

# **EFFECT OF JACKFRUIT ON THE BEHAVIOUR OF GLOFISH**



*Project Submitted to the University of Kerala in Partial Fulfillment of the  
Requirements for the Degree of Bachelor of Science*

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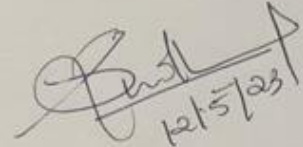
**May - 2023**

## CERTIFICATE

This is to certify that this project entitled "EFFECT OF JACKFRUIT ON THE BEHAVIOUR OF GLOFISH" is an authentic record of the work carried out by Ms. ELSA ANNIE ROY, B.Sc. Zoology (VI semester) student under my supervision and guidance and that no part of this report has been submitted earlier for any other degree or diploma.

  
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Valued by,

1. 

2. 

## **DECLARATION**

I **Ms. ELSA ANNIE ROY**, do hereby declare that this project entitled "**EFFECT OF JACKFRUIT ON THE BEHAVIOUR OF GLOFISH**" is the bonafide work carried out by me under the supervision and guidance of Dr. Sunitha Vijayan, Department of Zoology, Bishop Moore College, Mavelikara for the partial fulfillment of the requirements for the degree of Bachelor of Science and that no part of this project work has been submitted earlier for award by any other degree, diploma or recognition of any university.

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## **INTRODUCTION**

The jackfruit (*Artocarpus heterophyllus*), also known as the jack tree, is a species of tree in the fig, mulberry and breadfruit family (Moraceae). Its origin is in the region between the Western ghats of southern India. The jackfruit is a staple fruit in Asia, where it is an important source of energy, protein, minerals and vitamins. When the fruit is immature, the pulp can be used in several dishes like curries, pickles or cooked as a vegetable. It is a seasonal fruit and easily available. Jackfruit is a large, with a thick, yellow flesh and edible seeds and pods. The flesh has a sweet, distinctive flavor.

Jackfruit is a tropical fruit with various health benefits, including vitamin C and dietary fiber. It belongs to the Moraceae family. It is the largest & edible fruit in the world. Jackfruits have thick yellow flesh or pods inside a green or yellow rough shell. Jackfruit has a mild subtle flavor. This makes it ideal for sweet and savory dishes. There are two varieties of Jackfruit, firm which is crunchier and considered to be of a higher quality and soft, which has small, spongy flakes. Jackfruit is often used as a substitute for pulled meat. Its stringy texture is said to resemble pulled pork. Whole Jackfruit is a source of key nutrients like vitamin C and its seeds are a source of protein, potassium, calcium and iron. It also contains vitamin B, vitamin B6, niacin, riboflavin and folic acid. Jackfruit's rich vitamin C and antioxidant content make Jackfruit beneficial in terms of improving skin health and preventing skin problems such as aging. Vitamin C plays a role in the production of collagen, which makes the skin look plump and smooth.

High amounts of lipids in the blood are the leading cause of coronary heart disease. This is characterised by high levels of bad cholesterol and low levels of good cholesterol and vitamin B6 in Jackfruit may help lower the levels of homocysteine, reducing the risk of heart disease and stroke. High blood pressure can lead to stroke and other heart diseases. Research shows that this fruit contains a huge amount of phytochemicals such as phenolics, tannins, flavonoids, terpenoids, steroids, glycosides, saponins and alkaloids which exhibit antioxidant properties. Jackfruit is a good source of vitamin C, which is a powerful antioxidant that is essential for a healthy immune system. It is also a good source of potassium. It helps to reduce blood pressure. Jackfruit seeds also contain Prebiotics, which can help the growth of beneficial bacteria in the gut. A 2019 review noted that jackfruit contains numerous phytonutrients, which are plant based compounds with

antioxidant properties. They include lignin, isoflavones ,and saponins. In addition, the fruit is rich in fibre, which can help to reduce acid in stomach.

Egg yolks are highly nutritious than egg white. They are the yellow part at the center of an egg. They contain high levels of cholesterol but also provide a range of vital nutrients of health benefits. Eggs are a low cost, nutrient dense food that is easy to access and prepare, making them an excellent dietary staple for many people worldwide. Egg yolks are a plentiful source of many vitamins like Vitamin B-6, Vitamin B-12, Vitamin A and Vitamin E. Egg yolk also contains, Riboflavin Thiamin and Niacin. Egg yolks contain atleast 7 essential minerals, including calcium, iron, sodium magnesium, phosphorus, potassium and zinc . Eggs are also a good source of omega 3 fatty acids, which are beneficial for the health of fish's skin and fins.

Benefits of feeding eggs to fish : Eggs are great source of proteins for fish. Eggs are easy to digest, helps to keep fish healthy and fit, helps to improve the colour of fish, helps to increase the growth rate of fish etc.

Though fish models are increasingly used for biomedical studies, fish have been routinely employed for ecological and physiological studies to examine various behavioural changes to understand the metabolic activities and also the toxicological thresholds of chemicals.

*Gymnocorymbus ternetzi* are one of the first genetically modified animals to become popular within the pet trade. These fish were developed by introducing different fluorescent proteins into the genome of the fish at the early stages of development. The goal of producing fish that had these fluorescent proteins was to improve biomedical and environmental research. It was thought they would be able to detect pollution within the environment. Now these fish are bred specifically for the ornamental fish pet trade. Glofish can live anywhere between 3-8 years under the appropriate husbandry conditions .Glofish get their name from their fluorescent colouration. They come in a variety of fluorescent colours such as red, pink ,orange ,green ,blue and purple. There colours are called starfire Red, Electric Green, Sunburst orange, Cosmic Blue, Galactic purple and Moonrise Pink. Glofish actually come from a number of different fish species.Glofish have been used in numerous scientific studies.

