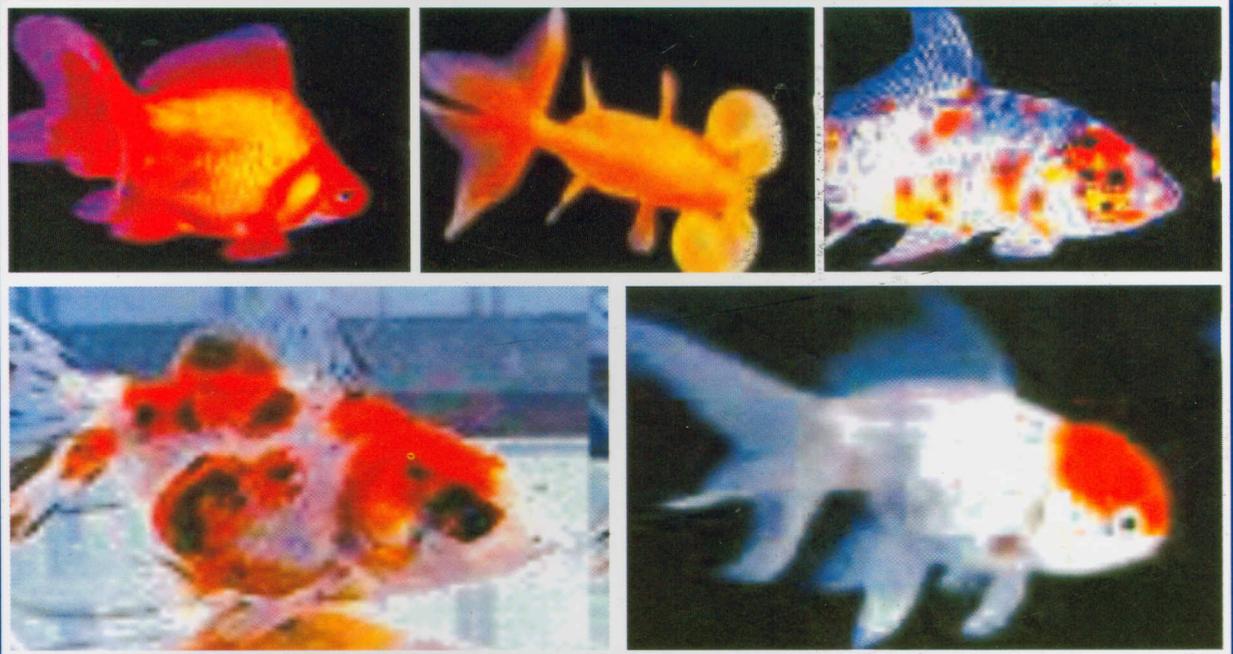


BREEDING OF GOLD FISH



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1. INTRODUCTION

In the recent years, the art of rearing and fish keeping in aquarium has become a passion and major hobby among millions of people around the globe. To many enthusiasts, watching these beautiful creatures swimming gracefully in the aquarium is a pure sense of joy and mental pleasure. It also adds to the aesthetic beauty of a house. The global trade of ornamental fish is about \$ 9 billion dollar of which 85% are freshwater species and the rest are marine species. The ornamental fish is one of the fastest growing sectors in fisheries with an annual growth of over 10% in the world. The domestic growth of ornamental fish trade is also about 20% per annum. There are about 300 freshwater ornamental fish varieties that are available in the market and being traded with different trade names. Among ornamental fish, gold fish (*Carassius auratus*) is considered to be the most popular and attractive pet fish due its many variations such as colour, finnages, tail, shape, size and body structure. Though similar in appearance to carp (*Cyprinus carpio*), gold fish lack barbels and a dark spot at the base of each scale. It is reported to grow up to 20-30 cm. It is the most common aquarium fish and one of the oldest and best known fish. Many aquarium fish keepers

considered that a community aquarium fish tank is not a complete one unless it is having few varieties of gold fish. It was developed in China more than 1000 years ago as a mutant arising from crucian carp. It can tolerate wide water temperature variations ranging from warm waters in tropics to cold waters where surface water freezes to ice during winter. They feed on aquatic plants and small aquatic animals and easily interbreed with carps under normal conditions.

