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## Proximate composition of fish feed ingredients available in Shibpur Upazila, Narsingdi district, Bangladesh

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### Abstract

The present study was conducted to determine the proximate composition of fish feed ingredients locally available in Narsingdi Region. In this study protein, lipid, moisture, ash, carbohydrate concentrations were assessed in rice bran, maize bran, wheat bran, mustard oil cake, soybean meal, DORB, meat and bone meal, mixed of oyster, shrimp shell and crab shell. Proximate composition was determined on the homogenous basis. The quantity of protein in different fish feed ingredients ranged from (12.04±1.30-47.23±0.61)%. Maximum amount of protein content (47.23±0.61)% was recorded from the meat and bone meal and minimum amount (12.04±1.30)% was recorded from the maize bran. The concentration of lipid in different feed stuffs ranged from (2.5±0.37-18.5±1.1)%. The highest value (18.5±1.1)% of lipid content was found in soybean meal and the minimum (2.5±0.37)% was recorded in Crab shell. Moreover, the value of moisture and ash were recorded (5.00±0.88-13.28±1.46)% and (7.43±0.12-22.55±1.32)% in the locally found feed respectively. The highest value of moisture (13.28±1.46)% was recorded from crab shell and the lowest value of moisture (5.00±0.88)% was recorded from meat and bone meal. The highest amount of ash (22.55±1.32)% was also found in meat and bone meal and the lowest amount of ash (7.43±0.12)% was found in maize bran. And finally last the concentration of carbohydrate in different feed stuffs ranged from (15.67±0.5-66.77±1.13)%. Maximum amount of carbohydrate content (66.77±1.13)% was recorded from the maize bran and minimum amount of carbohydrate content (15.67±0.5)% was recorded from the soybean meal.

**Keywords:** Proximate composition; fish feed ingredients; Shibpur; Narsingdi district

### 1. Introduction

During last decade, aquaculture became focus point worldwide as a means of improving world fish production that is presently on decline position due to dwindling output from capture fishery [24]. One of the major problems is the need to obtain a balance between rapid fish growth and optimum use of the supplied feed [4]. In the early 1950s, global production was less than a million tons whereas in 2004 it was 59.4 million tons at a value of US\$ 70.3 billion. In 2005, global aquaculture production reached 63.0 million tons, valued at US\$ 78.4 billion [23]. Moreover, the sector has been growing at an average compound rate of 9.2% per year since 1990, increasing over 3.7-fold from 16.83 million tons in 1990 to 63.0 million tons in 2005. It has been estimated that the growth of aquaculture will continue over approaching decades as the demands for and the consumption of aquaculture products increases [12, 28]. Specifically, by 2020, global aquaculture will expand by 1.9%, while the highest output forecast is to increase by 3.3% [12]. Fish feed key factor that play important role in aquaculture viability and profitability, because it accounts for at least 40 - 60% of the total cost of fish production [15, 34]. Fish meal is the major dietary protein source for aqua feeds, commonly making up between 20-60% of fish diets [27, 30, 58, 69]. It has been estimated that in 2008, the aquaculture sector used 60.8-71.0% of world fish meal production [27, 36, 53]. Dietary protein is the major and most expensive component of formulated aqua feeds [59] and feed costs have tended to increase with the rising price of fish meal. Thus, the cost of aqua feeds increased by 73% from 2005 to 2008 [27]. Therefore, in order to reduce feed costs and the use of fish meal in aqua feeds, more extensive use of alternative feed ingredients is needed [13, 30, 32, 36]. Today, there is an increasing emphasis towards developing cost-effective fish meal substitute using terrestrial animal- and plant-based protein sources [41]. The global production of industrially compounded aqua feeds in 2005 was about 23.13 million tones [54].

This figure compared favorably with [29], who estimated global aqua feed production to be approximately 25.4 million tonnes or 4% of global industrial annual feed production of 635 million tonnes in 2006. In the early 1980's, the animal feed manufacturing industry in China grew rapidly, however, over 95% of the feed produced is in mash form for pigs, poultry, cattle, sheep and only a small portion is produced in pellet form for rabbits, mink and shrimp [10]. Aquaculture in Asia, Latin America and Africa is growing rapidly and this presents significant growth opportunities for the aquaculture feed sector [23]. Commercial manufacture of compound fish feeds are just springing up in China and many other countries [10]. Farm-made aqua feed production within the selected Asian countries was as follows: China (10.88 million tons); India (6.16 million tons); Viet-Nam (800,000 tons); Thailand (762,173 tons); Philippines (384,896 tons); and India (275,850 tons) [18]. Although fish meal is a major source of protein but very costly but plant ingredients have high global availability at competitive prices, compared to fish meal and fish oil, and they have nutritional properties that can largely satisfy the nutritional requirement of fish [41]. Soybean is the most common source of plant proteins used in compound aqua feeds, with feeds for herbivorous and omnivorous fish species and crustaceans containing 15 to 30% Soya bean meal, with average of 25% in 2008 [26, 47, 51]. Using fish meal is not a sustainable long-term feeding strategy [25, 44, 51] and it will lead to the decline of some trash fish species and even to extinction [21]. As the aquaculture industry is projected to continue expanding, fish meal must be used more strategically as the required aqua feed production volumes increase [31]. This will be a major challenge for thousands of small scale striped catfish producers, as the feed is a major component of the total production costs and many fish farmers still rely heavily on trash fish and fish meal [53]. Increased use of cheap,

