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Studies on the mixed fish culture in the aquarium at Tamluk, East Medinipur, West Bengal, India

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Abstract

Human population growth in the world is increasing severely. As a result, many problems are arising dangerously such as food shortage, malnutrition, housing, shrinkage of land resources and many other problems. To supply quality protein to the future generations, animal protein is not sufficient. Fish protein can be replaced the requirement of the animal protein. To produce more fishes in less space is required to solve these burning problems. Those who are bound to live in the flats in the towns or in the cities have no ponds or tanks to grow the fishes. Here, the aquarium fish culture can play a great role to solve these problems. The flat owners can culture easily the mixed fish farming in their aquariums in the drawing rooms with the natural environment. Also it is the best way to control the dangerous and harmful mosquitoes in their rooms. Composite fish culture in the aquarium is the mixed fish farming with the compatible fishes; Khalisa, Nados and Gangetic Koi in one aquarium at a time. The quantitative growth and yield of the fishes in the treated aquarium by the use of feeds and manures were observed in high rate of percentage.

Keywords: Aquarium, Water storage tank, Fingerlings, Feeds, Medicines, Catching net.

Introduction

From the ancient time, it is the custom of the aristocrat rich or the kings to culture the coloured fishes in the tank of the park along with the zoo animals. It is an old fashion till now. Everybody enjoys the pleasure to see the playing of the coloured fishes in the water. Now-a-days many temples, parks and corporate companies maintain the aquarium to give the pleasure to the public. The coloured fishes of the aquarium is called the "Living Jewels" of the environment.

The culture of the ornamental fishes in the aquarium is called the "Aquaculture". That means the ornamental fish farming or culture is the culture of the attractive, colourful fishes of various characters. The fishes are reared in the confined aquatic control systems.

There are 30,000 fish species reported in the world. Out of this, 800 belong to the ornamental fishes. They include 8(eight) families. The increasing demand for aquarium fishes grows the International trade of Rs. 1800 crore per year, whereas India's share is just 20 crores only. The majority of the coloured fish species are available in the North Eastern part of India. Most of the coloured fishes are captured prior to their first maturity and sold in the fish market. There is high demand of the yellowish red coloured Khalisa in the aquarium market (Mitra et al., 2007). The price of Khalisa is as high as supply is less. Khalisa culture is very profitable business. There is a great scope to earn money for the unemployed youths (Panda,2016, Prakash et al., 2018, Chakraborty, 2020). Khalisa fishes control mosquitoes by eating the eggs, larvae, pupas etc. This fish is a friend of human being since long. So we get relief from the attack of the Dengue fever (Oldalin et el., 2017). There are beautiful colour combination on the body of the Khalisa fishes. Three varieties are identified as Red, Chuna and big Khalisa (Islam et al., 2016). In the fish culture of the world, China occupies the first position, India is in the second position (Sarkar et al., 2012). To produce more fishes in lesser space, with mixed fish culture in the aquarium is the only solution. Those persons who lived in the flats in the towns and cities, have no ponds or tanks, they can easily grow the fishes in their aquarium. In a small place like the aquarium, mixed fish farming is the only answer to yield more fishes in short time to supply easily digestible proteins to the next generations (Azad et al., 2004; Mitra et al., 2007, Chakraborti, 2020).

The selection of the fishes is the vital factor as it decides the ultimate fish production (Huet, 1975). The quantitative fish production will be maximum with the herbivorous, omnivorous, zooplankton, phytoplankton eating and detritus feeding fishes (Hora and Pillay, 1962). The composite fish culture is the mixed fish culture with the compatible fishes. More than one type of compatible fishes are cultured simultaneously in one pond at a time without hampering one another (Sinha et al., 1973; Jhingram, 1975; Panda, 2016; Prakash et al., 2018).

Lots of research works are observed in the Composite Fish Culture. But the research work on the Composite Fish Culture with the combination of the Indian originated fishes of Khalisa, Nados and Gangetic Koi Fish are not noticed (Mahapatra and Biswas, 2023(a)).

The fishes of various species can thrive well in much less space once their respiratory and food requirements are met sufficiently. The differences in the feeding habits of certain fishes can be utilised in this mixed fish culture. The proper combination of species in the suitable numbers minimises the inter and intra specific competition allowing the growth of all species to the desired marketable size with proper weight. The differences of the feeding habits of these fishes in different layers of the tank brings the higher yield (Huet, 1975, Mahapatra and Biswas, 2023(a)).

