

BIOMETRICAL FEATURES OF COMMON CARP (CYPRINUS CARPIO), SILVER
CARP (HYPOPTHALMICHETHYS MOLITRIX) AND THEIR F1 HYBRID

BY

Mohamed A. Essa

National Institute of Oceanography and Fisheries, Kayed Bay,
Alexandria, Egypt.

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ABSTRACT

The present study gives the results of the biometrical features of common carp (Cyprinus carpio), silver carp (Hypophthalmichthys molitrix) and their F1 hybrid. The cross breeding of common carp females X silver carp males was produced by using artificial propagation technique. Biometrical analysis was carried out on third-summer hybrids. The colour, shape of the body, scales, structure of fins, eyes, mouth, body length, the number of intramuscular bones, body ratios, the form of pharyngeal teeth and gill rakers of the hybrid were examined. The hybrid showed a strong maternal effect in respect of the morphological features with exception of colour, number of vertebrae, profile and head index which showed intermediate inheritance between the parental species. However, in case of the form of pharyngeal teeth and gill rakers, the hybrid showed intermediate inheritance. The F1 hybrid, by the described biometrical features, can be distinguished from the parental species and can be competitors of the cultured fish species in the near future.

INTRODUCTION

Among the edible fishes, the common carp (*Cyprinus carpio* L.) and silver carp (*Hypophthalmichthys molitrix* Vol.) have been the object of most of the studies undertaken so far

on genetic morphological and physiological characters (Kirpichnikov, 1971). Genetic improvement includes a wide range of activity and discipline, most promising of these is hybridization. Hybridization in fish aimed to evolve a hybrid or strain of superior characters and quality to those of the parent species.

Structural differences between the pure line species and its hybrids are commonly detected by measuring morphological and counting meristic characters (Krasznai and Marian, 1982; Beck and Biggers, 1983; Dunkam *et al.*, 1983; Leary *et al.*, 1983; Economidis and Wheeler, 1989).

The intensive hybridization studies proved that common carp and silver carp could be hybridized effectively (Bakos *et al.*, 1978; Essa, 1987 and Zaki *et al.*, 1987). Due to the broad variety of forms received in the hybrid generations, there is the possibility of getting new characteristics, some of which can be valuable from the point of view of fish production. Therefore, in this paper the biometrical features of common carp, silver carp and their F1 hybrids have been investigated.

MATERIAL AND METHODS

The interspecific hybrid of common carp (Mirror carp) females with silver carp males were produced at the Warmwater Fish Hatchery (TEHAG) Szazhalombatta, Hungary. Induced breeding was carried out with the well known techniques described by several authors (Aliev, 1961; Antalfi and Tolg, 1971; Woynarovich and Horvath, 1980). The fingerlings of the hybrids and the parental species-after 30 day nursing period-

were reared in one experimental big earthen pond given the same environmental conditions to all of them, for three summer periods. For investigation of biometrical features, random samples were obtained from the fish harvesting of the experimental pond during September, 1992, which have a body weight of 850 to 3000 grams. The colour, scales, structure of fins, eyes, shape of the body, bonyness (the number of intermuscular bones), body ratios, the form of pharyngeal teeth and gill rakers were examined according to Soliman (1969), Bagenal and Broum (1978). The data of characteristics of the body were measured with slide gauge and compasses. The counting of intermuscular bones was made from a one-side fielt, as well as the counting of vertebrae and the examination of pharyngeal teeth after removing the flesh from the bones. The condition factor has been calculated by using the modified correlation of Hile (1936), which is as follows:

$$CF = \frac{W_{(g)} 100}{L^3 (cm)}$$

The results of the examination are presented as the average of 40-60 examined specimens, emphasizing the minimum-maximum values.

RESULTS

1. Morphological Features of F1 Common Carp Hybrid:

1.1 Colour and shape of the body:

The dominant colour of the hybrid is silverish-leadен, the back is darker and the abdomen is faint. The colour of the

Table (1): Scale forms of common carp, silver carp and common carp x silver carp F1 Hybrid.*

Number of Scales	common carp	silver carp	Hybrid carp
On the lat.line	37(35-39)	112(103-120)	39(37-41)
Above the lat.line	6(4-7)	26(20-30)	6(4-7)
Below the lat.line	6(5-7)	15(13-16)	5(5-7)

* Between brackets are the minimum and maximum values.

Table (2). Fin forms of common carp, silver carp and common carp x silver carp F1 hybrid.*

Number of finrays	common carp	silver carp	Hybrid carp
C.(P.dorsalis) dorsal fin	III-21 (3/19-3/22)	III-2 (3/7-3/8)	III-18 (3/18-3/20)
C.(P.caudalis) caudal fin	32 (27-35)	28 (25-29)	28 (25-30)
A.(P.analis) anal fin	III-6 (3/5-3/6)	III-12 (3/10-3/13)	III-6 (3/6-3/7)
V.(P.ventralis) abdominal fin	I-8 (1/6-1/8)	I-7 (1/6-1/7)	I-7 (1/6-1/9)
F.(P.pectoralis) pectoral fin	I-16 (1/14-1/16)	I-16 (1/15-1/16)	I-16 (1/14-1/18)

* Between brackets are the minimum and maximum values.

hybrid is between that of the parental species.