locally available feed resources and more sustainable protein sources is considered a high priority in aqua feed industry and could provide a way to reduce the total production costs [20, 32]. Several agricultural and agro-industrial by-products have been evaluated for their production potential in poultry and livestock feed [5, 19, 45, 48, 49, 55, 56]. However, only few data are available which cover the suitability of this resource for fish feed [2, 11]. Almost 58% of animal protein requirement and fish consumption of people in Bangladesh rely on fish [38]. There is a paucity of information on the nutrient content of fish feed produced by different feed companies in Narsingdi region. There are also no reliable published information on chemical composition of commercial fish feed and feed ingredients in Narsingdi region. The farmers have to depend only on the existing information about the feed composition and growth performance that is given by the feed company. So, there is a great possibility that the farmers will be deceived by the feed manufacturers. The present research work was carried out to identify the aqua feed ingredients in Narsingdi region; to determine the proximate composition of the feed ingredients used in the feed mills and to make the data on proximate compound of aqua ingredients available to the feed mill growers.

## 2. Materials and Method

### 2.1 Study area and sampling of survey

The sample was collected from the local feed mill of Narsingdi Region in Bangladesh (Figure 1). These are rice bran, maize, wheat bran, mustard oil cake, soybean meal, DORB, meat and bone meal, mixed of oyster, shrimp shell, crab shell. It has been analyzed six plant origins and four animal origins. The collected feed ingredients was use number of fish in grower stages such as rui, silver crap, pangus, koi, shingi, talapia etc.