In recent years, due to advances in selective breeding and hybridization, numerous varieties with different colours, varied fin patterns and unbelievable shape and forms such as Coments, Calico, Fantail, Orando, Pyukin, Lion head, Pearl scale, Bubble eye, Telescope, etc., are available in the markets and has great demand both in domestic as well as international markets.

2. THE GOLD FISH VARIETIES

There are more than 100 varieties of gold fish that appeal to a wide range of aquarium fish lovers. All these varieties are originated from same species *Carassius auratus*. Some of the common gold fish are listed as follows:

Common gold fish

This is typically a carp shaped fish with paired pectoral and pelvic fins and single dorsal and caudal fins. The body colours of the fish include metallic, red, orange, yellow, white and black.

London Shubunkin (Nacreous group)

It has exactly the same body, head and finnage as the common gold fish. But it lacks the reflective tissue and metallic shine. The transparent scales allow a multiplicity of colours to be seen. The background colour of the fish is bright blue, interspersed with patches of red, yellow, brown, violet and black, over which there is a black speckling. The colours are even spread into the fins. It is suitable for keeping both in pond and aquarium.

Wakin (Metallic group)

This is the common gold fish of Japan with a similar body shape to the common gold fish, but having short fins. It has a double caudal fins.

Tikin (The peacock tail metallic group)

A very old variety developed from wakin. Apart from the caudal fin, the fins and body are the same as the wakin, although slightly compressed vertically and some are thicker in the belly region. The best ones have a

silver body with red lips and fins but perfect placement of the red colour is very rare.

Ryukin (Metallic group)

The Ryukin is popular with professional fish breeders because of its hardiness, ease of management and the high percentage of good progeny which it produces. It is Japan's second most popular variety of gold fish. The body is short, deep bodied and moderately compressed, often with a pronounced hump at the junction with the head. The fins are longer than those of the wakin, the caudal region is forked and divided into fins, and the anal fins are also paired. This fish is suitable for rearing both in pond and aquarium.

Fan tail

This fish variety is the western version of the Ryukin and found in both normal and telescope-eyed form. The fan tail can best be described as an egg-shaped fish. It is not so deep bodied as the Ryukin and has no trace of hump on its back. This breed is found in a range of colours, including metallic self, variegated and calico.

Demekin

'Kuro Demekin is a velvety black fish due to its excessive melanic pigment. Some tend to turn red with age. 'Aka Demekin' is the red metallic

type.'Sansho Demekin' is the nevarious form. The eye protrudes greatly from the head. The body shape and finnage is very similar to the Ryukin.

Tosakin

Tosakin resembles as that of Ryukin. But the main differences between these two varieties are that the Tosakin has slightly shallower body and shorter fins along with a peculiar caudal fin. The lower lobes of the caudal fin are greatly extended with up-turned outer edges, the fin has the appearance of being reversed and spread out in the direction of the head. This fish variety is suitable for aquarium only.

Comet

The comet is one variety of gold fish which is produced in large numbers. It is readily available in the market, very hardy and fares well both in aquarium and pond. Yellow is the most usual colour of this fish, however, a deep reddish orange is more preferred. In pond environment, it exercises its occasional turn of speed.

Veil tail

This variety is available both in normal and telescope-eyed forms. It is one of the most exquisite and graceful fish among the different gold fish breeds. Its pointed head has no hood growth. The double tail fins of

the veil tail have no indentation between the lobes. This square cut tail and the very high erect dorsal fin are the most characteristic features of this breed. Veils are often very rare as only a small percentage of their progeny develop in to true veil tails.

Moor

It is a telescope-eyed variety. The colour of the fish is velvety black extending to the tips of the fins. The body and finnage of this fish variety is identical to the veil tail in all respects. It is mainly reared by British aquarists.

Oranda

Oranda is a short bodied high-backed fish with long paired fins, a high dorsal fin and a hood growth covering the head. The hood should ideally grow equally in all sections, leaving only the eyes and the mouth exposed. However, the hood development is generally occurred in the cranial region.

Redcap Oranda and Redcap Lion head

The body of the fish is silver in colour and the hood is restricted to the top of the head. The head colour is red and hence, the name. It is suitable for pond or aquarium rearing.

Ranchu

This fish was developed in Japan. It

is a short, round-bodied fish having a broad head covered with a generous head growth. All the fins are short with the double tail fin being attached to the caudal peduncle at a sharp angle. The tail fin is held erect and can be fully divided or partially webbed. The curvature along the back is a smooth arch with a sharp angle downward as it nears the caudal peduncle.

