Growth Rate of Angelfish, *Pterophyllum* Sp. Feeding by Beef Heart and Dry Pellets

Khin Sandar Htay[1], Aye Aye Cho[2]

Abstract

The present study was conducted to compare the effect of the two types of food on the growth of Angelfish. Study period lasted from October 2017 to February 2018. Two glass aquaria measuring 45cm x 30cm x 30cm were used to culture fish. One month old 15 fish were introduced into each aquarium. Beef heart and dry food pellets were used in the present study. Each of 15 specimens from two aquaria were measured to the nearest centimeter and weighted to the nearest gram. Measurements were taken monthly. The growth performance parameters (final length, final weight, condition factor, food conversion ratio and specific growth rate) of fish fed beef heart were greater than that of fish fed dry pellets. Colour intensity of fish fed beef heart was brighter than that of fish fed dry pellets. Moreover, angelfish showed interesting behaviours that combined with feeding behaviour.

Keywords: Anglefish, beef heart, dry pellets, condition factor, food conversion ratio, specific growth rate

Introduction

Ornamental fish keeping is one of the most popular hobbies in the worldwide interest. More people become interested in the keeping of ornamental fishes due to their peculiar behaviours, beautiful and attractive colouration.

In Myanmar, ornamental fish rearing started in 1960 and ornamental fish trading business was initiated during 1978 and since then it became very popular. Nearly 80% of ornamental fishes from other countries could be successfully bred in Myanmar. Many fishes that bred from Thailand, Singapore, Malaysia, China and Hong Kong were imported to Myanmar (Roy Mya Thein, 1995).

Myanmar exports about 50 species of ornamental fishes, all of which are native to Myanmar. About 20 species make up the bulk of Myanmar's exports. Myanmar has enormous potential to develop export markets for aquarium fish (Shwe Yinn Mar Oo and Sann Oo, 2007).

Among the ornamental fishes, the cichlids are the big fishes of the aquarium. In cichlids, the South American cichlid *Pterophyllum* species are most popular and common members of the general community. Since the introduction of this species around 1911, they have held a unique position in the fish keeping world (Wakes, 1991).

Angelfish are largely carnivorous and typically a voracious feeder and the adept hunter of small fishes. Angelfish have already been bred over many generations in captive nature, so they have largely lost the dietary habits of their wild conspecific. In captivity it is possible to acclimatize the angelfish to almost all kinds of substitute food.

Correct and balanced amount of food is essential to improve the health of fish and the productivity of the ornamental fishes. Therefore, knowledge of feeding is essential for culturing ornamental fishes.

[1]MSc Candidate, Department of Zoology, Hinthada University
[2]Associate Professor, Dr, Department of Zoology, Hinthada University

The present study was conducted with the following objectives;

- to record and compare the effect of two types of food on the growth of fish
- to investigate on colouration of fish
- to study the feeding behaviour of fish

Materials and Method

Study site

This study was carried out at the Laboratory in Department of Zoology, Hinthada University, Ayeyarwady Region.

Study period

Study period lasted from October 2017 to February 2018.

Preparation and Maintenance of Aquaria

Juvenile Angelfish obtained from an ornamental fish breeding farm in Yangon were put into three aerated bags and transported to the Zoological Laboratory of Hinthada University. Two glass aquaria measuring 60cm × 30cm × 30cm were used to culture the Angelfish. Glass aquaria have been filled with water before two days to get rid of toxic substances. After aquaria were introduced fish, one third of water in the aquarium was siphoned off and refilled fresh water again daily. Every aquarium was cleaned and water was renewed weekly. Regular aeration was applied to all aquaria (Plate. 1).

Apparatus

Thermometer, pH meter and aerator were applied in keeping of the fish culture (Plate 2).

Acclimatization

Fish were acclimatized gradually and carefully to the new aquarium. The plastic bag containing fish was floated on the water surface of new aquarium for half an hour. Meanwhile, small quantities of water from the aquarium were added to the plastic bag. Within half an hour, temperature, hardness and pH value of the water in the plastic bag were nearly the same as those in the aquarium. Then, fish were released into the aquarium carefully.