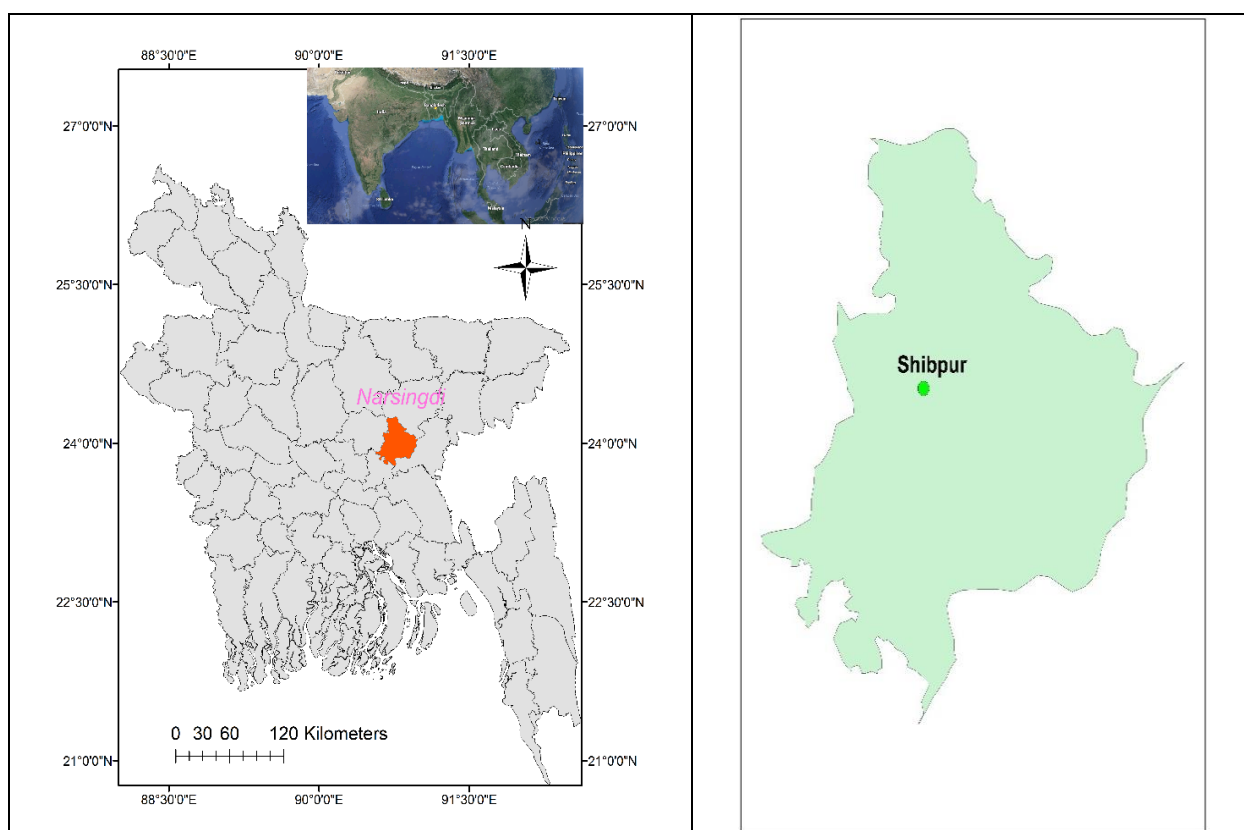


Fig 1: Map showing the sampling sites of the study area

## 2.2 Collection of secondary data

The secondary data were collected from, term paper and thesis, Institute of Marine Science and Fisheries; thesis data, Zoology Department, University of Dhaka; thesis data, Fisheries Dept. University of Dhaka; and data from Fisheries Research Institute, Bangladesh. The Secondary data of proximate composition on feeds and feed ingredients, which are available at different books was gathered and arranged according to the types of feed and feed ingredients i.e. plants origin and animal origin.

## 2.3 Preparation of Analysis

The collected samples were taken to the Nutrition Laboratory of Institute of Marine Science and Fisheries, Chittagong University for proximate composition analysis of moisture, ash, protein, lipid and carbohydrate.

## 2.4 Method of proximate analysis

### 2.4.1 Moisture determination

Moisture contents in the feed were determined by the following oven method [37].

### Materials

The materials used to determine the moisture contents are analytical balance, drying oven, porcelain crucible and desiccators.

### Methods

Firstly, weight 2 gram sample into a tarred crucible; then dried it in an oven at 105°C – 110°C until the weight of the sample become constant; after that cooled the dried sample in desiccators before interval weighing; and recorded the final weight of the dried sample.

### Calculation

% of moisture = {weight of original sample – weight of dried sample} / weight of original sample} × 100.

### 2.4.2 Ash determination

#### Principle

Ash is the residues of the inorganic matter (mineral) of the sample after burning. If the sample in a muffle furnace at 600°C the organic matter is evaporate and residues are called ash. Ash content of each feed was estimated by following incineration method [40].

### Materials

The materials used to determine the ash content are porcelain crucible; desiccators; muffle furnace; analytical balance; and drying oven.

### Methods

Firstly, a clean porcelain crucible was heated in an oven are 105°C for 2 hours and cooled in a desiccators until a content weight is reached; then weighed 2gram sample in a dried crucible; then the crucible containing the sample put to a Muffle furnace to at (550°C-600°C) for 4 to 6 hours; after that decreased the temperature to 105°C and remained it for 20 minutes; and lastly cooled the porcelain crucible in desiccators and recorded the final weight of the crucible with ash.

### Calculation

% of ash= (weight of ash ÷ weight of sample) × 100

## 2.4.3 Crude protein determination

According to Kjeldhal methods proteins are hydrolyzed to amino and with H<sub>2</sub>SO<sub>4</sub>. Further heating decomposes the amino acid releasing- Ammonia which immediately trapped on (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and water. Micro kjeldhal method [33, 42, 46] was to determine the crude protein.

### Apparatus

The apparatus used to determine the crude protein are less filter paper (11cm); Kjeldhal flask; semi-micro Kjeldhal distillation unit; analytical balance; and Kjeldhal digestion unit.

### Reagents

The reagents used to determine the crude protein are K<sub>2</sub>SO<sub>4</sub>. CuSO<sub>4</sub>. (1:4); Na OH (50%); Conc. H<sub>2</sub>SO<sub>4</sub>; 4% Boric acid; 0.1N HCl; mixed indicator BCG-MR; punic stone; and distilled water.

### Procedure

Firstly, 0.5 g of sample was taken in a kjeldhal flask; then 2 g CuSO<sub>4</sub>: K<sub>2</sub>SO<sub>4</sub> (1:4) mixture was added; then 10 ml conc. H<sub>2</sub>SO<sub>4</sub> was added; it was set up with the digestion unit for 2 hours until greenish color; after that the kjeldhal flask was cooled; 40ml of NaOH sol (40%) and few pumice stone was added; then 40 ml of boric acid (4%) was taken in entermier flask; after that 3+4 drops of mixed indicator BCG-MR was added; it was set up with the distillation unit until green color; and then the solution was titrated against HCL of 0.1 N and calculated.

### Calculation

$$\frac{\text{value of HCL} \times 0.1 \times 0.014}{\text{weight of sample}} \times 100$$
  
% Nitrogen=  
% of Crude Protein =% Nitrogen × Conversion factor  
(Conversion factor for animal and plant origin is 6.25 and 5.90 respectively)

## 2.4.4 Crude fat determination

### Principle

Fat is examined with low boiling organic solvent (petroleum ether/ diethyl ether, xylem) by soxhlet extraction and the extract thus obtained weighed after recovery of the solvent. Crude fat was determined through Soxhlet extraction technique [33, 40] using hexane (65 °C-70 °C) as the solvent.

