RESEARCH ARTICLE

Studies on Fish Feed Formulation

K. Raju Yadav[1*], A.U. Muzaddadi[2], Vikas Kumar[3]

[1*] Depart of Agricultural Engineering, AIET, Mijar, Karnataka
[2]Senior Scientist (Fish Processing Technology) of TOT Division of CIPHET, Ludhiana
[3]Scientist (Fish Processing Technology) of TOT Division of CIPHET, Ludhiana

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ABSTRACT

Good nutrition in animal production systems is essential to produce a healthy, high-quality product economically. In fish farming, nutrition is critical because feed represents 40-50% of the production costs. Fish nutrition has advanced dramatically in recent years with the development of new, balanced commercial diets that promote optimal fish growth and health. The development of new species-specific diet formulations supports the aquaculture (fish farming) industry as it expands to satisfy increasing demand for affordable, safe, and high-quality fish and seafood products Conducted experiments on studies on fish feed formulation at CIPHET, Ludhiana. The present study evaluates the importance of fish feed pellets as alternative feed ingredients for fish feed preparation. Commonly available materials i.e., debittered mustard oil cake, fish meal, maize powder, and mineral powder mixture. The crude protein content of the feed ingredients ranged from 10 to 60 % and the crude fat contents were recorded as 4 to 12%. Crude fiber contents were between 1 and 8 % and ash contents ranged from 6.9 to 38 %. In this study, results showed that the minimum volume of pellets is 700.4 mm^3 and maximum volume is 925.504 mm^3 and the minimum density of pellets is 0.00092 g. mm^{-3} and the maximum density of pellets is 0.00107 g. mm^{-3} of the pellets. The 0.5838g weight of the pellet will take less time to dissolve completely when compared with more 0.9127g weight of the pellet.

Keywords : *Crude Protein; Crude Fat; Crude Fiber; Density, Pellets, Volume*

INTRODUCTION

Manufacturing compound pellet feed includes a series of operations, the end goal is to combine several raw materials in previously determined proportions for the precise nutritional objective. The feed production involves grinding of raw materials mixing steam condition palletization grading and packing which contribute to the production of good quality feeds.

The diversity of forms (crumbles and different sizes of granules/pellets) and properties (physical resistance to holding and to leaching in water susceptibility to rehydration, sinking, and floating) required for feeds of aquatic animals impose significant adaptation to manufacturing processes.

Feed formulation is essentially applied nutrition. A number of terms and expressions are introduced that will be put to practical use as information is presented on the nature and qualities of various feed stuff and the information presented on the nutrient requirements of fish. A precise understanding of these terms is essential to their correct application. One must recognize that some of these terms have a built-in error that cannot be escaped. This does not eliminate their usefulness in feed formulation. However, one must appreciate that some are useful approximations of the values and not true ones.

The terms one needs to understand to formulate practical fish diets are crude protein level; energy

*Corresponding author's e-mail: rajuyadav201804@gmail.com

level, expressed as either metabolizable energy (ME) or as digestible energy (DE); specific amino acid levels; crude fiber level; and ash level. Since most complete practical fish diets are supplemented with a vitamin premix at levels over the dietary requirement, this category of nutrients will be ignored temporarily. The potential problems occur when one fails to recognize that all of the above-mentioned terms, except ME and DE, represent the quantity or level of a nutrient in the feed as determined by chemical tests on a specific feedstuff sample. These chemical tests generally correlate well enough with biological methods of feed evaluation (growth studies, tissue, levels) to be very useful to feed formulators, but they are still chemical tests that are subject to an experimental error during nutrient level determination. For example, the proximate composition of fish meals changes during the spawning season. Generally, the lipid levels increase before spawning and decrease after spawning. This will alter the percent of protein, ash, and carbohydrates in the fish meal as the seasons change. Similarly, many plant feedstuffs vary in proximate composition with their stage of maturity at harvest, location grown, and other environmental conditions, such as the weather. Tabled values represent an average value that is usually close enough to the actual value to allow accurate feed formulation. However, one must be aware that assumptions are being made to recognize the potential sources of error that may exist.