Fish Specimen

Approximately the same sized (1.5 ± 0.40 g in weight, 3.2 ± 0.25 cm in total length and 2.70 ± 0.25 cm in standard length) 15 fish about one month old were introduced into each aquarium.

Rearing condition of fish

Two glass aquaria were filled with fresh water and then, one month old 15 fish were used for test in each aquarium. Tested aquaria were supplied regular aeration. Water temperature and pH were recorded daily at 9:00 AM.

Two kinds of food, wet food (minced beef heart muscles without fat and tendons) and dry food pellets (optimum) were used in this experiment. Same amount of food was fed the fish two times per day. Each aquarium was cleaned prior to feed session, to remove faeces. Quantity of feeding was increased 1.0 g per month. To avoid water pollution, remain of excess food was siphoned off approximately half an hour after feeding (Plate 3).

Data collection

Growth rate of 15 Angelfish specimens from each aquarium were conducted monthly. It meant to evaluate on morphometric measurements as body weight, total length, standard length. Scaled ruler and digital balance were utilized. The measurements were taken in each of 15 fish from both aquaria. The daily feeding weight was also recorded.

Water quality management

Water temperature was measured in all aquaria daily using a thermometer.

Calculation of data

The data calculation was performed by following parameters in accordance to

(i) Length-weight relationship

The length- weight relationship for these cultured fish species was calculated as per cube law by LeCren (1951) as follows:

$$W = CL^3$$

W= Weight of fish

C = Condition factor

L = Length of fish

This formula was also expressed in logrithumic form as:

$$\log W = \log a + n \log L$$

(ii) Condition Factor (K)

The value of condition factor (K) was determined by given formula:

$$K = \frac{W \times 10^5}{L^3}$$

Where W = Wet fish body weight (g)

L = Wet fish total length (mm)

Number 10^5 is the factor bringing the ponder index or condition factor (K) near the unity (Carlander, 1970).

(iii) Food Conversion Ratio (FCR):

FCR = total diet fed (gm) /total wet weight gain (gm).

Data analysis

Pair-wise comparative values of body conditions in different feeding was analyzed by using "Student-t" test. Relation of increased body weight and standard length, body weight and total length were analyzed by regression correlation analysis,the effects of diets on the colouration of fishes were analyzed by using Chi-square (X^2) test. All analyses were calculated by using statistical package for social science (SPSS version 16.0) software and Microsoft Excel Program. All statistical computations were performed at the p = 0.05 probability level.

Identification method

The studied fish were identified and classified followed after (Axelord, 1977).

Systematic position

Phylum	-	Chordata
Sub-phylum	-	Craniata
Super-class	-	Gnathostomata
Series	-	Pisces
Class	-	Osteichthyes
Sub-class	-	Actinoterygii
Order	-	Perciformes
Family	-	Cichlidae
Genus	-	*Pteryophyllum* Heckel, 1840
Species	-	*Pteryophyllum* sp
Common name	-Angel	

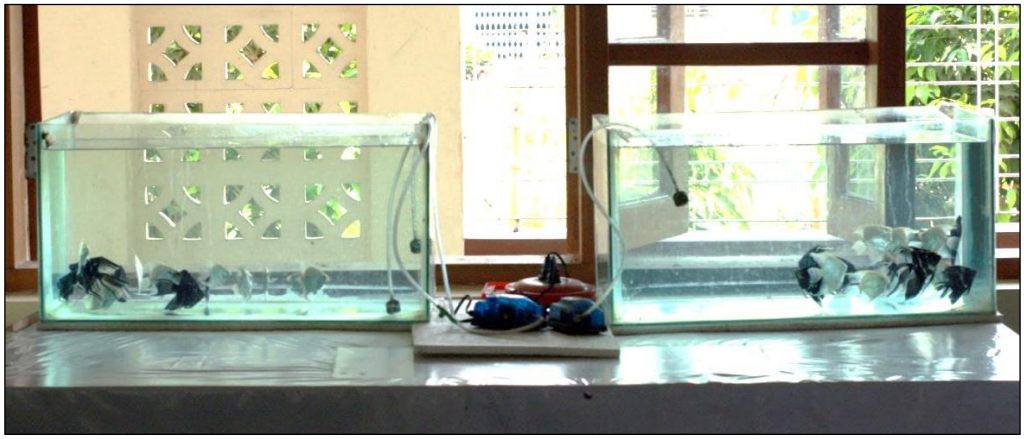


Plate (1) Fish aquaria.

