$

$$\boxed{= 26.0\ \%}$$

TABLES

TABLE 1

Protein levels of the ingredients in the formulations used in this study

Ingredients	*% protein*	*Sources*
Shrimp meal	68.4	Borlongan (1997)
Fish meal	63.4	Borlongan (1997)
Mungbean flour	20.0	Philippine Tech. Journal "A Mungbean Primer"
Wheat flour	12.0	Bato Balani Senior Vol. 14 No. 6
Rice Bran	10.0	Borlongan (1997)
Soybean oil	0	Golden Value Soybean Cooking oil
Vitamin mix	0	
Mineral mix	0	

TABLE 2

Sources of carbohydrates, lipids, and vitamins(Borlangan, 1997)

Some carbohydrate sources	*Some lipid sources*
barley	coconut oil
breadflour	corn oil
cassava meal	fish oils
corn starch	Lard
dextrin	olive oil
linseed flax	peanut oil
molasses	soybean oil
oats, grain	squid oil
peas, seed	Tallow
potato, starch	
rice, bran	
rice, grain	
rye, grain	
sorghum, grain	
wheat flour	

TABLE 3

The essential amino acid requirements of common carp summarized from Jauncey, 1982. Values are expressed as g/100g of dry diet. In parentheses, the numerators are g/100 g of protein and the denominators are percentage total protein.

Amino acid	*(Nose, 1978)*	*(Ogino, 1980)*
arginine	1.6 (4.3/38.5)	1.52 (3.8/40)
histidine	0.8 (2.1/38.5)	0.56 (1.4/40)
isoleucine	0.9 (2.5/38.5)	0.92 (2.3/40)
leucine	1.3 (3.3/38.5)	1.64 (4.1/40)
lysine	1.2 (5.7/38.5)	2.12 (5.3/40)
methionine	1.2 (3.1/38.5)	0.64 (1.6/40)
	cystine=0%	cystine = +
	0.8 (2.1/38.5)	
	cystine=2%	
phenylalanine	2.5 (6.5/38.5)	1.16 (2.9/40)
	tyrosine=0%	tyrosine= +
	1.3 (3.4/38.5)	
	tyrosine=1%	
threonine	1.5 (3.9/38.5)	1.32 (3.3/40)
tryptophan	(0.8/38.5)	0.24 (0.6 /40)
valine	1.4 (3.6/38.5)	1.16 (2.9/40)
TOTAL	13.7 (38.5)	11.28 (28.2)

note: methionine varies with the level of cystine, and the phenylalanine with tyrosine.

TABLE 4

An example of practical feed formulation for larval milkfish

Ingredient	*Amt. g/100kg diet)*
Fish meal	33.0
Soybean meal	18.0
Squid meal	10.0
Shrimp meal (Acetes sp.)	12.0
Bread flour	6.69
Cod liver oil	8.0
Vitamin mix	3.0
Mineral mix	3.0
DL-α-tocopherol acetate	0.01
Lecithin	1.0
Butylated hydroxyanisole	0.05
β-carotene	0.25
κ-carrageenan	5.00
Proximate Composition	(% dry matter)
Crude protein	46.3
Crude fat	11.4
Crude fiber	5.6
Nitrogen-free extracts	27.3
Ash	9.4

TABLE 5

Minimum dietary vitamin requirement for common carp(NRC, 1983)

Vitamins	*(per kg diet)*
A	10,000 I.U.
E	300 I.U.
Pantothenic acid	50 mg
Riboflavin	7 mg
Pyridoxine	6 mg
Biotin	1 mg
Niacin (nicotinic acid)	30 mg
Choline	4,000 mg
Inositol	440 mg

PLATES

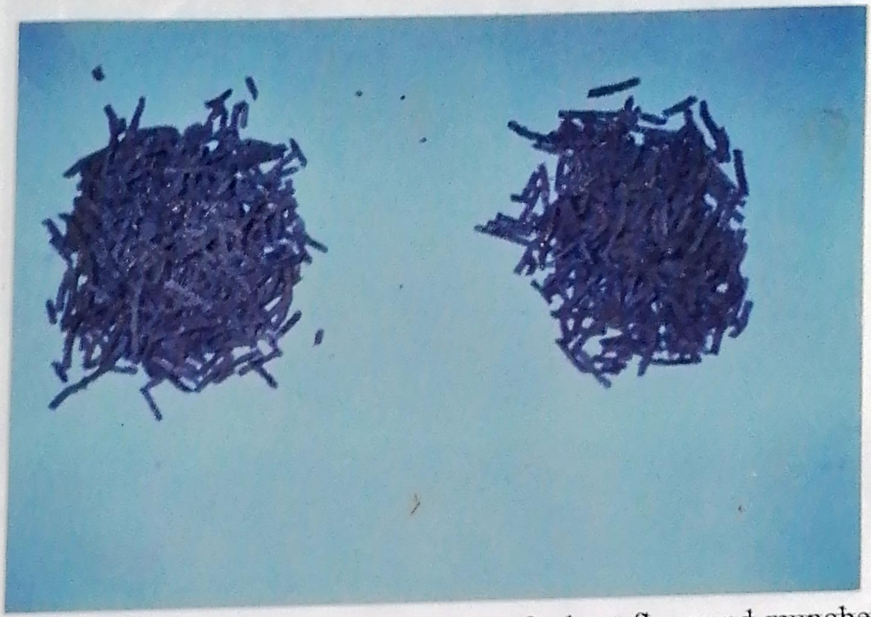


Plate No. 1 The physical appearances of wheat flour and mungbean flour feed pellets closely resemble each other.