### Material

The materials used to determine the Crude fat are extraction thimble; soxhlet apparatus; soxhlet flask; drying oven; analytical balance; and hexane.

### Methods

Firstly, weighed 2 gm sample on a crude filter paper; then folded the paper with sample and put into an extraction thimble; then thimble was then allowed to dry in an oven at 105°C for 4 hours; after that set up the soxhlet flask with enough hexane (app. 175ml) and the flask was dried to constant weight in an oven before using for extraction; certainly removed the sample and air dried to remove excess hexane; then removed sample was reserved for crude fiber determination; then removed hexane by distilling into the extraction chamber; after that dried the soxhlet flask with the extracted fat in the oven at 105°C until the weight is constant; lastly, recorded the weight of the fat containing in flask and

the fat was used for acid value determination;

**Calculation**

$$\% \text{ of crude fat} = (\text{corrected weight of fat} \div \text{weight of sample}) \times 100$$

**2.4.5 Carbohydrate determination**

**Procedure**

Carbohydrate content was determined by difference that is by subtracting from hundred the sum of the values for moisture,

ash, protein and fat contents per hundred gm of the sample.

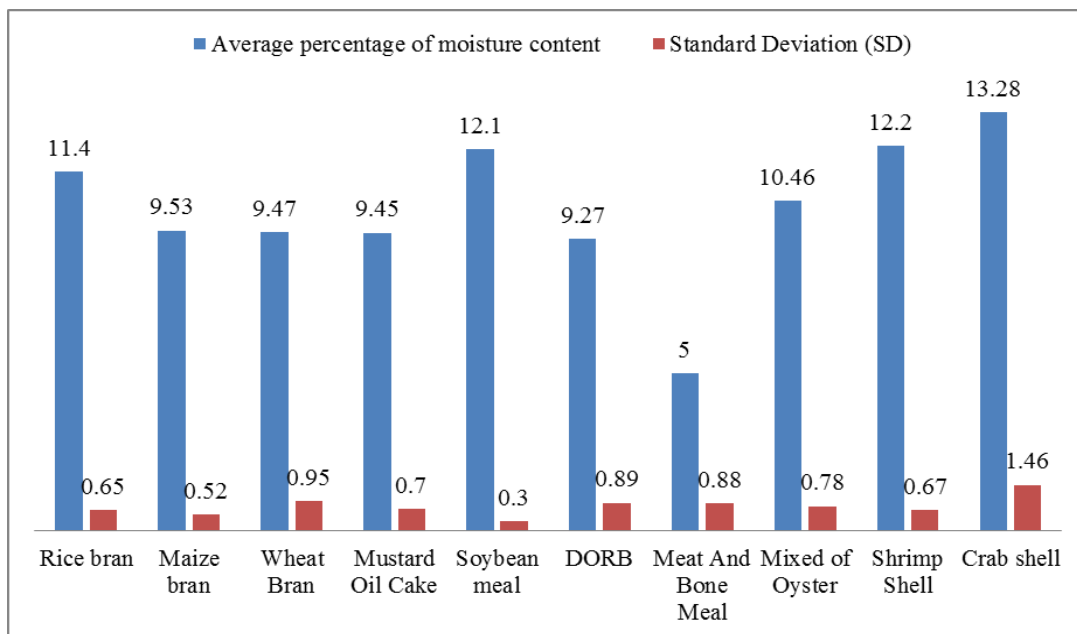
**Calculation**

$$\% \text{ of carbohydrate} = 100 - (\text{moisture} + \text{ash} + \text{protein} + \text{fat})$$

**3. Results**

**3.1 Moisture content of the fish feed ingredients**

Among the ten fish feed ingredients highest moisture content (13.28)% was recorded for the Crab shell and lowest moisture content (05.00)% for the Meat and Bone Meal (Figure 2).