A. Digital balance

B. pH meter

C. Aerator

Plate (2) Utilized apparatus.

A. Beef heart

B. Dry pellets

C. Feeding fish

D. Measuring fish

Plate (3) Foods, feeding and measuring of fish.

Results

Effect of feeds on the growth of Angelfish

The fish of two aquaria were the nearly same body weight (1.50±0.40) g, nearly same standard length (2.70±0.25) cm and total length (3.20±0.25) cm at the beginning of the experiment. The body weight, standard length and total body length increased gradually through the study period (Table 1).

At the end of the experiment, mean body weight of fish feeding on beef heart was 3.88±2.51gm and those on dry food pellets were 2.56±1.45gm. Mean standard length of fish feeding on beef heart and dry food pellets were 4.21±1.02cm and 3.61±0.74cm respectively. Mean total length of fish feeding on beef heart and dry food pellets were 5.42±1.39cm and 4.59±1.06cm respectively (Table 1).

The increased of mean body weight of fish feeding on beef heart was greater than those of fish feeding on dry food pellets. There was significant difference of increased body weight by the feeding of two different foods, beef heart and dry food pellet ($t=6.480$, $df=74$, $p<0.01$) (Fig. 1).

The mean body standard length of fish feeding on beef heart was growing longer than that of fish feeding on dry food pellets. The increased standard length of fish was highly significant difference between the feeding of beef heart and dry food pellets ($t=9.423$, $df=74$, $p<0.01$) (Fig. 2).

The mean total body length of fish feeding on beef heart was longer than that of fish feeding on dry food pellets. It was observed that the increased of total length by feeding of two different foods were significantly different ($t=10.930$, $df=74$, $p<0.01$) (Fig. 3).

Length-weight relation of Angelfish fed the two different types of feed

During five months of culture period, positive relation between length and weight growth of fish fed with the two different types of feeds was observed.

Table (1) Comparison between fish fed with two different types of food on monthly mean body weight, standard length and total length

Sr. No	Month	Body weight (gm)		Standard Length (cm)		Total length (cm)	
		Beef Heart	Dry food pellet	Beef Heart	Dry food pellet	Beef Heart	Dry food pellet
1	October	1.46 ± 0.40	1.47 ± 0.40	2.70 ± 0.25	2.70 ± 0.25	3.20 ± 0.25	3.20 ± 0.25
2	November	2.02 ± 0.44	1.59 ± 0.44	3.87 ± 0.40	3.10 ± 0.21	4.87 ± 0.40	3.93 ± 0.37
3	December	3.37 ± 0.55	2.09 ± 0.46	4.30 ± 0.41	3.63 ± 0.35	5.83 ± 0.41	4.77 ± 0.56
4	January	4.85 ± 0.88	2.95 ± 0.80	4.57 ± 0.37	4.00 ± 0.27	6.17 ± 0.41	5.00 ± 0.42
5	February	7.69 ± 2.25	4.69 ± 1.52	5.63 ± 0.30	4.63 ± 0.40	7.03 ± 0.64	6.07 ± 0.46
TOTAL MEAN		3.88 ± 2.51	2.56 ± 1.45	4.21 ± 1.02	3.61 ± 0.74	5.42 ± 1.39	4.59 ± 1.06