Metabolizable, energy and digestible energy values are obtained biologically and, thus, should accurately represent the true energy value of feedstuffs to fish. However, ME values may be obtained in different ways (face collection methods) and thus may be subject to experimental error. It has been reported that the digestibility of feed by rainbow trout was lower at 7 ° than at 11 °C or 15°C. At 11°C and 15°C body size (18.6 g, 207.1 g, or 585.7 g) did not affect feed digestibility. The digestibility of carbohydrates and energy was slightly reduced by meal size in rainbow trout fed at 1.6 percent body weight. Protein and fat digestibility was not reduced by meal size. Obvious differences exist between fish species in nutrient digestibility, especially in the carbohydrate fraction of feed. Herbivorous and, to a lesser extent, omnivorous fish have longer digestive tracts than carnivorous fish and can obtain more digestible energy from carbohydrates. An awareness of these facts will prevent the misuse of ME and DE values.

Each feedstuff in any diet formulation should be present for a specific reason; i.e., it is a good energy source, it is rich in limiting amino acid, etc. In addition, each feedstuff in a particular diet formulation should be the least costly ingredient available for its particular function. This leads to another assumption in feed formulation any nutrient in a particular feedstuff, such as an amino acid, is just as valuable as the same nutrient in any other feedstuff. This allows feed formulators to interchange one feedstuff with another as cost and availability change. Thus, it is assumed that there is no “ideal formulation”, but rather an almost infinite number of possible feed formulations that meet the nutritional needs of the fish equally well. While this assumption may not be entirely valid and some nutritional judgment must be employed in any feed formulation, it does seem to be valid in most cases. As with the previously mentioned assumption, an awareness of the potential pitfalls involved is necessary for the fish feed formulation so that allowances can be made in diet formulation and problems can be anticipated and avoided.

MATERIALS AND METHODS

Balancing Crude Protein Level

Material required

1. De-bittered mustard oil cake (DMOC)
2. Maize powder
3. Fish meal (FM)
4. Mineral mixture

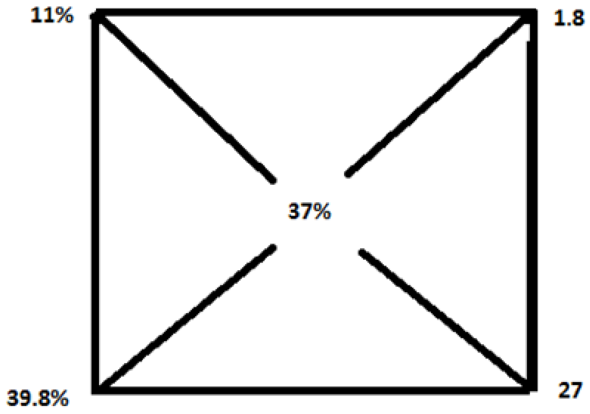
- Crude protein which is less than 20% is called’ basal feed’.
- Crude protein which is greater than 20% is called ‘protein supplements

Protein supplements

Debittered mustard oil cake and fish meal having the protein supplements.

The average protein supplements of DMOC and FM is = (23.6+56)/2 = 39.8%

The two feed ingredients are kept on the two left corners, along with the protein content of each. The desired protein level of the feed is placed in the middle of the square. Next, the protein level of the feed is subtracted from that of the feed ingredients , placing the answer in the possible corner of the feedstuff. Ignore positive or negative signs.



3% addition to compensate leaching

Maize powder =1.8/28.8×100 =6.25%

protein supplements =27/28.8×100 =93.75 %

DMOC+FM =93.75%

DMOC =93.75/2=46.875%

FM =93.75/2=46.875%

Total Composition

Maize powder = 6.25 gm

DMOC = 46.875 gm

FM = 46.875 gm

Total = 100 gm

Check Correction

Maize powder = 6.25×11/100 =0.68

DMOC = 46.875×23.6/100=11.0625

FM = 46.875×56/100 =26.25

Total amount = 0.68+11.0625+26.25=37.99= 38%

Feed formulation for 1 kg fish feed

Maize = 62.50 gm

DMOC = 468.75 gm

FM = 468.75 gm

Total = 1000 gm

Working Procedure

1. Dry fish was ground and cleaned ,followed by collection of fish meal powder of 468.75gm.
2. Debittered mustard oil cake was ground ,sieved and cleaned, then collect DMOC 0f 468.75gm was collected.
3. Grind, sieve, and clean maize to obtain 62.5 grams of maize powder.
4. Add 20 grams of the mineral mixture.
5. Combine all raw materials in a bowl, then add 90ml of water and mix well.
6. Place the mixed raw material in a cooker containing 1 liter of water, and boil for 10 to 15 minutes to adjust moisture content.
7. After boiling, mix the powder thoroughly and slowly drop it into the pelletizer to form pellets.
8. After pelletizing, place the pellets in a solar tray dryer for 2-3 hours to remove moisture, resulting in the finished pellets.