The body of the hybrid is elongated similar to that of the common carp. The condition factor characterizes the body shape, as it shows the fattness of the fish. When comparing the condition factor of the common carp, silver carp and their F1 hybrids, the following values were found:

Common carp	CF = 2.23 ± 0.05
Silver carp	CF = 1.13 ± 0.02
F1 hybrid	CF = 1.81 ± 0.04

These values also demonstrated that the body shape of the F1 hybrid is close to that of the common carp.

1.2 Scales:

The common carp used for the crossing was mirror carp strain. On the scaly variety of the species, rounded scales can be found which cover each other closely. While in case of silver carp, the small scales cover each other closely, the big rounded scales of the hybrid cover each other not as closely as in case of common carp.

The scale form of F1 hybrid, compared to that of the parental species is shown in Table 1. The number of scales is an important features is distinguishing the parent species from F1 hybrid. The scales of hybrid are similar to those of the common carp and showed a strong maternal effect.

1.3 Structure of fins:

The fin consists of connected finrays; rays taken into account were only those embedded into the muscle and had bony bases. The number of finrays of the parental species and their F1 hybrid is shown in Table 2 (The Roman numbers of the table

show the hard finrays, and Arabic numbers the soft ones).

From the examined cases, the silver carp has the smallest dorsal fin, with the least number of finrays. The length of the dorsal fin of the hybrid as well as the number of its finrays (III-18) are between those of the parental species, but closer to the mother fish common carp.

The silver carp has the longest caudal fin. The caudal fin of the hybrid is similar to that of the father fish silver carp (28 soft rays), while the length of the hybrid caudal fin is intermediate between the two parent species.

The anal fin of silver carp is elongated, the number of its finrays is twice that of the common carp and the hybrid. The anal fin of the hybrid is similar to that of the mother fish common carp, which is proved by the number of its soft finarys (III-6).

There are no differences in the form or in the number of rays of abdominal and pectoral fins of the parent species and hybrid (1-7-8 and I-16, respectively).

1.4 Eyes:

The location of the eyes of the hybrid is similar to that of the common carp, transitional between upper and lower edges of the head. However, the eyes of the silver carp are located more lower.

1.5 Mouth:

The opening of the mouth of the hybrid is terminal, similar to that of the mother fish common carp. In the silver carp, however, the mouth opening is shifted upwards. The two pairs of whiskers of the hybrid are more developed than those

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Table (3). Number of vertebrae of common carp, silver carp and common carp x silver carp F1 hybrid.

Number of vertebrae	common carp	silver carp	Hybrid carp
Dorsal Vertebrae (Mean) (Range)	18.5 (18-21)	20.5 (19-22)	18.9 (16-21)
Caudal Vertebrae (Mean) (Range)	17.9 (16-18)	17.3 (16-18)	17.2 (16-20)
Total Number of (Mean) vertebrae (Range)	35.7 (34-38)	37.8 (37-39)	36.1 (34-38)

Table (4). Characteristic body indices of common carp, silver carp and common carp x silver carp F1 hybrid.

Relative sizes to total length*	common carp		silver carp		Hybrid carp	
	Index	%	Index	%	Index	%
Profil Index L/Tm	2.47	36.40	4.16	24.00	3.02	35.10
Caudal Index L/fh	2.66	37.50	2.17	46.00	2.62	38.10
Head Index L/fe	4.02	24.50	4.68	21.36	4.38	22.80
Width Index L/sz	6.08	16.40	9.41	10.62	6.62	15.10

* Remarks:

L = total length
 fh = length of tail
 sz = width of body

Tm = height of body
 fe = length of head

of the common carp.

1.6 Body length:

The length of the body depends on the spinal column; i.e. on the number of vertebrae and on the typical curve of the spinal column characteristic to each species. The number of vertebrae in the parent species and the F1 hybrid is shown in Table 3. The total number of vertebrae of the hybrid showed intermediate inheritance.

1.7 Bonyness:

The number of fish intermuscular bones (bonyness) is an importance character from the point of view of human consumption. The number of intermuscular bones of the common carp and the hybrid is 83, while silver carp has 116 intermuscular bones. The minimum and maximum values are as follows:

	Minimum	Maximum
Common carp	76	96
Silver carp	106	126
Hybrid carp	60	98

The hybrid showed a strong maternal effect in respect to the number of intermuscular bones.

1.8 Body ratios:

When describing the characteristic ratios of different parts of the body, various indices were used which are shown in Table 4. The profile index of the hybrid showed intermediate inheritance between the parental species. The caudal and width index of the hybrid (2.62 and 6.62, respectively) showed a strong maternal effect. However, in

case of head index the hybrid is similar to that of the father fish, silver carp (4.38 VS 4.68), it means that the head of the hybrid is shorter than that of the common carp.