Mature female glofish are rounder and larger than males, while males have more pointed dorsal and anal fins than females. Acidic tap water contains large amount of toxic substances, that affect glofish. Open areas for swimming , a cover is needed since these fishes are jumpers. Fish is more sensitive than other mammals, so slight change in their habitat will be fatal to them. To keep them healthy conditions, we want to maintain the following conditions;

Water Temperatures : 68°F to 78°F

Water PH : 6.0 to 7.0



## **REVIEW OF LITERATURE**

Jackfruit is a tropical fruit. And one of the benefits of jackfruit is its high nutritional value. The seeds and flesh hold a variety of nutrients such as carbohydrates, proteins, vitamins, minerals and phytochemicals. The various parts of jacktree including the fruit, wood and bark have been used intraditional medicine such as antifungal, antimicrobial etc. And for food to many organisms. Their health benefits are, provide instant energy, improve vision, cures anaemia, prevent diabetes, digestion etc. Although it is helpful in many way but also cause sleepiness and harmful to people who have kidney diseases. In its natural sources, jackfruit has been consumed by man through out the world for centuries. Today jackfruit and egg were consumed by billions of people around the world and varied culture practices and even vital for some economics.

Studies by [J ExpBiol (1963)] discussed that observations made on bream, goldfish and dace swimming in the 'Fish Wheel' apparatus are described. These include: An account of the complex changes in curvature of the caudal fin during different phases of the normal locomotory cycle. Measurements of this curvature and of the angles of attack associated with it are given. An account of changes in area of the caudal fin during the cycle of lateral oscillation. Detailed measurements of these changes, which may involve a 30 % increase in height or a 20 % increase in area. The varying speed of transverse movement of the caudal fin under various conditions and the relationship of this to the changes in area and amount of bending. Details of the way this transverse speed may be asymmetrically distributed relative to the axis of progression of the fish. Extent of the lateral propulsive movements in other parts of the body. These are markedly different in the different species studied. Measurements of the wave length of this movement and of the rate of progression of the wave down the body are given. It is concluded that the fish has active control over the speed, the amount of bending and the area of the caudal fin during transverse movement. The bending of the fin and its changes in area are considered to be directed to the end of smoothing out and making more uniform what would otherwise be an intermittent thrust from the oscillating tail region. Some assessment is made of the proportion of the total thrust contributed by the caudal fin. This is found to vary considerably, according to the form of the lateral propulsive movements of the whole body, from a value of 45% for the bream to 84% for the dace.

[W Pfeiffer, G Riegelbauer, G Meier, B Scheibler, 1985] on their Journal of Chemical Ecology 11, 507-523, 1985 discussed about the effect of hypoxanthine oxide and hypoxanthine oxide on Central nervous excitation of the black tetra, *Gymnocorymbus ternetzi*. The change of state in the central nervous system of *Gymnocorymbus ternetzi* after detection of hypoxanthine oxide, hypoxanthine oxide, and of the alarm substance from conspecifics was measured quantitatively by means of the fishes' equilibrium behavior. The fish swam freely in a tiny cage, illuminated horizontally from one side. The change of the angle of inclination of the dorsoventral axis of the fish was registered by means of a video recorder. The recordings were later measured on the monitor in single frames at 0.2-sec intervals where the equilibrium position of the fish could be accurately determined. Various substances were presented to the fish, and their effects upon equilibrium position were recorded. An enhanced optical alertness shown by an increase in the fishes' inclination was generally produced with alarm substance. Without any additional stimulation, the factor U, representing quantitatively the degree of the change of central state, varied slightly within the experimental period of 1 min; however, this factor never exceeded U in control fish. The increase of U usually exceeded considerably the value 1.15 when skin extract from conspecifics or 7–8 µg of hypoxanthine oxide were given. However, when hypoxanthine oxide was presented, U generally did not exceed 1.15. The difference between hypoxanthine oxide and hypoxanthine oxide was highly significant. This result is in accordance with the findings on fish schools of *Danio malabaricus*, where hypoxanthine oxide elicited the fright reaction, but hypoxanthine oxide was ineffective. The results support the hypothesis that the alarm substance from the skin of *Phoxinus phoxinus* identical with hypoxanthine oxide. The results with alarm substance or hypoxanthine oxide did not show any adaptation. This was also true in fish that were stimulated repeatedly at intervals of a couple of minutes only. In *Gymnocorymbus*, which has compensated for removal of the otolith of one utricle, conspecific skin extract triggers the typical postoperative phenomenon, i.e., rotation around the fishes' long axis towards the operated side. Whereas such a decompensation could be elicited by hypoxanthine oxide as well, hypoxanthine oxide had no effect. This finding is interpreted as an effect of the alarm substance and of hypoxanthine oxide on the centers of equilibrium.

[ SSS Sarma, J Amador López-Rómulo, S Nandini Hydrobiologia 510, 207-216, 2003 ] They studied the feeding behaviour during the larval stages (from hatching until 8 weeks) of the Mexican blind fish *Astyanax fasciatus*, black tetra *Gymnocorymbus ternetzi* and angel fish

*Pterophyllum scalare* using four zooplankton species (two rotifers: *Brachionus calyciflorus* and *B. patulus* and two cladocerans: *Daphnia pulex* and *Moina macrocopa*). Components of feeding behaviour (numbers of encounters, attacks, captures, ingestions, rejections and escapes) were quantified for 10 min observation periods per larvae. Data on the increase of the body length and mouth size of the three fish species during this period were also collected. When *B. calyciflorus* was used as prey, *P. scalare* showed higher capture and ingestion rates than *A. fasciatus* or *G. ternetzi*. With reference to age, *B. calyciflorus* was more frequently attacked, captured and ingested by *G. ternetzi* and *P. scalare* than *A. fasciatus* from the first to the 8th week. When offered *B. patulus* as prey, larvae of the three fish species showed increased consumption of *B. patulus* with time. *A. fasciatus* sometimes rejected *B. patulus* which could also escape after being captured. *A. fasciatus* began to attack and ingest *Daphnia pulex* and *Moina macrocopa* from the first week onwards while, *G. ternetzi* could neither capture nor ingest cladocerans until the fifth week. *P. scalare* began to ingest *M. macrocopa* and *D. pulex* from the third week onwards. These results are discussed with reference to the non-functional eyes of larval *A. fasciatus*.

[ Studies by Rupert .J.Egan and Etal(2009) ] Discussed that in their present study, zebrafish behavior was observed and quantified in the novel tank diving test, in which manual phenotypic measurements were reconfirmed using video-tracking technology. Overall, behavioral and physiological endpoints measured in the present study proved to be highly sensitive to environmental and pharmacological challenges.