Considering the above mentioned factors, the following three fishes are selected in this project of Research. The fishes are –

1. Khalisa (*Trichogaster fasciata*; Bloch and Schneider, 1801).
2. Nados(*Nandus nandus*; F. Hamilton, 1822), and
3. Gangetic Koi Fish (*Anabas cobojius*, Hamilton, 1822).

The Khalisa fish is surface feeder, Nados is the middle zone feeder and the Gangetic Koi fish is the mud loving bottom feeder (Mahapatra and Biswas, 2023)(a).

Materials and Methods

1. Aquarium
2. Storage Tank
3. Supply Water
4. Pump (for water lifting).
5. Mini Air Blower pump.
6. Electricity
7. Fingerings
8. Feeds
9. Medicines: Lime, $KmnO_4$.

1. Preparation of Aquarium

One glass aquarium was selected for the experiment at Tamluk (Latitude - 22.2858° N, Longitude - 87.9189° E) East Medinipur, West Bengal, India. The depth of the aquarium is preferably about 4ft in height, length is 5ft and breadth is 3 ft. The light must be present on the tank for 12 hours. There should not be any shadow on the aquarium. If there is any shadow on the aquarium, the photosynthesis of blue green, algae, phytoplankton etc. will be hampered. The production of the food materials of the fishes will be disturbed (Jhingram, 1975; Hora and Pillay, 1962). The mother fishes prefer the glass aquarium to give birth their offsprings under the controlled temperature, pH, Oxygen, Light and air as per their demand. They utilises the aquarium as the labour room of the hospital.

2. Supply of Water

A separate storage tank was installed above the aquarium to supply continuous water flow in the aquarium. The sedimented salt of the corporation water will be settled at the bottom of the storage tank. Then the water was passed through the water - filter before supplying to the aquarium. This purified water is good for the health of the aquarium fishes. The water was slightly alkaline which is good for the health of the fishes.

3. Air Blower Pump

An Air Blower pump was installed to blow fresh Oxygen in the aquarium, so that the cultured fishes get sufficient Oxygen in the aquarium. This will boost the growth of the fishes and keeps them away from the invasion of the several diseases.

4. Supply of Electricity

For the supply of the electricity continuously special care should be taken up. There must be ready for the arrangement of the extra Generator/U.P.S/ Inverter, to confirm the continuous supply of the electricity so that the fish culture may not be hampered.

5. Temperature

The temperature of the water of the aquarium should be fixed between 25°C to 35°C.

6. Manuring

One month before the culture of the fishes the manures are applied in the water of the aquarium. In accordance with the decimal of area it was applied as such: Cowdung - 10 Kg, Ground nut cake - 8Kg, Lime - 6 Kg(Where pH of water is 6.5), Single Super Phosphate - 6 Kg, Urea - 2Kg and micronutrients - 500 gm. ,then stagnation of water in the aquarium (Chakraborty et al, 1975b, Sinha, 1979, Mukherjee and Gupta, 1946, Mahapatra and Biswas,2023(b), Swingle and Smith, 1938).

After the 15 days, algae, fungi, bacteria, protozoa, phytoplankton, zooplankton etc. will start to grow in the water. The colour of the water would be changed from the colourless to the light green. Then the aquarium was ready for the fish culture (Chaudhuri, 1971; Mahapatra and Biswas, 2023(b)). The organic and inorganic manure used in this aquarium produces the in-situ microorganisms which will help the three fishes for their better growth (Chakraborty et al, 1975b, Sinha, 1979).

7. Fingerlings

The selected offsprings must be healthy, disease - free vigorous, always jumping up and down and brightened colourin appearance. Fingerlings were purchased from a reputed fish farm of Tamluk,East Medinipur, West Bengal, India.

8. Feeding

After the fingerlings were freed in the water of the aquarium some amount of rice bran powder or protein powder were to be sprinkled on the water surface as a feed. After five days, the formulated feed (Table No. - 1) in the form of small pellets were given on the trays in various corners in the water of the aquarium. The feeds were given twice a day as per requirement of the fingerlings (

Mukherjee et al, 1946; Chakraborty et al,1975b ; Sinha,1979; Mahapatra and Biswas, 2023(b)).