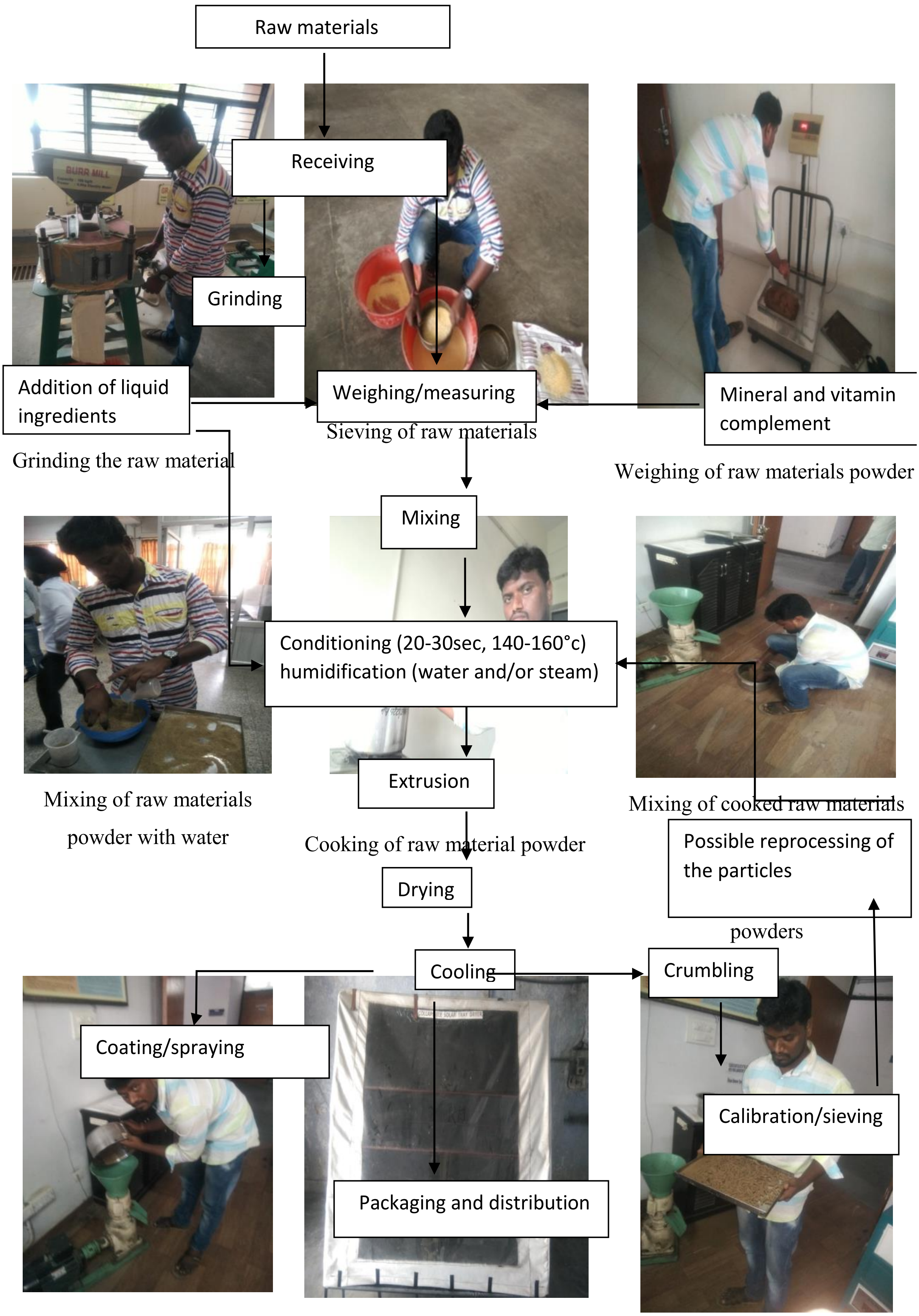
RESULTS AND DISCUSSION

Pellets (sinking)