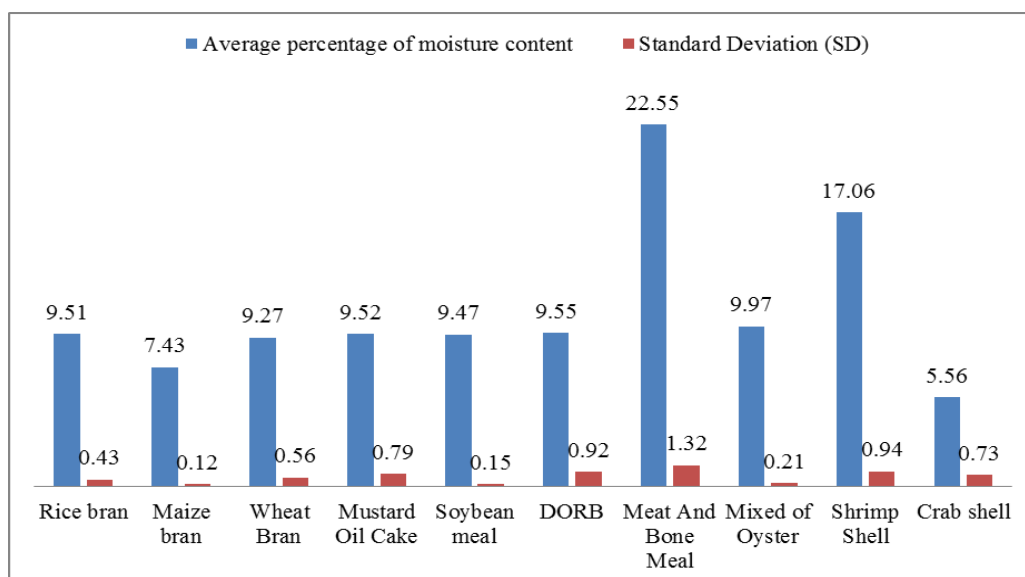


**Fig 2:** Average percentage of moisture content in different fish feed ingredients.

**3.2 Ash content of fish feed ingredients**

The percentage of ash of different feed ingredients ranged was from (22.55%-7.43%). The highest Ash content (22.55)%

was recorded for the species wheat meal (Figure 3). The lowest Ash content (7.43)% was recorded for the Maize bran.

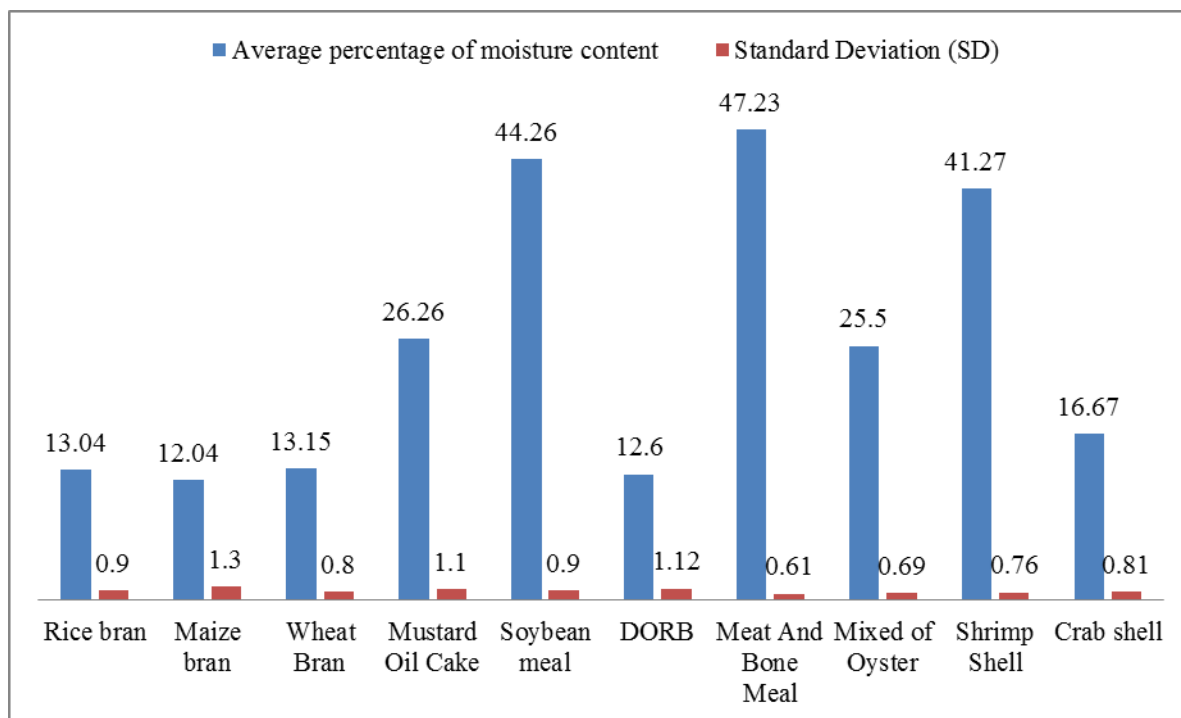


**Fig 3:** Average percentage of Ash content in different fish feed ingredients

**3.3 Protein content of fish feed ingredients:**

Proximate composition was determined on the homogenous basis. The percentage of protein in different feed ingredients ranged from (12.04%-47.23%).The highest percentage of protein content (47.23)% was recorded in the Meat and bone

meal (Figure 4). Even though Meat and bone meal is a noble source of protein, but these ingredients are costly. It is well-known that highest protein is essential for better production. On the contrary, the lowest protein content (12.04)% was recorded from the maize bran.