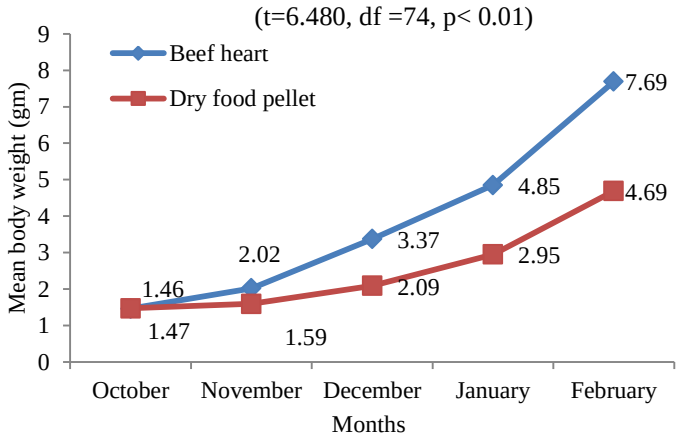


Figure (1) Monthly increased body weight of fish fed with two different foods.

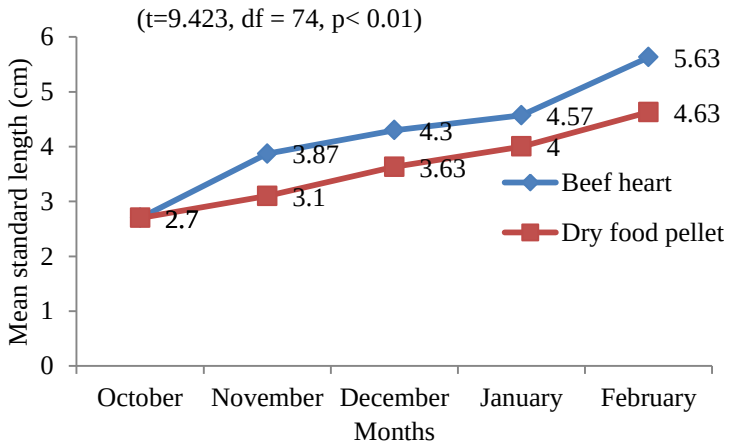


Figure (2) Monthly increased standard length (cm) of fish fed with two different foods.

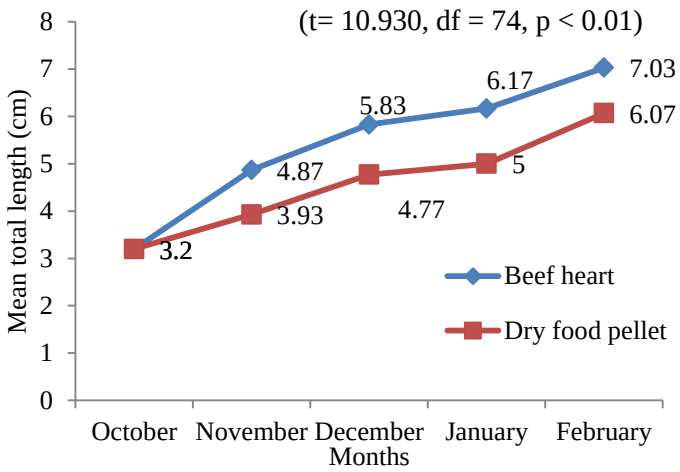


Figure (3) Monthly increased total length (cm) of fish fed with two different foods.

Relationship between standard length and body weight of fish fed beef heart

Mean standard length of fish that feed beef heart ranged from 2.70±0.25 to 5.63±0.30 cm and mean weight ranged from 1.46±0.40 to 7.69±2.25gm were recorded in the five months study period (Table 1). There was significant relationship between increased standard length and body weight of fish by feeding beef heart ($y=2.74x^{0.3444}$, $R^2=0.7248$) (Fig. 4).

Relationship between standard length and body weight of fish fed dry pellets

Mean standard length of fish that fed dry pellets ranged from 2.70±0.25 to 4.63±0.40 cm and mean weight ranged from 1.47±0.40 to 4.69±1.52gm were recorded during the study period. Relationship between standard length and body weight of fish fed dry pellet was significant ($y=2.6893x^{0.3389}$, $R^2=0.6633$) (Fig. 5).