Zebrafish have proven to be a useful animal model for high-throughput behavioural drug screens [McGown et al., 2016, Rihel et al., 2010]. The temporal trajectories of behavioural responses induced by administration of psychoactive compounds in zebrafish are rarely reported. The time-dependent behavioural interactions between different psychoactive drugs have not been examined. Alcohol and caffeine are widely consumed drugs (Beydoun et al., 2014). Zebrafish have become a popular animal model for behavioural pharmacology due to their small size, rapid development, and amenability to high throughput behavioural drug screens. Furthermore, water-soluble compounds can be administered via immersion of the fish in the drug solution, which provides a non-invasive drug delivery method. Numerous studies have demonstrated stimulant effects of alcohol. Diazepam and caffeine, on the other hand have been found to have inhibitory effect on locomotor activity in zebrafish. However, the time-dependent changes induced by these psychoactive drugs are rarely reported, and potential drug interactions have not been examined in zebrafish, despite the translational

relevance of this question. In the current study, we examine time- and dose-dependent changes in zebrafish following exposure to caffeine, diazepam, and ethanol quantifying four different behavioural parameters over a 30 min recording session. We subsequently analyze potential drug-drug interactions by co-administering the three drugs in different combinations. Our time-course and dose-response analyses for each of the three drugs represent so far the most detailed studies available serving as a foundation for future psychopharmacology experiments with zebrafish. Furthermore, we report significant interactions between the three drugs corroborating findings obtained with rodent models as well as in humans, providing translational relevance for the zebrafish model.

The study about the antidiabetic and antioxidant activity of jackfruit by [ Agung Biworo, Efrilia Tanjung, Khairina Iskander, Eko Suhartono, 2015 ] reveals that, the increase of haemoglobin glycation concentration is followed by increase of jackfruit extract concentration. Also showed that, it contain phytochemical constituent with ascorbic acid is the highest and followed by beta-carotene and lycopene. The result suggest that the jackfruit extract potential as an diabetic agent.

Study conducted by [ Jannatul Hema, M. Ahiduzzaman, Md. Mofazzal Hossain , 2016 ] on development of nutritious dried powder from jackfruit bulb and seed. The research said that, potassium present in jackfruit powder is higher than others. Other minerals found are Na, Ca, Mg, P etc. Result reveal that the sugar content increased with the increase of pulp in mixture. As the powder rich in protein and minerals, it retains nutrient values. It could be preserved for a long period.

[Bruce-Nyamweha,Kalid-Mpiigwa,Tweheyo-Collins, August2017] Feeds contribute the largest percentage of costs in aquaculture production hence making the project more costly and less attractive to the majority of the farmers in Uganda. Therefore need to find out affordable feed alternatives whose raw material is easily obtained in the country. The experiment was conducted at Aquaculture laboratory in Mountains of the Moon University and it evaluated the three (3) kinds of feeds processed from plant materials i.e. chia seed, jackfruit seed and mixed chia and jackfruit seeds processed into pellets. Ugachick feed was used as control since it was what African catfish used to be fed with before experiment. Five (5) grams of each feed were given to adult African catfish daily for the period of one (1) month. The parameters in the study were feed consumption, and water qualities which were measured every two days. Fresh body weight was measured at beginning and end of the

experiment by Soehnle plateau digital scale. Data analysis was done by use of " R " software to perform one way ANOVA to find significant differences in consumption and water qualities. For fresh body weight, a paired T test was performed. The most consumed feed was jack fruit seeds with 7.5 grams by consumed by fish and the least consumed was chia with 3.79 grams in day 14. There significant differences in feed consumption rate among the feeds with  $p < 0.05$  (one way ANOVA). African catfish registered a drop in fresh body weight with all feed tested except chia-jack fruit seeds in which it increased by 1 gram. Chia-jack fruit seeds was the most suitable feed since fresh weight of the fish was fed with, did not drop. Jack fruit seeds is a potential fish feed since it is the most consumed. Experiment was conducted under stressful conditions such as low dissolved oxygen, low temperature and high ammonia therefore need to reexamine the feeds in suitable conditions. There is need to try these feeds with fish fry since their growth is more active than old ones. A feed processed from chia and jack fruit seeds was the most suitable for African catfish since no loss in body weight registered with the fish that consumed it and produces less ammonia. Therefore this necessitates to find out the correct formulation of chia and Jack fruit seeds to produce better quality. Jack fruit seeds are potential feeds for catfish since they were the most acceptable compared to other feeds in the study. Experiment was conducted under stressful conditions such as low dissolved oxygen, low temperature and high ammonia therefore it can be re-conducted under suitable conditions. There is need to try these feeds with fish fry since their growth is more active than adult fish.

[ International Journal of Fisheries and Aquatic Studies 2017, E Prabu, S Felix, N Felix, B Ahilan and P Ruby ] studied on an overview on significance of fish nutrition in aquaculture industry . Their results includes Nutrition and feeding influences the growth, reproduction and health performances of fishes and their response to physiological and environmental stressors and pathogens. Feeding the fishes with nutritionally enriched feeds may dramatically increase the overall production. The production of high quality cum low polluted feeds for cage culture systems may reduce the negative impacts on environment by aquaculture activities. Replacement of fish meal with various plant based ingredients will be a superior way to reduce the cost of the fish feed without changing the nutritional profile. There are several plant based ingredients like soybean meal, rapeseed meal, cottonseed meal, cassava starch, canola meal, corn gluten meal, ipil ipil meal sesame meal, corn starch could be used to replace fishmeal in the fish diet. Though fish convert feed to human food very efficiently, the feeding cost of production needs to be controlled. Fish consume feed for

energy. They use this energy for growth, activity and reproduction. In the fish diet, feeds containing protein, fats and carbohydrates supply energy. These feeds enter the digestive system, where enzymes break down the protein, fats and carbohydrates to simpler compounds that the fish uses for energy and to form tissue, enzymes and bone. Protein in the diet also supplies 10 essential amino acids and fat in the diet supplies essential fatty acids. Fat soluble and water soluble vitamins are also supplied by the diet. Minerals are supplied by the diet and by the water. Feed additives and attractants are added into the fish diets to increase the growth performances, immunity, survival, effective feed utilization and feed acceptance. With the great understanding of the nutritional aspects, it is very much possible to make the feed nutritionally balanced. So that higher growth, best food conversion ratio and less polluting to the environment could be achieved.