Lion head

It is considered to be the "King of Gold fish". This breed has the largest head growth among all gold fish varieties. A double tail propels the short boxy body. The tail looks like butterfly wings, which is very attractive. The back outline is straighter than found in the Ranchu, but still has a gentle, even curve, which is carried right to the caudal peduncle.

Phoenix

The body of phoenix is midway between the common gold fish and the Ranchu. It also lacks a dorsal fin. The fins are very long with anal fins being paired. The double caudal fin is very deeply forked to give a 'Ribbon-tail' appearance. It is suitable for the community aquarium.

Pearl scale

The pearl scale is another rare variety of gold fish. In this variety, the scale is silver with large red patches. The body is very fat, almost dropsical

in appearance with a deep belly and flattish back. The fins are very similar to those of Fan tail. The main features of this variety are the scales, which are domed. This raised area is usually white in colour and looks like a half pearl pasted to each scale, thus the name pearl scale. The double tail fin is square cut like the vail tail. In the last few years, pearl scale has been seen with oranda head growth, long fins and larger bodies. Pearl scale variety is also found either in red or calico colour.

Pompon

It is a dorsal fin-less breed. It has a short, round boxy body like lion head with short double tail fins. The nasal septum dividing each nostril develops in to a fleshy lobe that resembles like a pompon. Body shape is similar to bubble eye. There are several breeds of gold fish that are called as pompons. Pompon orandas, Lion heads Pompon and Hanafusa (dorsal pompon) are the few examples which are available in the market.

Telescope

The Telescope variety has number of forms and colours. In fact, all fish with protruding eyes are belonging to this particular variety. It is also commercially named as Calico, Plain scale less, Moor and so on.

Celestial

This is a remarkable fish, with a body shape similar to the Chinese Telescope. The body colour of this fish variety is of uniform black or pale orange or a combination of these two in mottled pattern. Most striking feature of this fish is its eye formation, the pupils being situated on top of the eyeballs, so that the fish seems to be gazing heaven-wards, hence, the name celestial. Because of its restricted vision, more care is needed for feeding this fish

Toad head

It is very similar to the celestial gold fish variety. The eyes are normal but below them is a small bladder like growth that gives the face somewhat toad-like appearance, hence called toad head.

Bubble eye

It has fluid-filled sacs beneath the eyes and a growth contoured body without a dorsal fin. The fish with large bubble (fluid-filled sac) is more demanding and fetches more price in the market.

Meteor

This is a strange egg-shaped fish with no caudal fin. The over-development of the other fins- especially the pectoral and anal fins compensate the lack of caudal fin.

Golden orfe

It is a fish of European origin which is becoming more or more popular with fanciers. The Golden orfe is a slender fish, orange-gold on its top side and a paler yellow gold colour on its underbelly. It is extremely graceful as it darts about and is said to be one of the fastest living fish. When reared in outdoor pool, it leaps from the water very often in pursuit of feeding the insect.

3. BIOLOGY OF GOLD FISH

The fish belongs to the family Cyprinidae and the order Cypriniformes. Generally there are two types of gold fishes i.e. fancy and common or normal. The maximum length of fancy type gold fish is about 6 to 8 inches in length where as normal gold fish size may extend up to 14 inches. The oldest gold fish recorded by a hobbyist is stated to be 43 years of age. The general life span of gold fish is 10-12 years. It is an omnivorous fish, which feeds on wide variety of live and prepared feeds. They swim at all levels of the water in the aquarium tank and feeds on both floating and sinking type of feeds. This is very good fish for the community tank due to its compatibility and non-aggressiveness.

4. BREEDING OF GOLD FISH

Water Quality Requirement For The Breeding

Maintenance of water quality is of paramount importance for successful breeding of ornamental fish. The most important water quality parameters to be maintained in hatcheries are: pH, dissolved oxygen, temperature, ammonia, hardness and alkalinity. Some of the important water quality parameters are given below:

Temperature

Temperature sets the pace of metabolism by controlling molecular dynamics (diffusibility, solubility, fluidity) and biochemical reaction rates. The preferable water temperature for growth and culture is 15.5 to 23.6 °C. For breeding purpose, the ideal water temperature ranges between 20 to 23 °C.