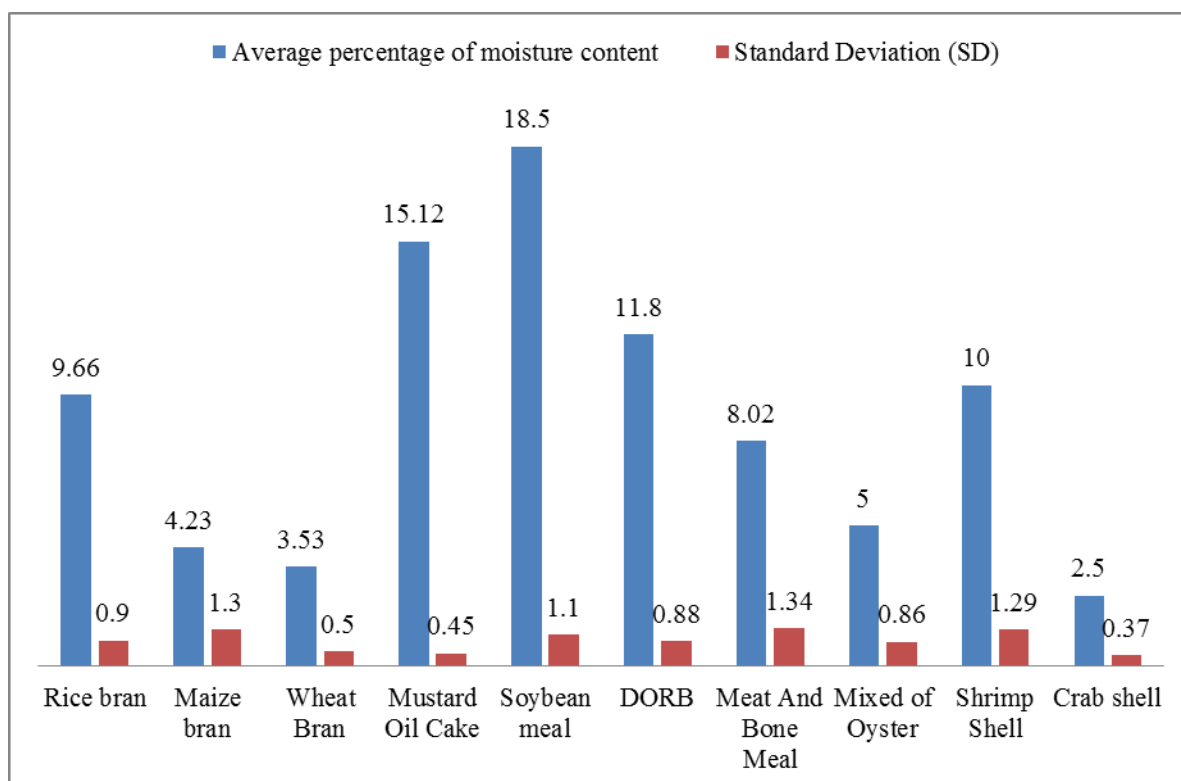


**Fig 4:** Average percentage of Protein content in different fish feed ingredients

**3.4 Lipid Content of fish feed ingredients:**

The percentage of lipid was found in different feed ingredients varied from (18.5%-2.5%). The maximum lipid

content (18.5%) was recorded for the Soybean meal (Figure 5).