[ Zaccone, G.Lauriano ,E.R.Capillo ,G.& Kuciel in 2018 ] In fishes, exploitation of aerial gas exchange has evolved independently many times, involving a variety of air-breathing organs. Indeed, air-breathing occurs in at least 49 known families of fish [ Graham, 1997 ]. Many amphibious vertebrates, at some stage of their development are actually trimodal breathers that use various combinations of respiratory surfaces to breath both water (skin or gill) and air (skin or lung). The present review examines the evolutionary implications of air-breathing organs in fishes and the morphology of the peripheral receptors and the neurotransmitter content of the cells involved in the control of air-breathing. Control of breathing, whether gill ventilation or air-breathing, is influenced by feedback from peripheral or central nervous system receptors that respond to changes in pH. Although the specific chemoreceptors mediating the respiratory reflexes have not been conclusively identified, studies in water-breathing teleosts have implicated the neuroepithelial cells (NECs) existing in gill tissues as the O<sub>2</sub> sensitive chemoreceptors that initiate the cardiorespiratory reflexes in aquatic vertebrates. Some of the air-breathing fishes, such as Protopterus, Polypterus and Amia have been shown to have NECs in the gills and/or lungs, although the role of these receptors and their innervation in the control of breathing is not known. NECs have been also reported in the specialized respiratory epithelia of accessory respiratory organs (ARO's) of some catfish species and in the gill and skin of the mudskipper *Periophthalmodon schlosseri*. Unlike teleosts matching an O<sub>2</sub> oriented ventilation to ambient O<sub>2</sub> levels, lungfishes have central and peripheral H<sup>+</sup> or CO<sub>2</sub> receptors that control the acid-base status of the blood.

Studies conducted by [ Xiangsheng Hong , JinmiaoZha2019] discussed that fish behaviors have great potential as models for the study of pharmacology, genetics, and neuroscience. Zebrafish (*Danio rerio*), Japanese medaka (*Oryzias latipes*) and Chinese rare minnow (*Gobiocypris rarus*) are popular freshwater animal models. However, their behavioral use in aquatic toxicology research is generally hampered by oversimplified behavioral tasks and the fact that they are not well-developed animal models for toxicology. Here, this study presented a comparative analysis of multiple behavioral traits (i.e., anxiety-like behavior, novel object recognition, social preferences, habituation to light-dark stimulus and noise stimulus, and spatial learning and memory). We found that only medaka (d-rR) presented a weak or no response to repeated light-dark stimulus and noise stimulus. In addition, no significant behavioral changes were observed for the three species of juvenile fish models after 7 days of exposure to 0.01% v/v carrier solvents (i.e., ethanol, acetone, and DMSO). In contrast to zebrafish and Chinese rare minnow, medaka showed no significant changes in spatial memory after subacute exposure to 1 mg/L imidacloprid or 2.5 µg/L chlorpyrifos (cpf); instead, a hyperactivity response in the open field test and reduced social time were induced by cpf and imidacloprid, respectively. Our results suggest that: (1) behavioral effects are negligible when using <0.01% v/v carrier solvents for behavioral assessment; (2) given the differences in sensitivities of behavioral responses, a single behavior used alone as an endpoint may be insufficient for estimating the toxic impacts of pesticides or other environmental contaminants. In conclusion, these results could have major implications for aquatic toxicology research and water quality monitoring and ecotoxicological risk assessment.

Studies by [F. Akter and M. A. Haque(2019)] discussed that increasing pressure on the existing resources, there has been a substantial effort for the use of more and more agricultural waste and by-products to value-added products. Using jackfruit wastes and by-products for further exploitation have gained augmented interest because of their high value contents. The current review summarizes the important research efforts and findings on the utilization of jackfruit waste and byproducts to make the information handy. The compiled information in this article would help the cattle feed producers, alternate food manufacturers and future researchers. Commercial production of animal feed using jackfruit peel, perianth and central core can be recommended in Bangladesh, as this country produces huge amount of these wastes every year. The seeds powder can be supplemented with other ingredients in the bakery food formulation.

[ Megan. F Mickle, Christopher.M Harris, Oliver. P Love, Dennis.M Higgs 14 January 2019 ] On their Canadian journal of fisheries and aquatic sciences discussed about the morphological changes in fish of increasing concern about the effect of underwater noise on fish due to rising levels of anthropogenic noise. We performed experiments on the black bullhead (*Ameiurus melas*), a species with known hearing specializations and located within the Laurentian Great Lakes where there is considerable commercial and recreational boat traffic. We tested and compared physiology (baseline cortisol), behaviour (activity, sheltering), and morphology (ciliary bundles of hair cells) of bullhead to boat noise. At 140 dB we saw clear behavioural effects in terms of both activity and sheltering levels despite no obvious morphological or physiological stress. Following both short- and long-period acute exposure to higher — but environmentally relevant — noise levels, bullhead were less active and sheltered more and also exhibited a decrease in ciliary bundles. These results suggest that there are sublethal effects of anthropogenic noise on fish behaviour and ciliary bundles, which may have direct implications on population health. Moreover, commonly used metrics such as stress hormones may not always offer the most relevant biomarker of the response to anthropogenic boat noise.

Guppies show sex and individual differences in the ability to inhibit behavior [07 February 2020, Tyrone Lucon-Xiccato, Angelo Bisazza & Cristiano Bertolucci ].In humans, individual and sex differences have been long reported for several cognitive tasks and are at least in part due to variability in the function that inhibits behaviour (i.e. inhibitory control). Similar evidence of individual and sex differences in inhibitory abilities is also present in other vertebrates, but is scarce outside primates. Experiments on reversal learning, which requires inhibiting behaviours, suggest that this variability may exist in a teleost fish, the guppy, *Poecilia reticulata*. We tested this hypothesis by observing guppies in an inhibitory task. Guppies were exposed to unreachable prey inside a transparent tube for six trials. Guppies showed a marked reduction in the number of attempts to catch the prey within the first trial and also over repeated trials. We found a striking sex difference in the capacity to inhibit foraging behaviour. Males attempted to attack the prey twice as often as females and showed negligible improvement over trials. Irrespective of sex, individuals remarkably differed in their performance, with some guppies being systematically more skilled than others across the repeated trials. These results confirm that individual and sex differences in the ability to inhibit behaviour are not restricted to humans and other primates, suggesting



that they might be widespread among vertebrates. Variability in inhibitory ability provides an explanation for emerging records of variability in other cognitive tasks in fish.