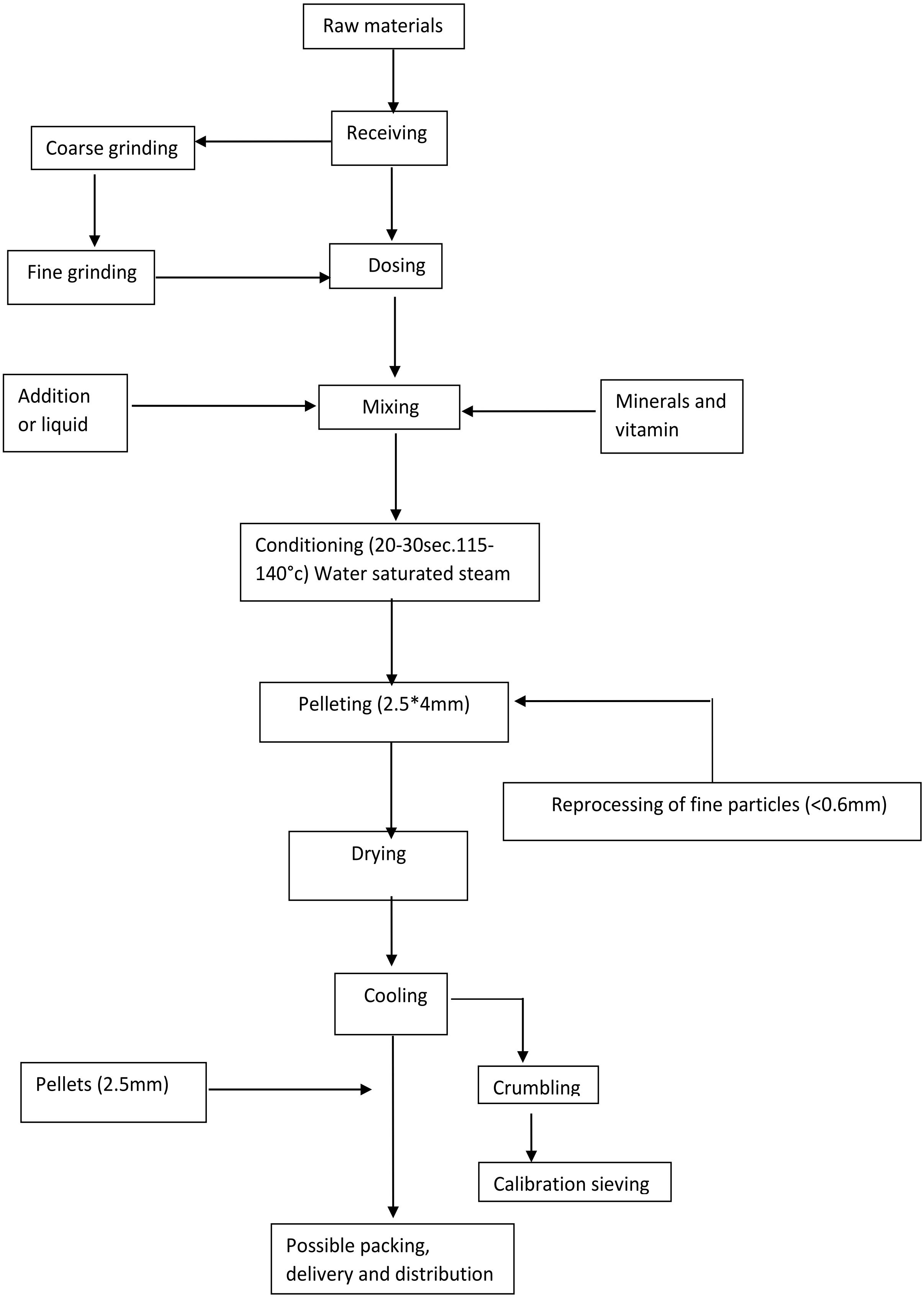
The prepared pellet feed weights are 0.9127 gm, 0.6124 gm, 0.7832 gm, 0.5838 gm, and 0.6648 gm. According to Fig.1, the weight of the pellet of 0.9127 gm takes the shortest time to sink at 0.0192 sec, while the weight of the pellet of 0.5838 gm takes the longest time to sink at 0.0198 sec. This is due to the difference in weight between pellets i.e. when compared to a pellet with less weight, the pellet with more weight sinks faster.