Relationship between total length and body weight of fish fed beef heart

Mean total length of fish that fed beef heart ranged from 3.20±0.25 to 7.03±0.64cm and mean body weight ranged from 1.46±0.40 to 7.69±2.25gm were recorded during five months culture period (Table 1). There was significantly relationship between total length and body weight of fed beef heart ($y=3.3879x^{0.3736}$, $R^2=0.7001$) (Fig. 6).

Relationship between total length and body weight of fish fed by dry pellets

Mean total length of fish that fed dry pellets ranged from 3.20±0.25 to 6.07±0.46cm and mean body weight ranged from 1.47±0.40 to 4.69±1.52gm were recorded in the five months study period (Table 1). Relationship between total length and body weight of fish fed dry pellets was significant ($y=3.2945x^{0.3767}$, $R^2=0.6204$) (Fig. 7).

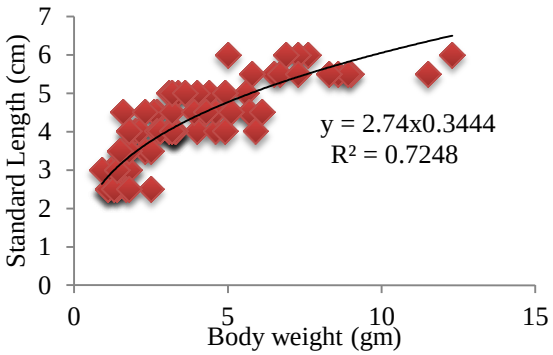


Figure (4) Relationship between increased standard length and body weight of fish fed by beef heart

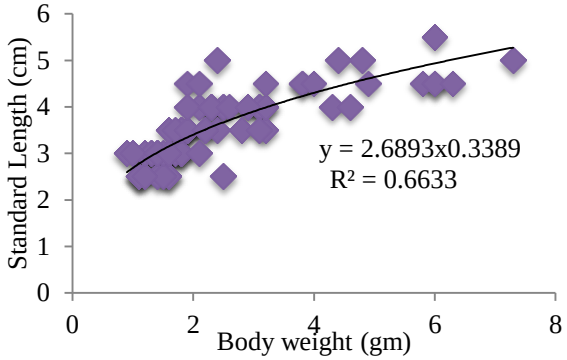


Figure (5) Relationship between increased standard length and body weight of fish fed by dry pellets

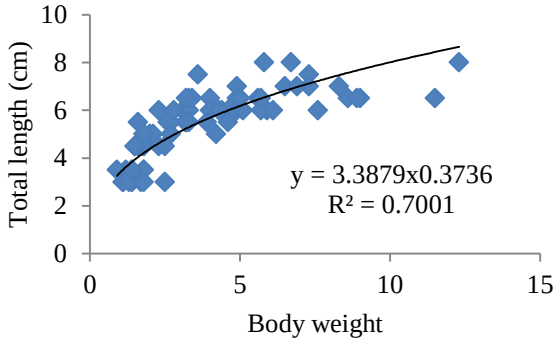


Figure (6) Relationship between increased total length and body weight of fish fed by beef heart

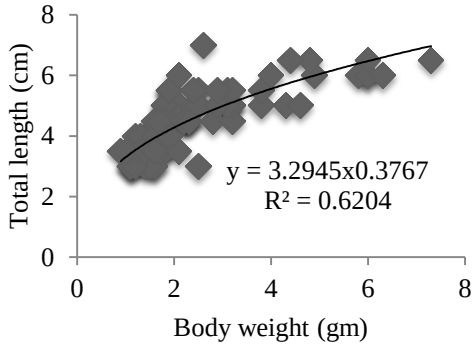


Figure (7) Relationship between increased total length and body weight of fish fed by dry pellets

Monthly variation of condition factors (K) and food conversion ratio (FCR)

The monthly variation of condition factors for fish that fed beef heart were 4.63±1.77, 1.78±0.44, 1.76±0.55, 2.12±0.53 and 2.34±0.96 respectively. Condition factors of December and November were lowest than other months. The monthly variation of condition factors for fish fed dry pellets were 4.64±1.66, 2.67±0.79, 2.04±0.69, 2.45±0.80 and 2.11±0.61 respectively. Conditions factors for most of months except October were found to be stable (Table 2). Monthly FCR of fish feeding on beef heart were 3.57, 2.96, 4.05 and 2.81. Those of fish feeding on dry pellets were 16.67, 8.0, 6.98 and 4.6 (Fig.8).