[ Fisheries College, Guangdong Ocean University, Zhanjiang, China 15 December 2021 ] Guangdong Research Center on Reproductive Control and Breeding Technology of Indigenous Valuable Fish Species, Guangdong Ocean University, Zhanjiang, China..etc are conducted studies about Neuroendocrine Regulation of Feeding and Reproduction in Fish. Fish Feed Intake, Feeding Behavior, and the Physiological Response of Apelin to Fasting and Refeeding. Their results shows that ,Generally, appetite-inducing hormones (hunger or orexigenic hormones) serve as hunger signals, causing an increase in feed ingestion. On the other hand, appetiteinhibiting hormones (satiety or anorexigenic hormones) cause a reduction in food intake, thus fasting or starvation does not affect their expression but rather feed intake causes an up-regulation of these appetite-inducing hormones. Thus, appetite-inhibiting hormones in fish demonstrate preprandial decreases and postprandial increases in their concentrations.It has been demonstrated that the peripheral or central orexigenic hormone injections in fish persuade a significantly increase in food consumption rate as indicated in some research studies. Also, experiments demonstrating the acute and or chronic effect of anorexigenic hormone injections on either peripheral tissues or the brain of some fish species revealed that there were significant reductions in food ingestion for a short period in the acute and a long period all through the whole experiment for the chronic injection.

On the study of the phytochemical profiling and antioxidant activities of *Artocarpus heterophyllus* Lam (jackfruit) by [ P 5 Sreeja Devi, Neethu S Kumar, and K.K.Sabu , 2021 ] concluded that jackfruit is a functionlly, nutritionally and medicinally important fruit. It is rich in phtocompounds such as flavonoids, morin, artocarpanone etc. which makes potent antioxidant, anti-inflammatory, antibacterial, antifungal etc.Also benefit to anticancer and anti-aging.

[In 2021, Amrutha Gopan, Syamlal Lalappan, Tincy Varghese, Manas Kumar Maiti, Rohan Maria Peter ] Centurion University of Technology and Management Parlakhemundi, India Central Institute of Fisheries Education Mumbai, India. Fishery Survey of India, Chennai, India are conducted studies based on Anti-Nutritional Factors in Plant-Based Aquafeed Ingredients: Effects on Fish and Amelioration Strategies. Their results includes quest for alternate feed ingredients to replace fish meal and fish oil addressed the need for utilising the plant-derived feed ingredients. Recently more efforts have been made in the field

of utilising non-conventional feed ingredients to minimise the competition from others feeds producing sectors. As the presence of ANFs is the main factor which affects the utilisation of thenon-edible plant seeds in the feed industry, it is the high time to remove it from the ingredient to improve their utilisation. In the case of conventional plant feedstuffs, the presence of anti-nutrients will not lead to mortality at the level they exist. However, it can produce an adverse effect on the fish but varies with different factors such as species, kind, level of the anti-nutrients and the culture systems. Hence, there is a need for a species-specific approach to investigate the effect of plant-derived anti-nutrients before employing effective elimination strategies.

[Sophie Nansereko and John. H. Muyonga,2021] Animal feed According to Ndyomugenyi [126], the food grains produced in most developing countries are mainly intended for human consumption, resulting in a persistent shortage of animal feed. This has spurred a necessary dependence on alternative feeds to sustain livestock feeding. The jackfruit peel is a valuable raw material for cattle feed because it is high in carbohydrates, protein, and fibre [127]. Ndyomugenyi [126] established that jackfruit seeds could be used as energy sources for poultry feeding. However, the study also found that seeds contain anti-nutrients such as triterpenes sterols and, which have to be eliminated before seeds are included in animal diets.

In [Apr-Jun 2021, Leandro Araújo da COSTA Izaura Cirino Nogueira DIÓGENES Marília de Albuquerque OLIVEIRA Sádwa Fernandes RIBEIRO Roselayne Ferro FURTADO Maria do Socorro Rocha BASTOS Maria Aparecida Santiago SILVA Selene Daiha BENEVIDES ]are conducted studies about Smart film of jackfruit seed starch as a potential indicator of fish freshness. Their result shows that Smart films based on jackfruit seed starch with anthocyanins from grape skins added, both co-products from food processing industries, was developed, characterized and evaluated as a potential indicator of fish freshness. The results were found to be interesting from an industrial and commercial point of view, since both the materials used and the color change of the studied films can be adapted to different applications, helping the consumer when buying food. The color change occurred due to the release of TVB-N during the fish deterioration, altering the pH of the products which reacts with the anthocyanin. It was possible to establish a correlation between the color change and the freshness of the tested samples. However, further testing, including modifications of the starch used or polysaccharide blends, or even some type of reinforcement should be performed to verify improvements in mechanical characteristics. Different applications of the

film in other foods and in adverse environmental conditions will favor its applicability as a smart pH-indicating film. One possibility of applying this film would be as a visual indicator in the form of a label indicating the food freshness when inserted into the product packaging.

[ Studies by G. S. Champika Perera and Etal (2022)] discussed that the newly hatched nauplii of *Artemia* is extensively used as a live feed for ornamental fish hatchlings; however, its high cost and unbalanced nutrients necessitate exploring sustainable alternatives. An experiment was conducted to evaluate the effects of four formulated diets of 0%,5%, 10%, and 20% inclusion levels of egg yolk powder and other ingredients (fish meal, soybean meal, rice polish, corn) during the nursery stage of Guppy (*Poecilia reticulata*) compared to *Artemia salina* as a control. Results showed that survival did not differ among the diets. Weight gain, daily weight gain, and specific growth rate of the fry fed with 10% egg yolk-included diet containing 49.6% fish meal and 18.8% soybean meal were significantly higher than those of the other test diets and the *A. salina*. All the diets showed higher stress indexes than the control; the test diets did not affect pigmentation.