Dissolved oxygen

This is an important factor not only for the respiration of ornamental fishes but also for maintenance of water quality. It controls many of the redox reactions and maintains an aerobic condition of water. Generally it is advisable to maintain the dissolved oxygen level at saturation level by providing aeration. Aeration also helps in expelling certain amount of ammonia from the water and in even distribution of temperature. The

preferable dissolved oxygen level for breeding is over 5 to 6 ppm.

pH

pH is a measure of hydrogen ion concentration in water and indicates whether the water is acidic or basic. Water pH affects metabolism and physiological process of fish. pH also exerts considerable influence on toxicity caused by ammonia and hydrogen sulphide. For breeding purposes, the water pH should be between 7.5 to 8.0.

Hardness

Hardness in water is caused by soluble salts of Ca and Mg i.e. bicarbonates, chlorides, sulphates etc. Their concentration is linked with alkalinity and pH. Total hardness in the aquarium should be greater than 40 ppm as CaCO₃. This concentration of hardness helps to protect fish against harmful effects of pH fluctuation and metal ions.

Ammonia

Total ammonia is an important parameter to be cautiously monitored. Gold fish are very much sensitive to unionized ammonia and the optimum range is 0.02-0.05 ppm in the aquarium.

Nitrite

In normal condition, the nitrite concentration of aquarium is negligible, as the aquarium is kept

well oxygenated. Even though it is found, its concentration should be less than 0.01 ppm.

Nitrate

Nitrate is certainly less toxic to fish than either ammonia or nitrite. Nitrate concentration preferably should be less than 20 ppm in aquaria.

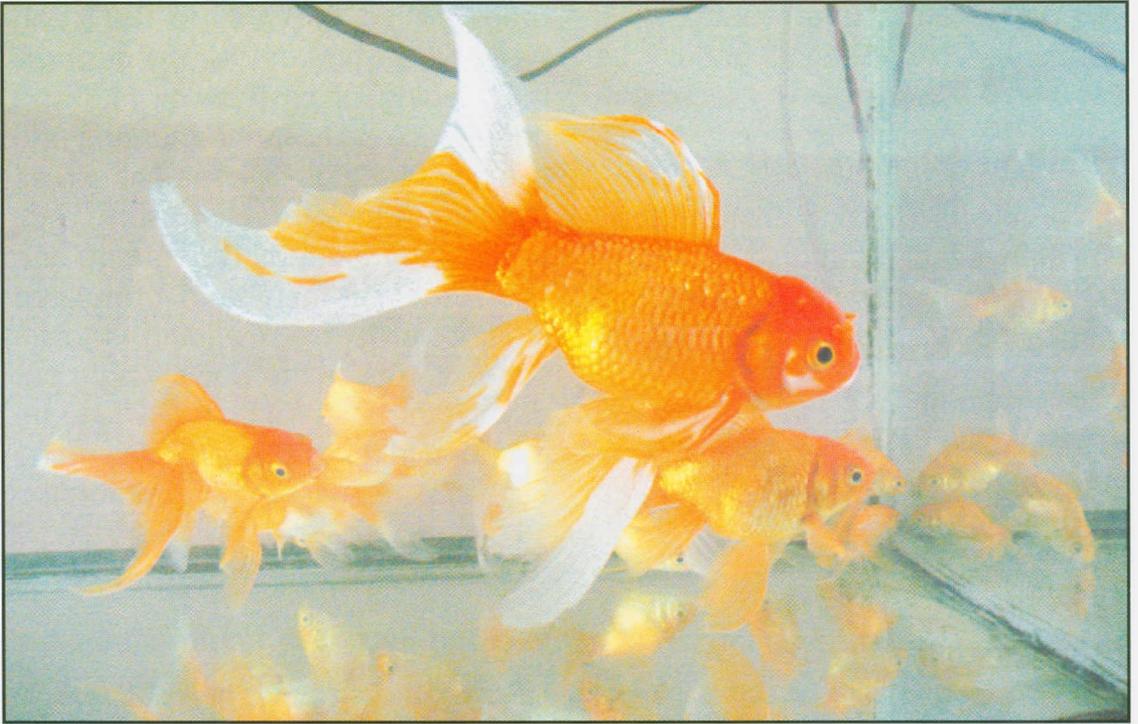
Broodstock development

Fishes of 8 to 15 months of age

ranging in size from 40 to 100 g can be used as broodstock. In general, the feeding of broodstock is being done thrice daily. In the morning and evening feedings, live feeds such as tubifex, earthworm, bloodworm, etc. are recommended. But during the noon time, the feeding of formulated diets is advisable. Feeding is to be done @ 10% of the body weight per day. Of the total ration, 30% is to be provided in the morning and evening each and the rest 40% in afternoon.