Table (2) Monthly variations of condition factors.

Month	Condition factor (K)	
	Beef Heart	Dry food pellets
October	4.63 ± 1.77	4.64 ± 1.66
November	1.78 ± 0.44	2.67 ± 0.79
December	1.76 ± 0.55	2.04 ± 0.69
January	2.12 ± 0.53	2.45 ± 0.80
February	2.34 ± 0.96	2.11 ± 0.61

Table (3) Monthly variations of food conversion ratio (FCR).

Month	Food conversion ratio	
	Beef Heart	Dry food pellets
November	3.57	16.67
December	2.96	8.00
January	4.05	6.98
February	2.81	4.60

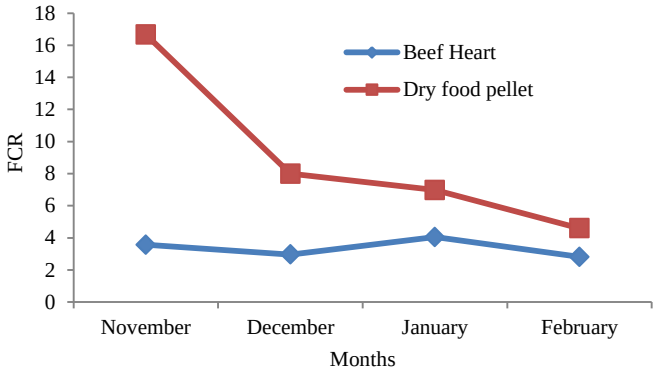
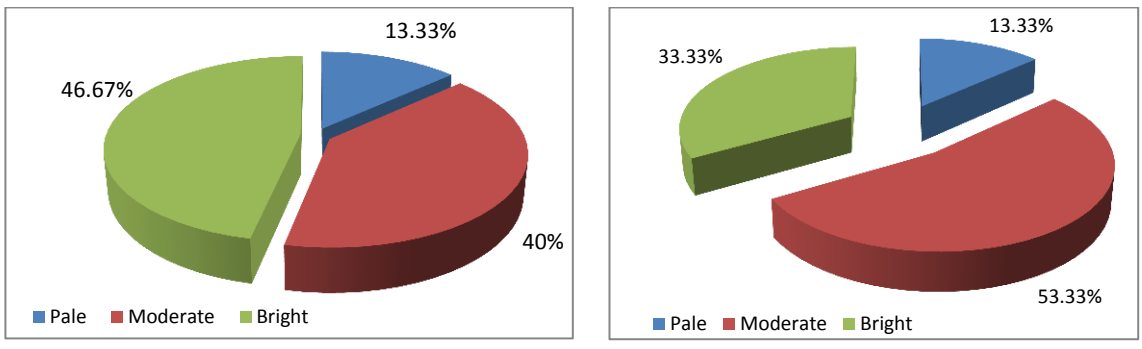


Figure (8) Food conversion ratio of fish.

Effect of feeds on the colouration of Angelfish

Variation of colour brightness was recorded among angelfish feeding on two kinds of feeds. Among the fish feeding on beef heart, 13.33% of fish were pale coloured, 40% were moderate coloured and 46.67% of fish were brightly coloured. Majority of fish feeding on dry food (pellets) found to be pale colouration, 13.33%, moderate colour were 53.33% and brightly coloured were 33.33%. Majority of fish having bright colouration were found on fish feeding on beef heart and the fish feeding on dry pellets showed the less of bright coloured (Fig. 9). The colouration of fish was not significantly different between the different foods (X^2= 6.016, p>0.05).



A. Beef heart B. Dry Pellets

Figure (9) Variation of the brightness of colouration between fish feeding on two types of food.

