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**A study of morphological characteristics in Malaysian freshwater
angelfish (*Pterophyllum scalare*) using meristic tools**

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Abstract

There are 46 varieties of freshwater angelfish produced for export in Malaysia. It is known that there are three species of angelfish, *Pterophyllum altum*, *P.eimekei*, and *P.scalare*, which are originated from the Amazone. This paper aims at the identification of different strains of *Pterophyllum scalare* available in Malaysia and morphological comparison of four varieties using meristic counts as a preliminary step in identification of the species.

Introduction

Aquarium fish trade is one of the steady increasing cash crops of the Malaysian aquaculture economy. Malaysia export about 250 species and 506 varieties of ornamental fish worth about 50 million ringgit in the world market, annually. *Pterophyllum scalare*, the freshwater angelfish is an all time favourite among them. The present study shows that including the short and long finned varieties, there are 46 varieties of angelfish produced for export in Malaysia. It is known that there are three species of angelfish, *Pterophyllum altum*, *P.eimekei*, and *P.scalare* which are originated from the amazone (4). Except a few works on the biology and nutrition, (1, 2,7) there has been not much work done to characterise the *Pterophyllum scalare* strains of Malaysia or even Southeast Asia. This paper aims at the identification of different strains of *Pterophyllum scalare* available in Malaysia and morphological comparison of four varieties using meristic counts as a preliminary step in identification of the species.

Strains of *P.scalare* available in Malaysia

The colour, scale and fin type genes determine variety. Colour genes are a (albino), D (black), C (chocolate), g (gold), Gm (gold marble), L (german blue), h (half-black), M (marble), S (blushing), Sm (smokey), Z (zebra) and + (silver/normal). The scale gene is p (diamond/pearl scale). The fin genes are n (long fin), V (veil tail) and Q1 and Q2 are the cap genes (5,6).

Following is the list of varieties present in the Malaysian aquarium trade, including their genotype and phenotypes, compiled from personal contact with fish breeders (8) and through breeding experiments conducted in the Ornamental Fish Genetics Laboratory, University of Malaya.

Silver (+/+), Silver Diamond (+/+p/p), Ghost (+/+S/+), Albino (a/a-/+), Albino Diamond (a/a-/+p/p), Gold (g/g), Red eye gold, Gold Diamond (g/g-p/p), Gold Blushing (g/g-S/S), Black (D/g or D/D), Black lace (D/+), Marble (M/g), Dark Marble (M/M), Marble Diamond (M/M-p/p or M/g-p/p), Gold Marble (Gm/g or Gm/Gm), Koi (Gm/Gm-S/S), Koi Blushing (Gm/g-S/S), German Blue Blushing (+/+S/S), Turquoise Blushing (D/+S/S), Leopard (SM/Sm-Z/Z or Sm/Sm-Z/+), Half Black (h/h), Zebra (Z/+ or Z/Z) and Zebra Lace (D/+Z/Z or D/+Z/+) are the varieties present in Malaysia.

Materials and methods

Axelrod and Burgess (3) has documented the range of meristic characters such as dorsal fin spines, dorsal fin rays, anal fin spines and anal fin rays in *P. scalare scalare* as follows.

Dorsal fin spines = 11 - 14

Dorsal fin rays = 21-28

Anal fin spines = 5-7

Anal fin rays = 22-30

Specimens of four strains of *Pterophyllum scalare* were selected and 25 fish from each strain were compared through a morphological study based on the following meristic counts. The strains selected were males of Silver (normal strain), Light Marble, Gold Marble, and Koi. These were selected due to the easy availability of these strains. They were collected from fish farms in Rawang, Ipoh, Johore and from local aquarium shops.

The 10 meristic counts which are recorded are, dorsal fin rays, dorsal fin spines, pectoral fin rays, pectoral fin spines, pelvic fin rays, pelvic fin spines, anal fin rays, anal fin spines, caudal fin rays and caudal fin spines. These counts were made in 25 fish from each strain. Analysis of variance (ANOVA) was done to estimate differences between the four strains using SPSS software version 10. Differences between the mean values of each meristic count was determined using Tukey's test.

Result

The range and mean values of these meristic counts are given in table 1. The dorsal fin spines of Silver and Light Marble strains ranged from 10 to 13 with mean values 11.68 and 11.56 respectively and those of Gold Marble, 11 to 13 with mean value of 12.04. Specimens of Koi variety had 11 to 14 dorsal fin rays and a mean value of 12.08. Using Tukey's test the mean difference of this count among the four varieties was found insignificant at the 0.05 level.

Dorsal fin rays of Silver variety ranged from 22 to 24 and that of Light Marble variety, from 21 to 25 with mean values of 22.64 and 22.56 respectively. Gold Marble variety had dorsal fin rays in the range 21 to 24 with a mean value of 22.16. Koi variety had 18 to 23 number of dorsal fin rays with a mean value of 21.84. A comparison of the mean of this count among the four varieties using Tukey's test showed that the mean difference

between Silver and Koi varieties was significant at 0.05 level while the mean difference between the other varieties was insignificant at the 0.05 level.