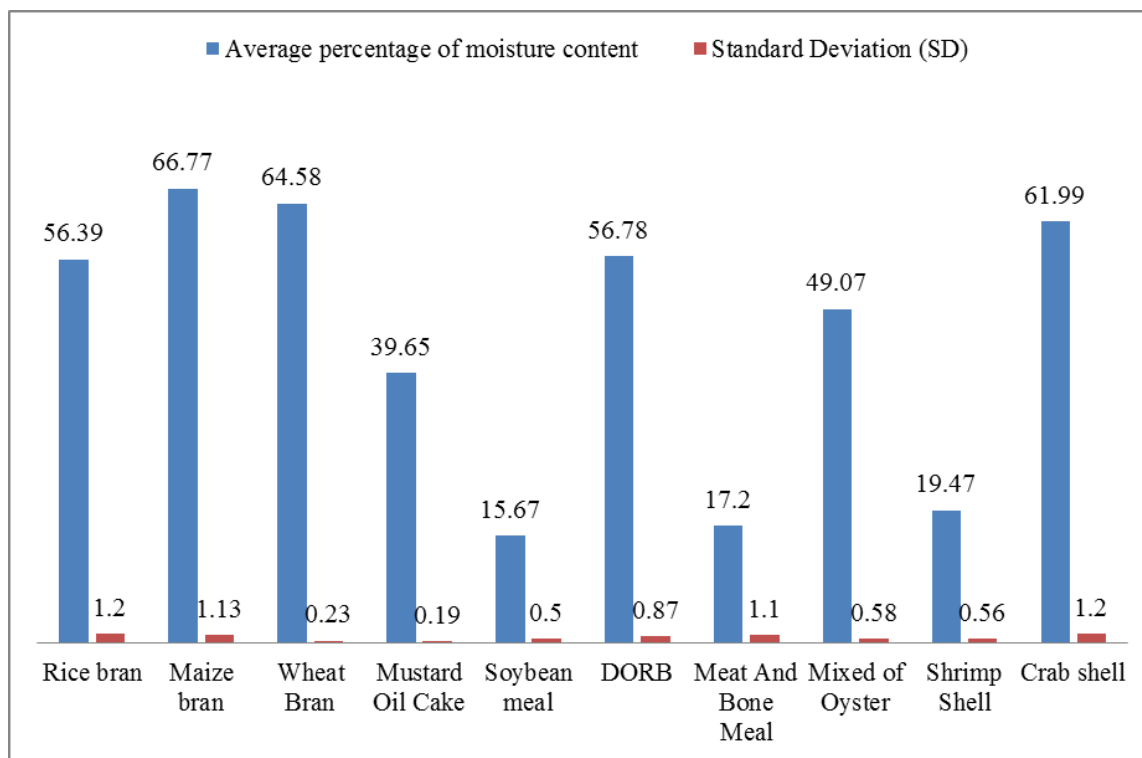


**Fig 5:** Average percentage of Lipid content in different fish feed ingredients.

**3.5 Carbohydrate content of fish feed ingredients:**

Among the ten fish feed ingredients highest Carbohydrate content (66.77%) was recorded for the Maize Bran. The

lowest Carbohydrate content for the Soybean meal is (15.67%). All the results show at a glance in (Figure 6).



**Fig 6:** Average percentage of Carbohydrate content in different fish feed ingredients

#### 4. Discussions

Rice bran, maize bran, wheat bran, mustard oil cake, soybean meal, DORB, meat and bone meal are recommended as mandatory nutrient and sources of protein and lipid by [65] as well as it is the main of sources homemade feed ingredients. In the present study the crude protein of the Rice bran was recorded ( $13.04 \pm 0.9$ )%. The proteins found in Rice bran were (12-15)%, reported by [22]. The results of the protein content were slightly higher in the present study. Crude Lipid content of the Rice bran was ( $9.66 \pm 0.9$ )%. In the present study the moisture content of the Rice bran was ( $11.40 \pm 0.65$ )%. Ash content of the Rice bran was ( $9.51 \pm 0.43$ )%. Ash contain Rice bran were (10.87)% lower than the presents study [52]. Carbohydrate content of the Rice bran was ( $56.39 \pm 0.82$ )%. The average protein content of Maize bran in the present investigation was found to be ( $12.04 \pm 0.8$ )%. [63, 69] revealed that, for homemade ingredient of brood stock nutrition could be, rice bran, oil cake, corn, fishmeal, soybean cake, flour and dicalcium phosphate and their known proximate is helpful for managing feed stuff. Crude Lipid content of Maize bran in the present study was found to be ( $4.23 \pm 0.5$ )%. The percentage of fat obtained for maize study was consistent and in agreement with other researchers. In the present study the moisture content in Maize bran was ( $9.53 \pm 0.52$ )%. Ash content of the Maize bran was ( $7.43 \pm 0.12$ )%. The percentage ash content falls within the range reported in the literature, ash content of maize in the range of (5.1)%. The results of the ash content were higher in the present study. Carbohydrate content of the Maize bran was ( $66.77 \pm 1.13$ )%. Some farmer used to feed their farm by homemade feed others practiced formulated feed and these feeds were rice bran, mustard oil cake and commercial pangus feeds (pellet) [62]. In the present study the Crude protein content of the wheat bran was ( $13.15 \pm 0.8$ )%. The results of the protein content of the wheat bran were slightly higher than (14.15)%, reported by [60]. Protein level 25% was recommended by [67] in fish and brood stock management. During the present study the crude lipid of