Discussion

Growth of the fish is dependent not only on the good genes but also on the quality and quantity of food. Angels are freshwater cichlid and thus are primarily carnivores. In nature, they feed on small fishes but over 100 years of the crossbreeding in captivity, they have lost their dietary habits. In the present study, beef heart and the dry pellets were used as the substitute foods. The difference of growth in fish was observed among the feeding of beef heart and that of dry pellets. The fish feed on beef heart were observed to have more growth rate.

Four growth performance parameters (final weight, final length and condition factor) of the fish fed beef heart and dry pellets were recorded. In fish, length has an important function for the weight and also the weight is considered to be a function of length. Length-weight relationships give information on the condition and growth patterns of fish (Laghari *et al*., 2009). In this study, there was a stronger relationship between body weight and standard length of Angelfish fed with the two different feeds. Another stronger relationship was also observed between body weight and total length of fish fed with those feeds.

Lamprakis *et al*., (2003) mentioned that different values in correlation coefficient can be the result of differences in the number and observed length ranges of specimens examined between sampling years and seasons or differences in food availability and species life history. Moreover, Oscoz *et al*.,(2005) described that length-weight relationship vary according to factors such as food availability, feeding rate, gonad development and spawning period and are not constant over the entire year. In this study, variation of length-weight relationship may be the difference of food availability. And also, Salam and Mahmood (1993) stated that if the fish retains the same shape and its specific gravity remains unchanged during the life time, the value of length exponent (b) would be exactly 3.0. A value less than 3.0 showed that 3.0 indicated the fish heavier for its length as it increase in size. In the present study, the value of the length exponent of angelfish fed the two types of foods was less than 3.0. The value of the length exponent may be different because of feeding.

Fish fed with dry pellets were found to be more stable in growth than beef heart according to condition factor (K). Values of the condition factors indicated that the growth of fish feeding on beef heart were better condition than other feeding on dry pellets. According to Giovanetti and Lucanus (2005) and Aye Aye Cho (2012), beef heart was easy, inexpensive food and promoted to growth in feeding of Discus fish. The present study noted that the feeding of beef heart is easier than those of dry pellets and increased growth in Angelfish.

A healthy and proper diet will produce healthy, colourful, disease resistant fish. Healthy fish are more colourful than unhealthy one. Colour has an important role in fish to camouflage, to escape the notice of predators, to attract mates and to get high economic value in ornamental fish. Some colour enhancing food can bring certain colour in fish. The fish fed on the pellets were observed to have more intensity of colouration than fed on other food Sweeney (1996). In the present study, the fish fed on beef heart got better colouration than fish fed on dry pellets. This may be that growth of fish could be brought together with better colouration.

One problem confronting fish culturists is to obtain a balance between rapid fish growth and optimum use of supplied feed. Among these feeding frequencies is an important factor for the survival and growth of fish at the early stage Abid and Ahmad (2009). Both over- and underfeeding can be detrimental to the health of the fish and may cause a marked deterioration in water quality, reduced weight, poor food utilization and increase

susceptibility to infection Nekoubin and Sudagar (2012). In nature, fish are constantly foraging. They can get very small quantities food all day long. In captivity, several times of feeding with small amount were better than a large amount of feeding Giovanetti and Lucanus (2005). These suggestions are in accordance with the finding of the present study.

Regarding the feeding behaviour of fish, the interesting behaviour of Angelfish was also recorded with feeding. Angelfish always come up the face of aquarium curiously when any stronger approached. They recognized their keepers and easy to tame. They picked up food from the keeper's hand which was familiar due to daily feedings. At night, Angels rested or slept quietly on the bottom of aquarium. In the early morning and after cleaning of aquarium, they were inactive and fed nothing immediately. After about half an hour later, they become active and start feeding. These findings are similar to the findings of Degen (1990) and Aye Aye Cho (2012) in the Discus fish rearing.