Studies by [ Neelam Pathak and Etal(2022) ] discussed that Jackfruit is a potential natural resource for many valuable biomaterials. The wastes from jackfruit are rich in carbohydrate, proteins, fats and phytochemicals. These wastes can be used as feedstock for the development of various bioproducts. The pretreatment strategies like biological, physical and chemical methods are being used for effective valorization of fruit wastes into value added products, like bioethanol, biogas, bioplastics, feeds, functional food additives, and other useful compounds. Bioenergy production from such renewable resources is an eco-friendly and cost-effective alternative option of fuels, unlike fossil fuels. The efficient bioconversion of fruit waste into useful biomaterials is facilitated by microbial fermentation process. Also, jackfruit peel is applied in the pollution abatement by remediation of dyes color from contaminated aquatic environment. Such technology can be used to develop a green economic model for waste utilization. This review addressed the utilization feasibility of jackfruit waste to produce value added products in order to reduce wastes and protect environment in a sustainable way. It can be utilized as animal feed. The jackfruit peel is highly recommended as a valuable raw material for animal feed due to its high levels of carbohydrate, protein, and fiber. The jackfruit waste supplementation improves feed intake and digestibility in ruminant. They researched jackfruit waste as a nutrient-enriched animal feed. Both crude protein and fiber were found to be highest in the jackfruit waste feed that was fermented using a combination of yeast and lactic acid bacteria supplemented with 2%

ammonium sulfate. The dried powdered feed made from jackfruit waste contained moisture, carbohydrates, protein, crude fiber, crude fat, and ash. Jackfruit waste, which includes the peel and axis, has great potential as a ruminant feed.

Study conducted by [Champika Perera, Ram C Bhujel, Salin KR , January 2022] on the varying inclusion levels of the egg yolk powder on growth, stress tolerance and pigmentation of Guppy. He concluded that, weight gain of fish treated with egg yolk powder more than the control. Pigment analysis shows that, similar to control. And the stress index might be high because of the artificial diet due to the nutritional factors.

## **MATERIALS AND METHOD**

### MATERIALS REQUIRED

- Glofish tetras
- Fish globe
- Egg yolk
- Water
- Jackfruit
- Normal fish feed

## **METHODS**

## **1.Selection of fish model**

Due to the attractive colour and easily availability of glofish made the choice for the experiment. About 36 samples of adult healthy male glofish were selected from the nearby petshop with 6-medium sized fish globes having 6 inches each.

Each globe is labelled with the information associated with it,ie, Globe that use high amount of pellets get labelled with high concentration, with 12 number of fish samples and amount of water in 1 litre. Another two fish globes are tagged with low concentration and the remaining two are tagged as control.

6 fishes were deposited in each globe and left to adapt to globe conditions for 1 day, worked in a place where all aerated ,temperature and pressure are well obtained.



Figure 1 : Fish in bowl were tagged with label.

## **2.Preparation of food**

Jackfruit is highly rich in vitamin C and one of the fruit that's have high B vitamins. It is also rich source of potassium. Egg yolk holds more than 90% of calcium, iron, phosphorous, vitamin B6 and vitamin B12. Glofish benefits from foods high in carotenoids and beta carotene.

One cup of jackfruit should be thoroughly washed, cleaned, and steamed for about 15 to 30 minutes and then dried using an oven. And finally made to a powder state. 2 egg is steamed for about 15 minutes and then cooled to taken egg yolk. Egg yolk is smashed and put on an oven to dry. Then made to powder state. It is mixed with jackfruit powder. And the mixture is added with water and made into small pellets for fish food. It is stored in an air tight container to prevent any fungus from affecting it.



Figure 2 : Freshly cutted Jackfruit



Figure 3 : Jackfruit in Oven



Figure 4 : Smashed egg yolk



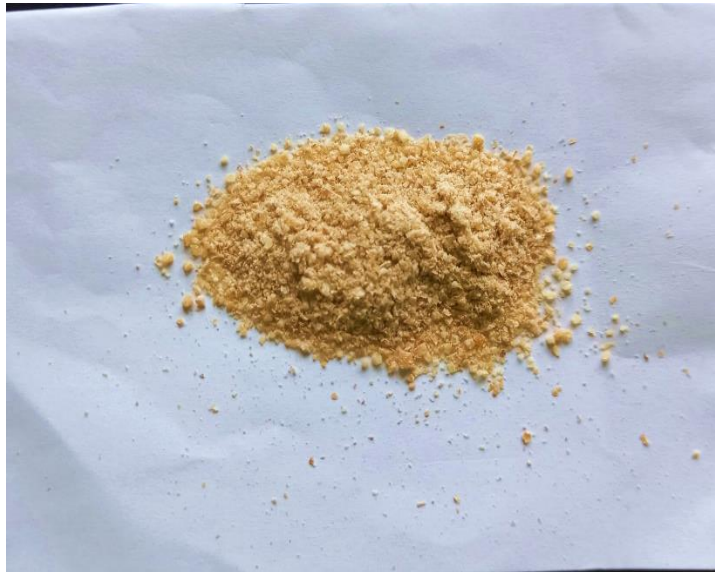


Figure 5 : Mixture of egg yolk and jackfruit.

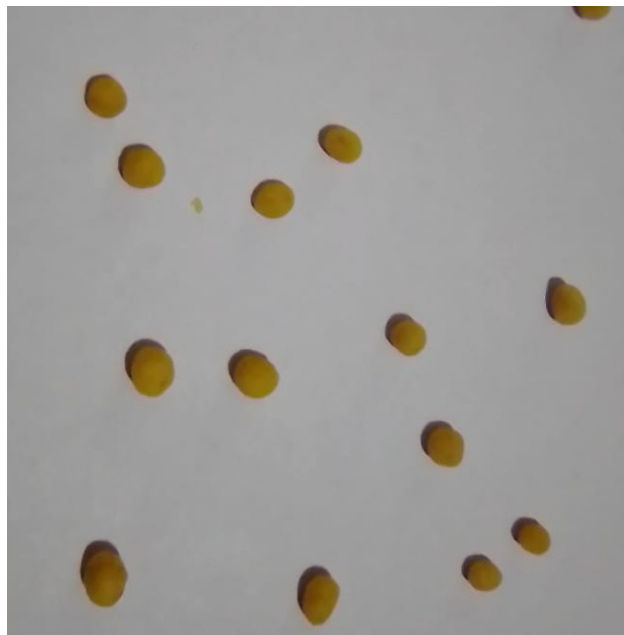


Figure 6 : Jackfruit egg yolk pellet

### **3. Jackfruit- Food measurement**

It was decided to arrange the experiment for a total of 15 days. For these 15 days, it was decided to give 5 gm of total fish food for 6 fish in each globe. The fish food previously stored in the container was taken in 6 sets of 5 gm each and the remaining food was replaced. Then pellet should be measured at 2 different concentration in 2 set of globe. That is 3 gm pellet at high concentration was taken for 5 gm of normal fish food. Low concentration should be 1 gm. All the measurements have been done in a precision weighing scale.