2. Meristic Features of the Hybrid:

2.1 Form of pharyngeal teeth:

The number and location of pharyngeal teeth perform characteristic marks for distinguishing the species of family Cyprinidae from each other.

The pharyngeal teeth of the common carp are smooth and are located in three rows, their formula being 1.2.3 - 3.1.1. The pharyngeal teeth of F1 hybrid are located generally in two rows, and the most common formula is 2.3- 3.2 and are similar to those of the common carp. Moreover, the following formulae were met with:

1.3-3.1, 1.3-3.2, 1.3-3.1.1 and 1.2-4.2.

2.2 Form of gill rakers

The number of gill rakers of the common carp is 235-240. The gill rakers in case of silver carp are long and provide a fine filter capable of retaining planktonic organisms. The number of gill rakers of the hybrid is 316-324, which is 34.8 percent higher than that of the common carp. The gill arches of the hybrid are similar to those of the common carp.

DISCUSSION AND CONCLUSION

There have been exceedingly few studies on the biometrical features of the interspecific hybrids of common carp and other species belonging to Cyprinidae. Therefore, the biometrical features of common carp, silver carp and their F1 hybrids have been investigated.

The results of the morphological analysis revealed that the hybrid showed a strong maternal effect with exception of colour, number of vertebrae, profile and head index which showed intermediate inheritance between the parental species. Kirpichnikov (1971) has shown that the colour of carp is a character inherited distinctly. According to other authors (Nenashev, 1966; Economidis and Wheeler, 1989), the heritability coefficient of the number of rays and vertebrae is more than 0.55, which means that the values of genotypical effects are higher than those of the environmental effect. The results of the morphological analysis were in most cases in agreement with the findings of Krasznai and Marian (1982). The latter authors came to the conclusion that the morphological traits of the hybrids between grass carp and bighead carp were between those of the parent species, but close to those of the female parents.

The results of the meristic analysis showed that there are considerable variations in formulae of pharyngeal teeth of the common carp X silver carp hybrids, that an average formula cannot be given. This was in good agreement with the findings of Kirpichnikov (1971) who reported that, during the crossing of different strains from common carp, instead of the usual three rows of pharyngeal teeth (1.1.3-3.1.1) there are two or only one row of them (1.3-3.1; 1.3-3 and 3 - 3, respectively). The results of the present study indicate also that the number of gill rakers (branchiospines) of the hybrids showed intermediate inheritance. The results of the meristic analysis, formulae of pharyngeal teeth and gill rakers, are in

good agreement with those of Economidis and Wheeler (1989) who studied the hybrids of *Abramis brama* with *Scardinius erythrophthal* and *Rutilus rutilus*. The latter authors found that the hybrids were intermediate between the parental species for most of the meristic characters.

Thereby, it is evident from the biometrical investigation that F1 hybrid can be distinguished from the parental species, and can be competitor of the cultured fish species in the near future.

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الصفات البيومترية لأسماك المبروك العادى والمبروك الفضى وهجينهما

د. محمد عبد الرازق عيسى

المعهد القومى لعلوم البحار والمصايد بالأنفوشى - قايتباى - الإسكندرية

استهدف هذا البحث دراسة الصفات البيومترية لأسماك المبروك العادى والمبروك الفضى وهجينهما . تم استخدام تكتيك التفريخ الصناعى لإنتاج هجين أنثا المبروك العادى مع ذكور المبروك الفضى . أجريت هذه الدراسة على أسماك ذات عمر ثلاث سنوات حيث درست الصفات الآتية: لون الجسم - شكل الجسم - القشور - تركيب الزعائف - العيون - فتحة الفم - طول الجسم - عدد الأشواك العظمية - نسب ومقاييس الجسم - تركيب وشكل الأسنان البلعومية والأشواك الخيشومية . ولقد أوضحت الدراسة النتائج الآتية:

١- تأثرت الصفات المورفولوجيه للهجين بدرجة كبيرة بالأسماك الأم حيث كانت صفات الهجين تماثل بدرجة كبيرة لصفات أنثا المبروك العادى فيما عدا صفات لون الجسم - عدد الفقرات العظمية - نسب طول الرأس إلى الطول الكلى للجسم وعمق الجسم إلى الطول الكلى للجسم والتي أظهرت نتائج وسط بين الأبوين (الذكور والأنثا) .

٢- بالنسبة لهنتى عدد رشق الأسنان البلعومية والأسنوك الخيشومية فقد أظهر الهجين صفات وسط بين الأبوين •

٣- لقد تبين من دراسة الصفات البيومترية للهجين والأنواع الأبوية من أسماك المبروك العادى والمبروك الفضى إمكانية تمييز الهجين عن الأنواع الأبوية وأيضاً إمكانية منافسة الهجين تحت الدراسة للأنواع السمكية المستخدمة حالياً فى المزارع السمكية
• مستقبلاً