Fish are fed in water medium. Food which is not consumed within a reasonable time is not economic lost, but also can reduce water quality. Therefore, feeding rate, feeding method and water stability are important factors that fish culturist must consider stated by Lovell (1987). It was concluded that the food types may affect on the growth of ornamental fishes.

Acknowledgements

We would like to express our sincere thanks to Dr Tin Htwe, Rector and Dr Mar Lar, Pro-Rector, Hinthada University, for their permission to conduct this research work. Special thanks are due to Professor Dr Aye Aye Tin, (Head) Department of Zoology, Hinthada University, for her valuable suggestions and editing in our research work and to Dr Yi Yi Win, Professor, Department of Zoology, Hinthada University, for her advice and encouragement.

References

Abid, M and M. S. Ahmed, (2009). Efficacy of feeding frequency on growth and survival of *Labeo rohita* fingerlings under intensive rearing. The Journal of Animal and Plant Sciences, 19: 111-113.

Axelord, H. R., (1977). *Atlas of freshwater Aquarium Fish, 9th Edition.* T. F. H Publications Inc. Neptune City, U.S.A., 718 pp.

Aye Aye Cho, (2012). *Breeding and Raising of the Ornamental Discus Fish, Symphysodon* sp. (Heckel, 1840). PhD (Dissertation), Department of Zoology, University of Yangon.

Carlander, D., (1970). *Handbook of freshwater Fishery Biology*, Vol.1. The Lowa State University Press, Lowa, U.S.A.

Degen, B., (1990). *Discus: How to Breed Them*. T. F. H publications, Neptune City, U.S.A., 128 pp.

Dhawan. A. and S. Kaur, (2002). *Pig dung as pond manure: Effect on water quality, pond productivity and growth of carps in polyculture system.* The World Fish Centre Quarterly, 25(1): 11-14.

Giovanetti, T. A., Lucanus, Q., (2005). *Discus fish*. Barron's educational, series, Inc. China, 96 pp.

Laghari, M. Y., Narejo, N. T., Mahesar, H., Lashari, P. K., Abid, M., (2009). Length-weight relationship and condition factor of indigenous catfish, *Rita rita* (Hamiltan) from cemented ponds in University of Sinda, Jamshoro. *Sindh University Research Journal* (Sci.Ser.), 41(2).47-52.

Lamprakis, M. K., Kallianoitis, A. A., Moutopoulos, D. K. Stergiou, K. I., (2003). Weight-length relationship of fish discarded by trawlers in the North Aegean Sea. *Acta Ichthyologica Piscata*, 33(20) 145-152.

LeCren, E. D., (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *Perca fluviatilis*. *J. Anim. Ecol.,* 20(2): 201-219.

Lovell, T., (1987). Nutrition and feeding of fish. Feeding formulation and processing. Yan Nostrant Reinhokld, New York, 229 pp.

Nekoubin, H. and M. Sudagar, (2012). Effects of feeding frequency on growth performance and survival rate of grass carp *Ctenopharyngodon idella*. World Applied Sciences Journal, 17(8): 1001-1004.

Oscoz, J., Campos, F., Escala, M. C., (2005). Weight-length relationship of some fish species of the Iberian Peninsula. *Journal of Applied Ichthyology*, (21): 73-74.

Roy Mya Thein, (1995). Wild caught Ornamental Fishes from the Upper Ayeyarwady River in Myanmar. *Aquarama*' 97, Conference Proceeding. Singapore.

Salam, A. Mahmood, J. A., (1993). Weight-length and condition factor relationship of a freshwater under yearling wild *Catla catla* (Hamilton) from river Chenab (Multan). *Pakistan Journal of Zoology*, 25(2):127-130.

Shwe Yinn Mar Oo and Sann Oo, (2007). Pretty fish sales hit a hump. (internet) (cited 2007 August 5) Available from: http://www.rnatt.Myanmar times.com.mm.

Sweeney, E. M., (1996). *Discus keeping and breeding them in captivity*. T. F.H. Publications, Neptune City, U.S.A., 64 pp.

Wakes, B., (1991). *A Rainbow of Angels*. Aquarium Fish Magazine. August, P.56.