Figure7 : weighing jackfruit, egg yolk mixture.

Therefore, the total fish food measurement calculations can be written as follows, TABLE 1:

	HIGH CONCENTRATION	LOW CONCENTRATION	CONTROL
FISH FOOD (15 DAYS)	5 gm	5 gm	5 gm
FISH FOOD (1 DAY)	0.33 gm	0.33 gm	0.33 gm
JACKFRUIT (15 DAYS)	3 gm	1 gm	
JACKFRUIT (1 DAY)	0.2 gm	0.06 gm	

However, it is difficult to measure food and pellets for each day. So they measured and stored for each concentration, a total of 15 days together.

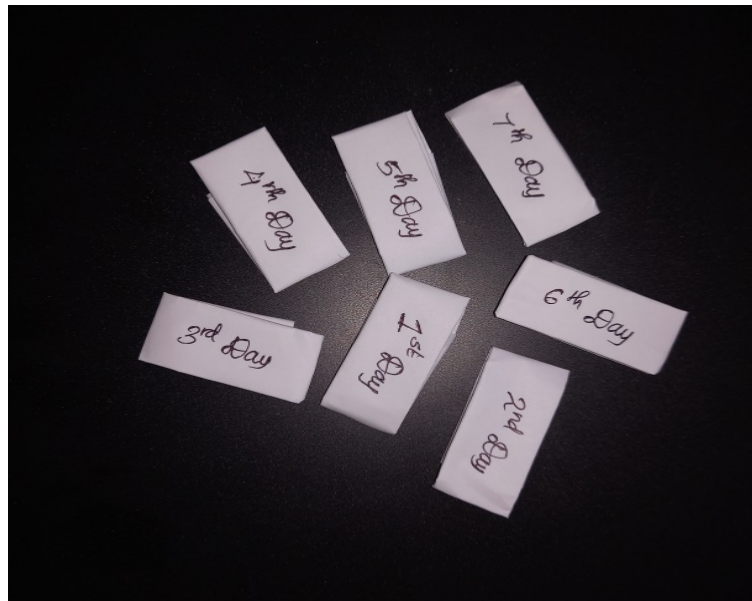


Figure 8 : Food mixture were packed in white papers with their corresponding labelling.

#### **4. Jackfruit - Food mixture to the fish sample**

From the first day of the experiment, the fish are fed at morning around 10am. Food is given only once at the same time every day. The observations on fish are completed in one hour after feeding. Changes in fish samples are monitored one time daily, noon based on these following parameters:-

**Rate of Gill movement** - Gill is the respiratory organ found in aquatic organism. Water enters the mouth and passes through the feathery filaments of the gills. These filaments absorb oxygen into the bloodstream.

**Opercula beat rate** - Opercula is the bony plate that covers the fish's gill. It serves as a water pump each time fish respire operculum moves.

**Atmospheric surface respiration** - Fishes depend on the surface oxygen available at some times. From the ASR rate the oxygen availability in water can be calculated.

**Rate of pectoral fin movement** - Pectoral fins found in pairs on each side, usually just behind the operculum.

**Rate of movement of lower jaw** - It is the bone that moves as the mouth opens and closes. Jaws were used in the buccal pump to pump water across the gill.

**Dorsal and caudal fin movement** - Fish use their back fin called caudal fin to help push them through the water. It is the only fin called tail that connected to the vertebral column and is accelerated by movement. Dorsal fins increase the atrial surface of the body during swimming and there by provide stability. Dorsal fin located on the back, serves to protect the fish against rolling and assist it in sudden turn and stop.

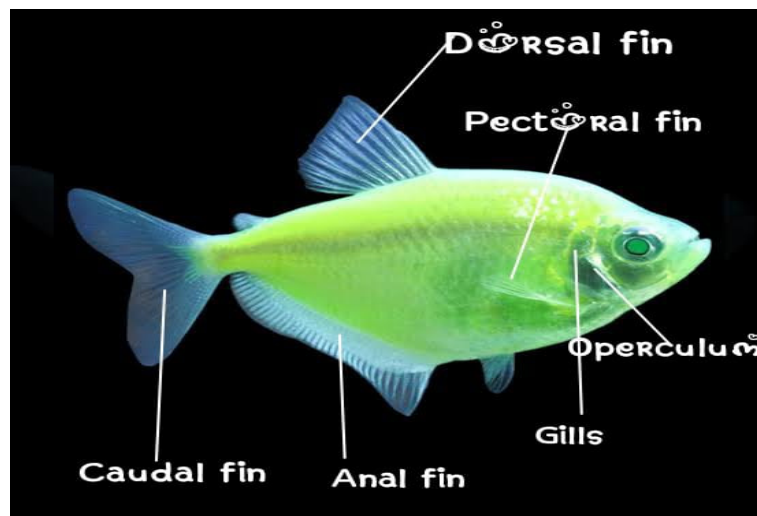


Figure 9 : Labelled diagram of glofish showing the body parts selected as parameters.

## **RESULT**

Fish appeared to be normally active before and after the first day of jackfruit-egg yolk pellet administration. No abnormalities were observed in the feeding of this pellet. The medium of fish is changed 3 days for half an hour before fresh feeding. This is because the medium is already contaminated by evening. So, the water medium of the fish has to be changed. For about 1 to 3 days, the parameters will have the same rating at all concentrations. But, by the end the difference is clear.

In the case of high concentration, all the ratings show a good change from morning to evening. The water medium becomes highly spoiled in the evening time. Because by evening the food and pellet became completely dissolved in the water. The temperature and pressure are lower in the morning and higher in the evening. The fish were seen spending more time at the water surface in the evening. Parameters including rate of gill movement, opercula beat rate, pectoral fin movement and dorsal-caudal fin movement are shown in the tables below.