Table1. Distinguishing characters of male and female gold fish during breeding season

| Characters | Male | Female |
|-------------------------------------|---|---|
| Tubercles | Appear on head, operculum, pectoral fins and other fins | Do not show breeding tubercles |
| Abdomen | Smaller, slender and firm and may have ridge | Large, fatty, no abdominal ridge and circular in outline. |
| Genital opening | Long, concave and smaller opening | Convex, large and protruding out side |
| 1 st ray of pectoral fin | Thicker edge and more pointed | Thinner edge and round pectoral fin |
| Lead (main) ray of anal fin | Thinner | Thicker |
| General body shape | Thinner, longer and symmetrical from the top | Fatter, shorter and asymmetrical from the top |
| Behaviour | Chase the female | Chased and harassed by male |



Gold fish broodstock development



A healthy gold fish brooder



Outdoor gold fish breeding tank (cement) with egg collector (plastic strip)



Gold fish brooders set for breeding



Indoor egg hatching tank with aeration



Outdoor larval rearing of gold fish



Hatchery produced gold fish fry



Hatchery produced gold fish seed



Adult gold fish



Gold fish ready for sale



Indoor gold fish rearing

Spawning

The distinguishing characters between male and female gold fish are given in Table 1.

During the on set of breeding season, male and female move in a pair, male taking a position below the posterior region of female with its snout nearer to the vent of the female and trunk below the caudal fin. Sometimes the courtship continues for several hours or even days. Then the female releases the egg that is fertilized by the milt released simultaneously by the male. Most of the eggs being sticky in nature, substratum may be provided in the form of soft aquatic weeds, tiles, corals, etc., for settlement and collection of eggs for incubation and hatching. As the parent fish has the habit of eating its own eggs, it is advisable to separate the egg collectors containing eggs into a different incubation and hatching container. Each healthy and matured female releases about 2500-3000 eggs. The gold fish breeds 5-6 times in a year. Fertilized eggs are transparent in colour and unfertilized eggs are cloudy. Fungus grows very quickly on the surface of unfertilized eggs and very often the infection spreads to healthy fertilized eggs too. Therefore, it is advisable to remove the unfertilized eggs as soon as possible once the egg laying is over.

Hatching

Fertilized eggs hatch in 2-4 days depending on water temperature. The incubation and hatching is generally being done in a separate container with the provision of sufficient oxygen. After hatching, the egg collectors are removed carefully so as to avoid mortality of newly hatched larvae.

Larval Rearing

The newly hatched larvae depend upon their yolk sac as food source for a couple of days and they do not require any external food during the time. The larvae start feeding after the yolk sac is absorbed. From the third day onwards up to seventh day of hatching, the mixed green algae are to be fed followed by infusoria for next seven days. In third week, the fry are to be supplemented with boiled egg yolk and micro-worms. From 4th week onwards, *Daphnia*, *Moina* and *Tubifex* are provided till it attains 10-15 mm length. Sometimes cannibalism occurs among the young fish if there is much difference in their growth rates and they are not provided with sufficient food materials. Therefore, only the fish of similar size should be kept together in a nursery tank. Care must be taken to avoid the overcrowding of fish in larval rearing

tank. After one month, the fry can be transferred to grow out outdoor tanks and fed with the prepared pelleted feed containing about 30% crude protein and 4.0 kcal/g gross energy till it attains the marketable size.

5. CONCLUSION

Since time immemorial, gold fish has been one of the most sought after ornamental fish by aquarium fish keepers throughout the world, particularly in tropical countries. Several varieties of gold fish that are available in the market today

originated from the parental stocks developed by the Chinese, Korean and Japanese breeders and have been given different commercial names. In India, the breeding technology of the numerous varieties of gold fish is still remained in its infant stage. Considering the huge demand of gold fish both in domestic as well as international markets, the breeding of several varieties of gold fish needs greater attention. The breeding technology of all the varieties of gold fish is very simple and more or less similar.