wheat bran was ( $3.53 \pm 0.5$ )%. The results of wheat bran crude lipid were (2.5 to 3.64)%, reported by [38]. Ash content of the wheat bran was ( $9.27 \pm 0.56$ )%. The moisture content in wheat bran was ( $9.47 \pm 0.95$ )%. The values for moisture content wheat bran radial enhanced between (10 to 15) percent, reported by [8]. Carbohydrate content of the wheat bran was ( $64.58 \pm 0.23$ )%. This agrees with the similar results of Soybean meal [8]. Mustard oil cake is a potential source of protein for animal. In the present study the moisture content in black Mustard oil cake was ( $9.45 \pm 0.7$ )%. This results of the moisture content were slightly higher than the results ( $8.3 \pm 0.2$ )% found by [38, 39]. The Crude protein of the Mustard oil cake was ( $26.26 \pm 1.1$ )% that lower (34%) than the results reported by [39]. However, [14] and [9] reported comparative equal amount of Crude protein content of the Mustard oil cakes. Crude Lipid content of the Mustard oil cakes was ( $15.12 \pm 0.45$ )%, different from the results of the Mustard oil cakes reported by [35]. Ash content of the Mustard oil cakes was ( $9.52 \pm 0.79$ )%. These data Ash content of the Mustard oil cakes are comparatively higher ( $7.12 \pm 0.12$ )% found by [17]. Carbohydrate content of the Mustard oil cakes was ( $39.65 \pm 0.19$ )%. Feed contained moisture-12.27%, protein-33.12%, lipid -11.41%, ash-15.97%, fiber -6.37% and carbohydrate-20.86% is the best for growth and development [61]. The average protein content of Soybean meal in the present investigation was found to be ( $44.26 \pm 0.9$ )% that agrees with the results (42-48)% of Soybean meal [6]. Crude Lipid content of the Soybean meal was ( $18.5 \pm 1.1$ )%. Similar results reported soybean meal crude lipid were (18-20)% [16]. The moisture content of the Soybean meal was ( $12.10 \pm 0.3$ ). The results of moisture content of the Soybean meal were also close to the findings of [43]. Ash content of the Soybean meal was ( $9.47 \pm 0.15$ ). The nutritional composition of feed was Moisture (12%), Crude protein (35%), Crude fat (6%), Fiber 5(%), and metabolic power (85%) [68]. the average protein content of DORB in the present investigation was found to be ( $12.6 \pm 1.12$ )%. Crude Lipid content of the DORB was

(11.8±0.88)%. Similar reported those crude fibers were (13)%. The moisture content in DORB was (9.27±0.89)%. Similarly reported moisture content of DORB was (10)%. In the present study the Crude protein content of the Meat and bone meal was (47.23±0.61)%. [3] reported in protein content of Meat and bone meal were slightly higher (48-52)%. Crude Lipid content of Meat and bone meal in the present study was found to be (8.02±1.34)%. The results of the Crude Lipid content Meat and bone meal were (8-12)% [3]. In the present study the moisture content in Meat and bone meal was (5±0.88)%. Similar results of moisture in Meat and bone meal reported by [57]. Ash content of the present study in Meat and bone meal was (22.55±1.32)%, The results of the Ash content of Meat and bone meal were higher (33-35)% [3, 57]. The proximate of formulated feed of brood stock should be crude protein- 29.35%, lipid- 8.68%, ash -12.76%, and moisture- 13.16% [64]. The average protein content of the Mixed of Oyster in the present investigation was found to be (25.5±0.69)%. Similar results reported by [7] in crude fiber of the mixed of Oyster were (4.3-4.41)%. Adulteration of feed due to excess moisture content can harm culture fish species with hampering growth and produce disease as well as he mentioned importance of commercial feed with its practical uses [66]. Ash content of the present study of the Mixed of Oyster was (9.97±0.21)%. Similar results of Ash content in Mixed of Oyster were (10-11)%, reported by [7]. The average protein content of Shrimp Shell in the present investigation was found to be (41.27±0.76)%. Moisture content of Shrimp shell in the present investigation was found to be (12.20±0.67)%. Moisture content of shrimp shell were higher (14.7±0.7)%, reported by [50] in biochemical composition of shell and flesh of the Indian white shrimp *Penaeus indicus*. Ash content of the present study in shrimp shell was (17.06±0.94)%. The ash found in Shrimp shell were (18.5±0.6)%, reported by [50] in biochemical composition of shell and flesh of the Indian white shrimp *Penaeus indicus*. In the present study the Crude protein of the Crab Shell was (16.67±0.81)%. Crude Lipid content of the Crab Shell present study was found to be (2.5±0.37)%. [1] Found (1.35-1.92)% crude lipid content of the Crab Shell Ash content of the Crab Shell was (5.56±0.73)%. [31] Reported (5.09)% ash content in crab shell body. This is a similar result in the present study.

## 5. Conclusions

Thus from the overall discussion of the present experimental results it has established that better growth and minimum feed cost of reared species may also be obtained using the feed with protein of plant and animal origin. These types of feed with natural feed contribute to increase the growth and survival and decrease the feed conversion of the rearing species. Supplementation of artificial diets to the natural food may further increase the growth and survival and decrease the feed conversion of the rearing species. To achieve a balance nutritional composition in fish feed, a more diverse choice should be made in selecting feed ingredients. A mixture of feed ingredients will provide more balance nutrients than only use limited feed ingredients to formulate fish feed. Consequently, the aqua farmer can detect the chemical composition of different feed ingredients effortlessly and select the right feed ingredients to their culture species accurately. So the aqua farmer can observe the chemical composition of different feed ingredients easily and they choose the right feed ingredients to their culture species properly.

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