### **GILL MOVEMENT RATE AND OPERCULA BEAT RATE**

<b>NO.OF THE DAYS</b>	<b>HIGH CONCENTRATION</b>	<b>LOW CONCENTRATION</b>	<b>CONTROL</b>
1	181	190	190
2	185	195	197
3	191	203	202
4	186	201	208
5	197	199	199
6	199	197	197
7	193	193	200
8	201	191	192
9	199	186	195
10	210	180	192
11	203	181	199
12	198	175	193
13	204	173	200
14	210	170	198
15	215	168	192

TABLE 2. Rate of gill movement is same as those of opercula beat and lower jaw movement rate. Here, their feeding of medium increasing towards the end of experiments . Towards the end, rating is increased in high concentration indicating that fish samples were able to survive in the particular medium.

**PECTORAL FIN MOVEMENT RATE**

<b>NO.OF THE DAYS</b>	<b>HIGH CONCENTRATION</b>	<b>LOW CONCENTRATION</b>	<b>CONTROL</b>
1	131	131	121
2	136	139	125
3	141	141	128
4	145	136	124
5	148	135	129
6	149	141	130
7	155	146	128
8	166	140	126
9	168	135	120
10	169	131	135
11	173	142	132
12	177	144	128
13	179	150	125
14	182	148	129
15	185	146	131

TABLE 3. showing the rate of pectoral fin movement in 15 days. By analysing the above readings, it is clear the fish body becoming strong by the experiment.

### **DORSAL AND CAUDAL FIN MOVEMENT RATE**

<b>NO.OF THE DAY</b>	<b>HIGH CONCENTRATION</b>	<b>LOW CONCENTRATION</b>	<b>CONTROL</b>
1	122	111	108
2	128	115	109
3	135	110	110
4	124	117	100
5	131	116	98
6	138	121	95
7	141	128	90
8	142	124	99
9	143	112	100
10	148	118	110
11	151	111	121
12	155	120	97
13	157	125	93
14	159	123	108
15	153	121	103

TABLE 4. Dorsal and caudal fin moves simultaneously as their body moves. Analysing the above readings ,it is clear that the condition of fish samples changes with the passing of the experiment days .

### **GROWTH RATE**

	<b>HIGH CONCENTRATION</b>	<b>LOW CONCENTRATION</b>	<b>CONTROL</b>
1 <sup>st</sup> Day	0.852	0.828	0.952
15 <sup>th</sup> Day	0.894	0.855	0.967

TABLE 5. Shows the difference between growth rate of the 1<sup>st</sup> day and 15<sup>th</sup> day. The growth of fish changes gradually. And shows more growth rate in high concentration compared to other two.

In addition, the fish began to adapt in various concentrations. After some days, upto the 6 days they show no changes that much. But towards the end of the experiment, the changes in each concentration is clearly visible in the data. Fishes in high concentration gets slightly more weight and efficient in movement and feeding mechanism. Fish in low concentration gain weight but less than in high concentration and is similar to controlled.

## **DISCUSSION**

The present study revealed, how the jackfruit feed changes the behaviour of glofish. The observations are done through their physical features and behaviour. Jackfruit is high in antioxidants and vitamin A and also rich source of vitamins B and C, and minerals. The potassium in this tropical fruit could help lower blood pressure, which can help stave off heart disease, stroke, bone loss and skin problems. Under the influence of jackfruit the normal behaviour of Glofish changes significantly. Glofish are one of the first genetically modified animals to become popular within the pet trade. Where it's normal body conditions are changed by the jackfruit feed.

Scientists have discussed the properties of jackfruit in several studies conducted in the same century. There by, all the beneficial properties of jackfruit and jackfruit containing vitamins and minerals are now clear.

Here, we got understand how jackfruit regulates the normal growth of fish in different amount. Glofish were not over eating creatures.

Feeding fish daily with high concentration of jackfruit and food, may increase the stress caused by water contamination in its normal environment. So there is need to change water every 2-3 days. Jackfruit feeding increase the movement and activities of the glofish. Compared to other concentration, high concentration of jackfruit make the fish move active. So the increase in the weight is also here. The same situation occurs with low concentration, but the growth ratio is relatively lower than at high concentration.

Low concentration of jackfruit increases the growth of glofish. *Gymnocorymbus ternetzi*, are never overeating. So there is no need to fed a lot. In control were highlighting only normal feed. Here the growth is also normal.



We did not provide any external source for oxygen in water. So, as the contamination of water increase the amount of oxygen that already in water decrease. Therefore, they are unable to breathe as needed. This also disturbs their peaceful condition in water. So, for their peaceful condition and growth, we need to ensure the presence of oxygen by changing water properly

The value of gill, opercula beat rate and lower jaw movement were found to be the same when viewed by parameters. This is because their movement is always simultaneous. Jackfruit makes its chemical activities in brain by inducing stimulating activities. Accordingly, the movement of fins and overall active appearance become increased.

Thus, from the study, it is clear that, *Gymnocorymbus ternetzi*, the active aquarium fish will favourably affected by jackfruit.

## **CONCLUSION**

From our study, we concluded that the prepared jackfruit -egg yolk pellet increases the activity of the fish, *Gymnocorymbus ternetzi*. Jackfruit contains proteins, fats and egg yolk contains vitamins, minerals and it is a good source of Omega 3 fatty acids whose use can increase the growth and activity of small animals such as fish. As the prepared fish pellet is consumed, their gill movement, OBR(Opercula beat rate), pectoral fin movement and dorsal-caudal fin movement begins to increase. This is because prepared fish feed pellet automatically regulates all metabolic functions in the body.

Fishes in high concentration gain weight and become more efficient in movement and feeding mechanism. In low concentration, fish gain weight but less than in high concentration and is similar to controlled. In high concentration, the gill movement rate and opercula beat rate increase and it decreases in low concentration. In controlled, it remains normal. Pectoral fin movement rate and dorsal - caudal fin movement increases in high concentration and low concentration. In controlled, it remains almost same. Thus, wastes of jackfruit and egg yolk can be used as a food for fishes which increases their activity and growth.

It can be concluded from our study that the jackfruit contains carbohydrates, proteins, fats, phytochemicals. Egg yolk contains vitamins, minerals and it is a good source of Omega 3 fatty acids, which are beneficial for the health of fish's skin and fins.

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