According to Fig.2, a pellet weighing 0.9127 gm takes the most time to dissolve, 32.24 minutes, and a pellet weighing 0.5838 gm takes the shortest time, 24.5 minutes to dissolve entirely. This is related to the weight differential between pellets i.e the weight of the pellets grows, and so does the time required to dissolve the pellets.

Fig..3, shows how the diameter, length, and weight of the pellets are used to calculate their volume and density. In this experiment, we used 10 replications and found that the highest volume and density of pellets were 925.504 mm^3 and 0.00107 g. mm^{-3}, respectively. The maximum length of 34.1 mm and weight of 0.995 gm, with a diameter of 5.88 mm account for this. The minimum volume and density of pellets were 684.685 mm^3 and 0.00106 g. mm^{-3} this is due to the minimum length of 24.72 mm and weight of 0.7317 gm, with a diameter of 5.94 mm. The volume and density of pellets are determined not only by their weight but also by their length and diameter.



Flow chart.1. Manufacturing floating extruded fish pellet feed



Flow chart.2. Manufacturing pellets (sinking)

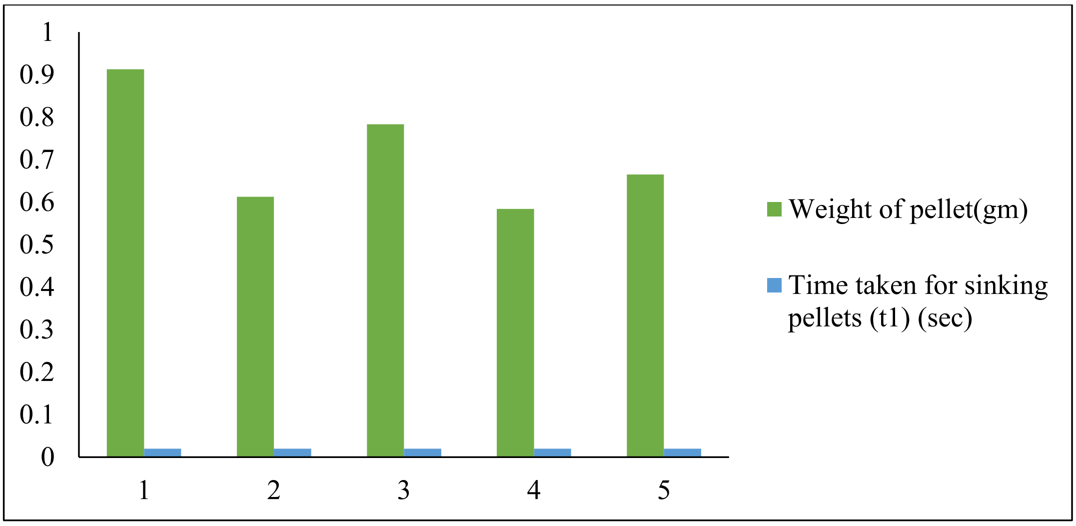


Fig.1. Time taking for the sinking of Pellets (sec)