Khalisa, Nados and the Gangetic Koi fish are the eco friendly fishes. Khalisa is the surface dweller. They survives mainly depending on the vegetative (85%) Algae and the decaying organic matter which are the favourite feed of the Khalisa fish (Gupta, 2015; Oldalin et al, 2017). Nados is the middle column dweller. This fish utilises the decaying micro-vegetation, filamentous algae, periphyton, zooplankton etc. This fish is also omnivorous and behaves like a predator also (Das and Moitra,1963; Talwar and Jhingram,1991).

The Koi fish is a bottom dweller, mud loving and hardy fish. It is also an omnivorous. That means, it is herbivorous cum predator also. It consumes the unused feeds and other materials of upper layer fishes of the same aquarium and keeps the water clean (Hora and Pillay,1962; Chakraborty et al,1979; Sarma et al,2010; Pethiyagoda,1991).

Results

The experiment in the Table No. I was conducted on the basis of our own formulation of the feed for the mixed culture of the three fishes: Khalisa, Nados and the Gangetic Koi fish in the aquarium. This feed was used in the powder and pellet forms which were convenient for the consumption of the fishes. The pellets were served to the fishes by keeping these on the hanging trays in the water in the several corners of the aquarium.

Table No. – I : Formulation of feed used for fishes in aquarium Culture.

Sl No.	Items	Amount(gm) %
1.	Dust of Dried Fish	20
2.	Dust of Ground Nut Cake	20
3.	Dust of Rice Bran	15
4.	Dust of Gram	20
5.	Molasses	10
6.	Wheat Flour	4
7.	Gram Powder	4
8.	Salt/NaCl	1
9.	Boiled Rice	4
10.	Micronutrients	2
	Total	100

The results of the Table – II revealed that the ,mean growth during the year 2021-2023 of the Khalisa *(Trichogaster fasciata*) is enhanced in length 23 %, in breadth 18% and in weight 15%. The better performances are observed in Khalisa of the treated fishes with comparision to the fishes of the control.

Table No. – II : Study on the morphology of Khalisa (*Trichogaster fasciata*) by the feed treatment in the aquarium culture during three years (2021-2023).

Year	Length (cm)			Breadth (cm)			Weight (gm)			Others
	Control	Treated	Growth (%)	Control	Treated	Growth (%)	Control	Treated	Growth (%)	
2021	8.5	10.4	22	2.8	3.3	18	16	19	18	
2022	8.4	10.5	25	2.7	3.2	19	15	17	13	
2023	8.6	10.7	24	2.9	3.4	17	14	16	14	
Mean	8.5	10.5	23	2.8	3.3	18	15	17	15	
Growth Rate	23%			18%			15%			44%

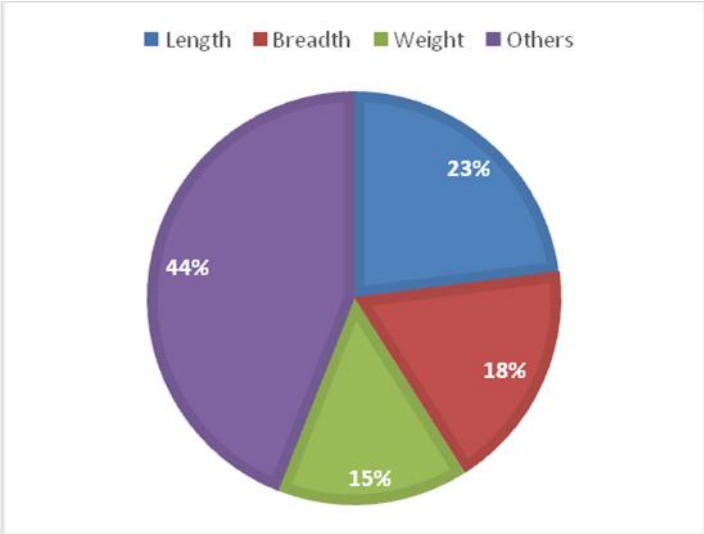

Fig.-1 : Pie chart of the growth percentage(%) of Khalisa fish (*Trichogaster fasciata*) in aquarium Culture technique in the three dimensions : Length, Breadth and Weight.