Plate No. 2 The feed pellets should be stored in an airtight container to avoid spoilage

Plate No. 3 The feed samples for moisture determination test are being oven-dried for six hours.

Plate No. 4 These are the dried samples for final weighing.

Plate No. 5 The samples are being submerged in bowls filled with tap water for water stability test.

Plate No. 6 After 10 minutes of submersion, the samples are being dried in the oven for four hours.

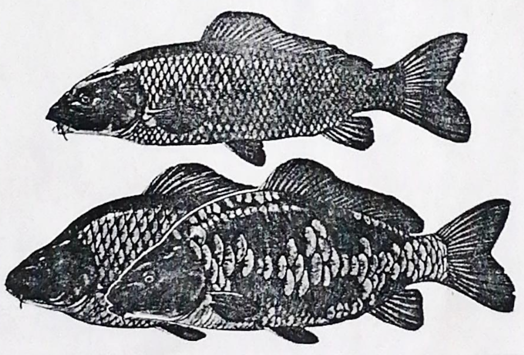
TBG

Plate No. 7 The dried samples are being cooled in a dessicator.

Plate No. 8 A sample is being weighed using an analytical balance for the final procedure in the water stability test.

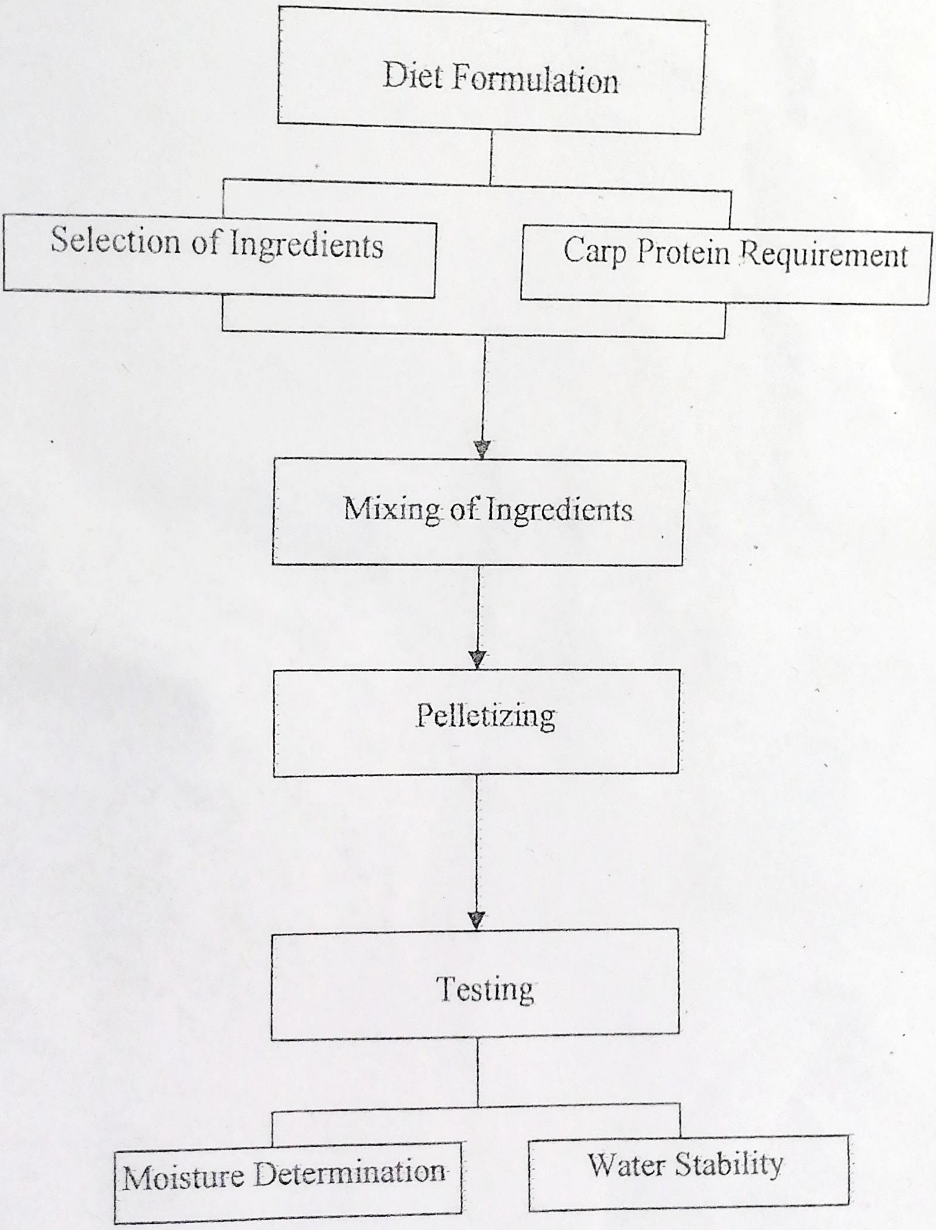
FIGURES

The common carp is of worldwide economic importance. The wild form (top) is a lean, long-bodied gamefish. Two forms of cultivated carp are the fully scaled (bottom left) *and the partially scaled mirror, or king, carp* (bottom right).



Common carp (*Cyprinus carpio*)

PARADIGM


Diet Formulation
Selection of Ingredients
Carp Protein Requirement
Mixing of Ingredients
Pelletizing
Testing
Moisture Determination
Water Stability