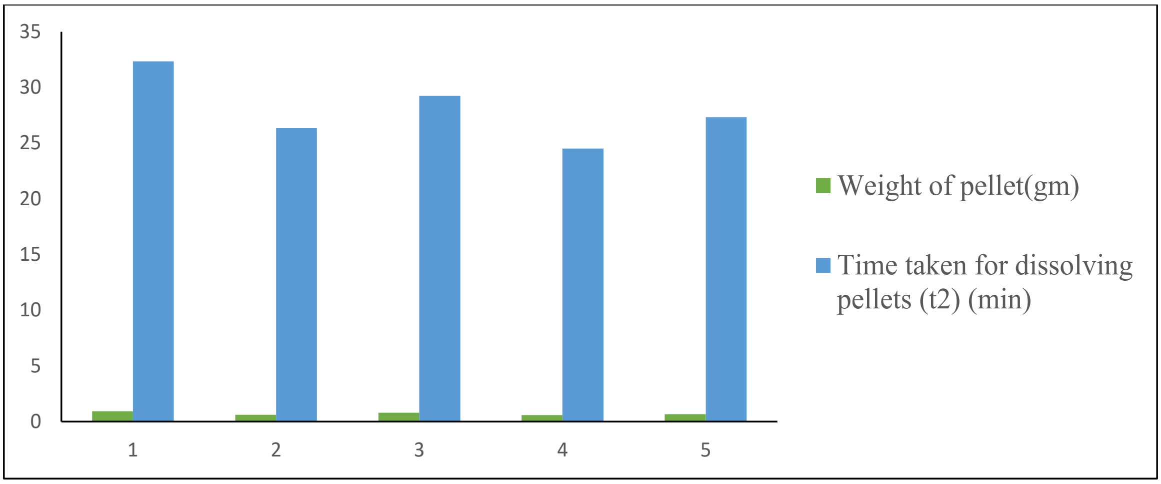


Fig. 2. Time is taken for Dissolving of Pellets (min)

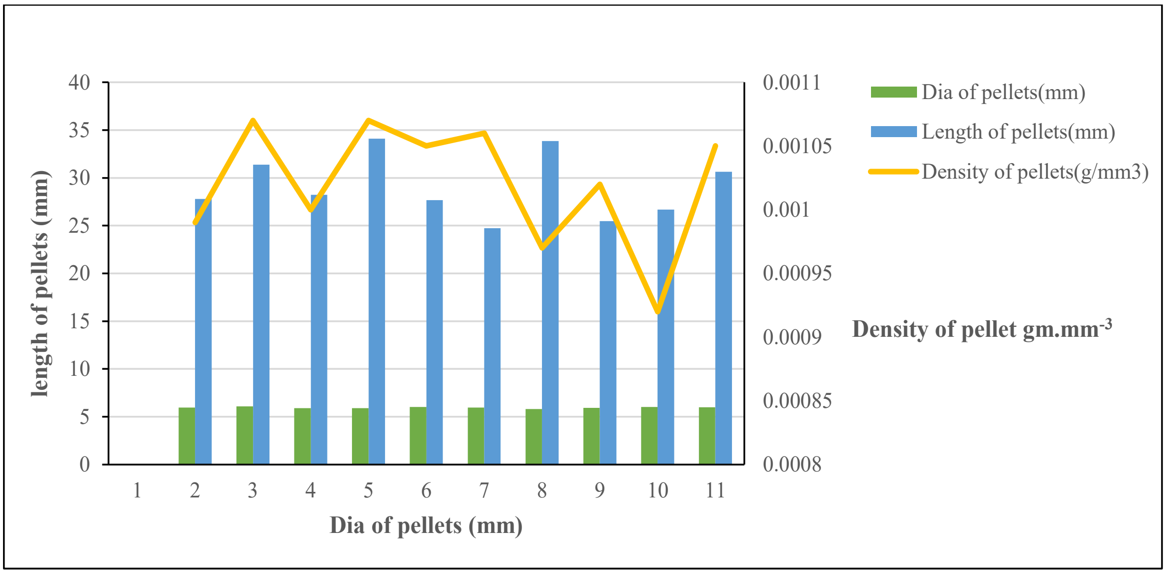


Fig. 3. Density vs Volume

CONCLUSIONS

Based on the study we conclude that the protein additions in the pellets are extremely advantageous to the growth of the fish. The crude protein concentration of the components in the protein supplements ranged from 10 to 60 % with crude fat amounts ranging from 4 to12 %. The crude fiber level ranged from 1 to 8 % whereas the ash contents ranged from 6.9 to 38 %. The finding of this study revealed that pellets have a minimum volume of 00.400 mm^3 and maximum volume of 925.504 mm^3 and the minimum density of pellets is 684.685 g. mm^{-3} and the maximum density of pellets is 0.00107 g. mm^{-3} of the pellets. The pellet weighing 0.5838 grams will dissolve faster compared to the one weighing 0.9127 grams.

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