The results in the Table III demonstrated the difference of the morphological figures of Nados (*Nandus nandus*) fish during the three years from 2021 to 2023 by the feed treatment. The average growth of the Nados (*Nandus nandus*) is enhanced 18 % in length, 13 % in breadth and 22% in Weight. The better performances are noticed in the fishes of the treated aquarium in comparision with the control.

Table No. – III : Study on the morphology of Nadosfish (*N. nandus*) by the feed treatment in aquarium culture during three years (2021-2023).

Year	Length (cm)			Breadth (cm)			Weight (gm)			Others
	Control	Treated	Growth (%)	Control	Treated	Growth (%)	Control	Treated	Growth (%)	
2021	10	12	20	3.5	3.9	11	19	23	22	
2022	12	14	17	3.0	3.4	13	17	21	23	
2023	11	13	18	2.8	3.2	14	18	22	22	
Mean	11	13	18	3.1	3.5	13	18	22	22	
Growth Rate	18%			13%			22%			47%

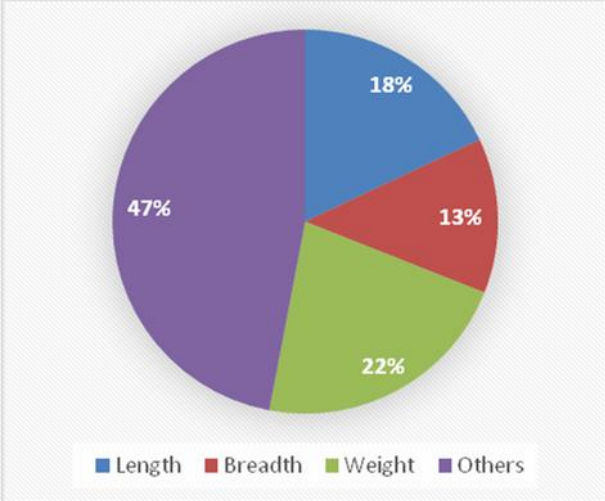

Fig.-2 : Pie chart of the growth of Nados fish (*Nandus nandus*) in aquarium Culture technique in the three dimensions : Length, Breadth and Weight.

The results of the Table IV showed that the differential growth % of the Koi fish (*A. cobojius*) during 2021 to 2023 by the effect of the feed treatment in the aquarium culture. The growth rate percentage of the Koi fish (*Acobojius*) is 17% in length, 14% in breadth and 26%in weight. The better performances are marked in the koi fishes (*A. cobojius*) of the treated Aquarium with comparision to the control aquarium.

Table No. – IV : Study on the morphology of Gangetic Koi Fish (*A. cobojius*) by the feed treatment in aquarium culture during three years (2021-2023).

Year	Length (cm)			Breadth (cm)			Weight (gm)			Others
	Control	Treated	Growth (%)	Control	Treated	Growth (%)	Control	Treated	Growth (%)	
2021	13.9	16.2	16.0	5.4	6.1	13.0	51.9	66.4	28.0	
2022	13.6	15.9	17.0	5.1	5.8	14.0	52.2	66.1	26.0	
2023	13.8	16.1	17.0	5.2	6.0	15.0	53.1	66.2	24.0	
Mean	13.7	16.7	17.0	5.2	6.0	14.0	52.4	66.2	26	
Growth Rate	17%			14%			26%			43%

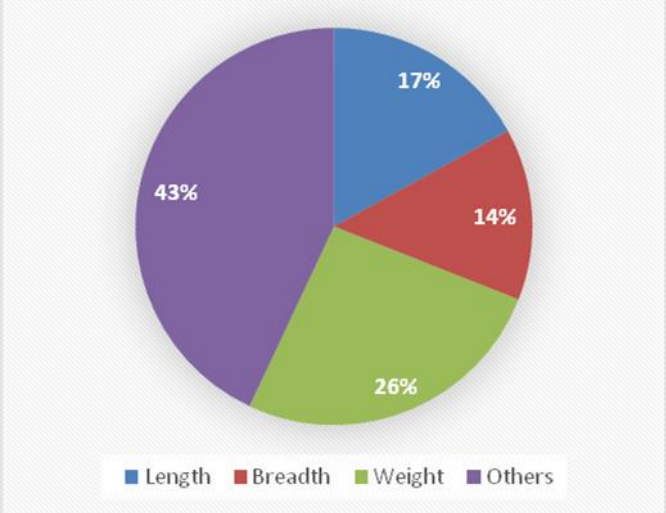

Fig.-3 : Pie chart of the growth of Gangetic Koi Fish (*A cobojius*) in aquarium Culture technique in the three dimensions : Length, Breadth and Weight.