Table 1. Values of meristic counts of Malaysian hatchery strains of Silver, Light Marble, Gold Marble and Koi angelfish, *Pterophyllum scalare*

Meristic counts	Range				Average			
	S	LM	GM	K	S	LM	GM	K
Dorsal fin spines	10-13	10-13	11-13	11-14	11.68	11.56	12.04	12.08
Dorsal fin rays	22-24	21-25	21-24	18-23	22.64	22.56	22.16	21.84
Pectoralfin spines	0-1	0-2	0-2	0-2	0.44	0.48	0.56	0.56
Pectoral fin rays	10-12	8-12	10-12	9-11	10.72	10.88	10.80	10.52
Pelvic fin spines	1-2	1-6	1-2	1-2	1.6	1.68	1.52	1.4
Pelvic fin rays	6-8	3-8	5-7	5-7	6.92	5.64	5.76	5.52
Anal fin spines	5-6	3-6	4-6	5-6	5.56	5.56	5.44	5.6
Anal fin rays	23-25	21-26	21-25	23-25	24.04	24.68	23.32	24.12
Caudal fin spines	0-2	0-2	0-2	1-2	1.12	1.48	1.44	1.56
Caudal fin rays	16-19	11-19	15-17	13-17	17.28	16.48	15.88	15.88

S = Silver
 LM = Light Marble
 GM = Gold Marble
 K = Koi.

Pectoral fin rays of Silver and gold Marble varieties ranged from 10 to 12 with mean values 10.72 and 10.8 respectively, while that of Light Marble was in the range 8 to 12 with a mean value of 10.88. The Koi variety had pectoral fin rays in the range 9 to 11 with a mean value of 10.52. There was no significant difference at 0.05 level between the four varieties, using Tukey's test.

The number of pectoral fin spines of Light Marble, Gold Marble and Koi varieties were in the range 0 to 2 with mean values of 0.48, 0.56 and 0.56 respectively and that of Silver variety were in the range 0 to 1 with a mean value of 0.44. Tukey's test at 0.05 level showed that the mean difference of this count among the four varieties was insignificant.

Pelvic fin spines of Silver variety was in the range 1 to 2 with a mean value of 1.6. This count for the Light Marble variety was in the range 1 to 6 with a mean value of 1.68, that for the Gold Marble variety was in the range 1 to 2 with a mean value of 1.52 and the Koi variety had a range of 1 to 2 with a mean value of 1.4. Tukey's test at 0.05 level showed that mean difference of this count among the four varieties was insignificant.

The Silver variety had pelvic fin rays in the range 6 to 8 with mean value of 6.92 and the Light Marble variety had this count in the range 3 to 8 with a mean value of 5.64. The Gold Marble variety had a range of 5 to 7 with mean value 5.76 and the Koi variety had a range of 5 to 7 with a mean value of 5.52. The mean difference was significant between Silver and the other three varieties at 0.05 level, using Tukey's test.

Anal fin spines of Light Marble variety was in the range 3 to 6 with a mean value of 5.56. The Silver and Koi varieties had anal fin spines in the range 5 to 6 with mean values 5.56 and 5.6 respectively and the Gold Marble variety had these in the range 4 to 6 with a mean value of 5.44. But the mean difference among these varieties was insignificant at 0.05 level, using Tukey's test.

Anal fin rays of Silver and Koi varieties were in the range of 23 to 25 with mean values of 24.04 and 24.12 respectively. These counts for Gold Marble was in the range 21 to 25 and for Light Marble 21 to 26 with mean values 23.32 and 24.68 respectively. The mean difference at 0.05 level using Tukey's test was significant between the Gold Marble and Light Marble varieties.

Caudal fins spines of Silver, Light Marble and Gold Marble varieties were in the range 0 to 2 with mean values of 1.12, 1.48 and 1.44 respectively. Those of Koi variety were in the range 1 to 2 with a mean value of 1.56. Tukey's test for the mean difference at 0.05 level showed an insignificant difference among the four varieties.

Caudal fin rays of Silver variety was in the range 16 to 19 with an average value of 17.28. This meristic count for Light Marble variety was in the range 11 to 19 with a mean value of 16.48. The Gold Marble variety had a range of 15 to 17 with mean value of 15.88 and the Koi variety had this count in the range 13 to 17 with a mean value of 15.88. There was a significant mean difference (Tukey's test at 0.05 level) between the Silver and Gold Marble as well as Silver and Koi varieties.

Discussion

Out of the 10 meristic counts evaluated, it was found that the range of these counts falls within the range described earlier (3). But it is also found that the difference between Silver and others as well as Silver and Koi was significant in dorsal fin ray counts and pelvic fin ray counts. Silver and Gold marble as well as Silver and Koi differs significantly in caudal fin rays and Gold Marble and Light Marble differs significantly in anal fin rays. This indicates a possible genetic difference between the normal Silver variety and the others, which is being verified through further allozyme study.

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