Table No. – V : Study on the productivity of the three fishes by the feed treatment during three successive years (2021-2023) in aquarium culture technique in weight basis.

Fishes	Khalisa (gm)		Nados (gm)		Gangetic Koi (gm)		Total Growth
Year	Control	Cultured	Control	Cultured	Control	Cultured	%
2021	16	18	19	23	31	51	
2022	15	17	18	22	30	49	
2023	14	16	17	21	30	50	
Mean Weight	15	17	18	22	30	50	
Difference per fish	2		4		20		
Growth %	13		22		65		100

In Table no. V, the productivity of the three fishes : Khalisa (*T fasciata*), Nados (*N nandus*), and the Gangetic Koi fishes (*A cobojius*) were evaluated during the year 2021 to 2023 by the feed treatment. The results revealed that growth of all the fishes increased remarkably. The growth percentage is enhanced 13% in Khalisa (*T fasciata),* 22% in Nados (*Nnandus*) and 65% in the Gangetic Koi fish (A *cobojius*). Better performances are noticed in all the three fishes of the treated aquarium culture with comparision to the Control.

Discussion

The tried fishes of the experiment in the aquarium culture, Khalisa (*Tfasciata*), Nados (*N nandus*) and Gangetic Koi Fish (*A cobojius*) are herbivorous cum predator in nature. As a result, they are omnivorous also. The eggs, larvae and pupa of the mosquitoes of the aquarium are the palatable feed of these three fishes. Consequently, people are getting relief from the attack of the poisonous mosquitoes. We are also able to be in safe-side from the attack of the dangerous mosquito borne diseases like Malaria, Dengue, Chikungunia, Encephalitis etc. These three fishes are the friends of the human being since long (Oldalin et al., 2017 , Mahapatra and Biswas, 2023).

Aquarium enhances the beauty of Parks, Museums, Offices, Drawing rooms of the rich and cultured people and in many other places of the society. To culture coloured fishes in the tank or in the aquarium ia an old fashion till now. Everybody enjoys the amusement to observe the playing of thecoloured fishes in the water. It develops the health of the mental strength of everybody with pleasure. The coloured fishes of the aquarium called the " Living Jewels " of the environment. There are beautiful colour combination of the body of the Khalisa fishes. Three varieties are identical: Red, Chuna and Big Khalisa. The male fishes are bright in colour and larger in size. The females are generally whitish green and lesser or short in figure (Mitra et al., 2007, Islam et al., 2016). There is high demand of the yellowish red coloured Khalisa in the aquarium market. As a result, the price of Khalisa fishes is as high as supply is less (Mitra et al., 2007). Lesser land area is required in the aquarium culture in the highly populated country like India (Mitra et al., 2007).

Consequently, Khalisa fish culture is a very profitable fish business. There is a lot of scope to earn more money for the unemployed youths (Panda, 2016; Prakash et al,2018; Chakraborti, 2020). The Khalisa fishes are in the group of " Super Food " due to high nutritious value. This small fishes protect the pregnant and milching mothers from the anaemia disorder. The rural Poor's get the main nutrition from this small fisheslike the Khalisa.

There are various good opportunities in the aquarium fish farming. It requires little space, lesser man power and lesser investment. It can be cultured in the room, in the corridor, on the rooftop even in the backyard of the houses . The house-wives can run the fishery unit smoothly. There is a great scope to improve their social and economic upliftment in the flat culture of the urban towns and cities where fish ponds are not available. There is a great scope to earn more money from the aquarium fish farming from the national cum international markets because the demand of the aquarium fishes are increasing day by day very fastly.

Nados (*N nandus*) is a popular fish in India and in the Indian sub- continent. It has many names (Forese and Pauly, 2016). The Nados is an important food fish as well as aquarium trade fish. They have high market value (Talwar and Jhingram, 1991). This fish inhabits in the streams, rivers, pools, lakes, ponds, canals, swamps, paddy fields and in the reservoir (Rainboth,1996). The natural population of the Nados is declining fatally due to the reckless fishing, habitat destruction, housing for population, pollution and other ecological changes in their territory. Now the Nados fish is going to be extinguish from the world (Mukherjee et al, 2002; Hossain, 2014; Mahapatra and Biswas, 2023(b)). The Nados fishes can be cultured in small tank or in aquarium mixedly with other compatible fishes

like Khalisa and Gangetic Koi Fishes. The male fishes are deeply blackish white and there is one black spot like the tip on the body near the tail. The females are lesser in size and coloured like blackish white with yellowish colour (Das et al., 2002). This fish is a freshwater fish and herbivorous cum predator in nature (Das and Moitra, 1963). The Nados fish is rich in protein, vitamins and minerals. No fat is present in this fish. So the doctor prescribed this fish as a diet for the sick people (Goswami and Dasgupta, 2007; Mahapatra and Biswas, 2023(b)).

The Gangetic Koi Fish (*Acobojius*) is popularly known as Koi. This fish is omnivorous that means it is herbivorous cum predator. Koi fish is mud loving bottom dweller and hardy fish. It can survive long time without water. It has special mechanism in the lung system to get oxygen directly from the air (Mahapatra and Biswas, 2023). It can walk by the help of thorny gill and by the support of the tail in rainy days. It is called " Climbing Perch " . The Koi fish consumes the unused feeds and other materials of the other twoupper layer fishes -Khalisa and Nadosof the same aquarium and keeps the water clean. It can tolerate the adverse conditions of the environment (Hora and Pillay, 1962; Chakraborty et al., 1979; Sarma et al., 2010; Pethiyagoda, 1991).

The Koi fish is rich in iron and copper which are the vital components for the haemoglobin synthesis (Sarma et al., 2010). It also contains an easily digestible poly unsaturated fatty acids (PUFA) and essential amino acids (EAA) (Kohinoor et al.,1991). The Koi fish is also an important diet for the sick and convalescent patients due to its high nutritive value (Saha et al., 2009). The demand of this Koi fish is enhancing among fish farmers for the high commercial trade value. There is a great scope for the better employment of the unemployed people (Panda, 2016).

These Koi fishes are also threatened day by day for the siltation from the deforestation, habitat destruction by the hydropower and dam development, housing, indiscriminate uses of pesticides, ecological degradation and also avaricious fishing pressure (Mahapatra and Biswas, 2023).

Rapid human population growth creates many problems of the society as food shortage, malnutrition, housing, shrinkage of land resources. The global population is assumed to reach 9.6 billion by the year 2050. To provide quality protein to the future generations, Animal protein is not sufficient. So, fish protein is needed inevitable. The demand of the day is to produce more fishes in lesser space. The mixed fish culture in the aquarium is the only way to solve the problem. Those persons who lived in the flats in the towns or in the cities have no ponds to culture the fishes. But they may be easily capable to culture the fishes in their aquariums in the Drawing rooms with the natural beauty to yield more fishes to supply the easily digestible proteins to their next generations. This is also a way to control the dangerous and harmful mosquitoes of the society.

Conclusion

The human population growth of the world is enhancing dangerously. Consequently many problems are also arising such as food shortage, malnutrition, housing, shrinkage of the land resources. To provide the quality protein to the people of the world is not sufficient. Fish protein might be able to replace the animal protein. To produce more fishes in lesser space is the demand of the day to solve these problems. Those people who are compelled to live in the flats in the towns or in the cities have no tanks to grow the fishes.

It is also impossible but the flat owners would be able to culture the mixed fish farming in their own aquariums of the flat with the enjoyment of the natural beauty of the fishes to make up the shortage of the fish protein. Also it is the other way to destroy the poisonous mosquitoes in their dwellings . As a result, people would be capable enough to be in safe side from the invasion of the dangerous mosquito borne diseases like Dengue, Malaria, Chikungunia, Encephalitis, etc. So, this is an eco-friendly compatible mixed fish farming to keep the environment in healthy and wealthy condition for our future generations. Aquarium mixed fish polyculture with Khalisa, Nados and Gangetic Koi fish will strengthen our mental health which will keep the blood pressure and blood sugar level in normal condition by looking up the coloured " Living Jewels" in the aquarium. The aesthetic value of dwellings would be enhanced in many times.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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