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A Study On Culturing of Infusoria and Analizing Its Growth Performance On Guppies (Poecilia Reticulata)

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Abstract

The life stages of young guppies (Poecilia reticulata) need to be fed nutritionally appropriate live food in order to optimize survival and growth. Infusoria, as a term for microscopic protozoa and other microscopic animals, is the best starter food because of its microscopic size, ease of culture, and high nutritional content. This study was done to culture infusoria on organic media and assess their efficacy as live feed on guppy fry growth performance. Infusoria cultures were set up according to controlled culture protocols, and population density was tracked to ensure regular supply. Infusoria diets alone were fed to newly hatched guppy fry, and their growth performance was quantified based on survival rate, increase in length, and general health throughout the experimental duration. The outcome revealed infusoria-fed fry were significantly better off in survival and development than those deprived of live food during the early stages. The research underlines the importance of infusoria culture as a cost-effective and sustainable live feed in ornamental fish aquaculture, especially for guppy fry rearing success promotion.

Keywords: Infusoria culture, live feed, guppy fry (Poecilia reticulata), ornamental fish culture, fry growth performance, survival rate, aquaculture nutrition.

1. Introduction

The term Infusoria was firstly introduced in the 18th century, “Infusoria" was initially used to refer to the microscopic creatures found in infusions of plants and animals. As microscopy, taxonomy knowledge, and molecular biology have advanced throughout time, the classification of infusoria has changed in several ways. Initial Thoughts (17th–18th Century) Using crude microscopes, Anton van Leeuwenhoek initially reported protozoa (including ciliate-like creatures) found in pond water (Leeuwenhoek, 1677).
Infusoria are single-celled microscopic aquatic organisms, mostly classified under the kingdom Protista. They are commonly found in organic- rich freshwater environments that cloudiness appeared in water when plant or animal matter, such as banana peels was soaked this process is known as infusion. Infusoria primarily consists of represent a diverse group including protozoa such as ciliates e.g., *paramecium*, stentor and flagellates. These organisms play a crucial role in freshwater ecosystems, especially in aquaculture, where they serve as a vital live food source for fish fry during their early developmental stages. Inaquaculture methods especially for ornamental fish larval rearing,infusoria are often cultivated to provide essential nutritious and easily digestibility food source. They are preferred by fish breeders

because of small size is typically 25 to 300 micrometres, which makes them ideal for newly hatched fish that cannot consume largeparticles. Infusoria is a collective for minute aquatic creatures such as ciliates, euglenoids, protozoa and unicellular algae and small invertebrates that exist in freshwater ponds. The term of infusoria is often used to include all forms of microscopic in animal and plants. The term is considered as formal classification in microorganisms it has single cell protozoan is belonging to family ciliate and grown in green water. There are about 2000-3000 species of infusoria protozoans which includeparamecium, Spirostomum, volvox,vorticella. Infusoria can be cultured easily cultured by soaking organic materials such as dried leaves, banana peels, or hay in freshwater. These materials decompose and release nutrients to promoting the growth of bacteria, which in turn serve as food for infusoria. This infusion becomes rich in microbial life within a few days and its making to suitable for feeding fish fry. The movement of live infusoria in water to stimulates the natural feeding insects of fish larvae to enhancing survival growth and overall health. Theirpresence maintains microbial balance in aquaculture systems.

AIM: A study on culturing of infusoria and analzing its growthperformance on guppies *(Poecilia reticulata)* during their early developmental stages.

OBJECTIVES:

- To set up the culture media for infusoria.
- Culture Infusoria using simple organic matter.
- To provide suitable live feed for hatched guppies fish fry.
- To evaluate the effect of Infusoria on fry survival and growth.
- To determine the suitability of infusoria as primary live feed for the early stage of guppies' fry.

METHODOLOGY

CULTURE TECHNIQUES OF FRESHWATER INFUSORIA

As per (Beer ,1928) Most natural spring water is suitable for Infusoria culture, but it is not ideal water (Das et.,2012; Anuraj et al.,2015).

- Infusoria culture by using the banana peelings
- Infusoria culture by using the banana peelings.
- For the use of a clean petri dish and add 1 litre of tap water or dechlorinated water.
- Infusoria starter of mature aquarium water to add 200ml of culture.
- After adding one piece of banana peel.
- Jar should be covered with muslin or loose thread for allowance of gaseous exchange for prevention of insects.
- Temperature up to 22-28ºC is suitable for the incubation for pattern of infusoria and placed in diffused light and not in direct sun and light to stimulate microorganism and growth avoiding overheating.
- container should be kept in cool place where natural light is available.
- Within 2-3 days the water surface becomes milky white in nature and odoriferous.

- The smell occurs following the multiplication of an enormous no of bacteria resulting rotting of banana peels.
- This forms the slime layer film on the surface of the water.
- Within 3-4 days the slim layer formed on the water surface will be bursting.
- Within 4-5 days the water is clear with light yellowish colour.
- The infusoria spores suspended in the air dropped on the surface of the water and dispart.
- The infusoria are now ready to be feed to early guppy fry stages

DESCRIPTION OF INFUSORIA

Infusoria are tiny, microscopic aquatic organisms commonly found in freshwater environments rich in organic matter. They are primarily protozoa and serve as a natural food source for small aquatic animals like fish fry.

Size: infusoria is a small a quiet and they are typically measures between 100 to 300 micrometres in length.
Shape: Generally, infusoria are oval or slipper shaped and through their shape can vary slightly depending on the species.
Surface: It's used for movement and feeding their body is covered with longitudinal rows of numerous tiny cilia is hairlike structure.
Cilia: In appearance are slightly hair and enabling to move in a coordinated ins spiral motion of these cilia are evenly distributed to over surface of the cell.
Habitat: It's found in stagnant freshwater bodies especially in organic rich environments.
Feeding: They infusoria consume bacteria, Lage and organic detritus.
Reproduction: The mostly reproduces asexually through binary fission in some can also sexually reproduce.
Oral Groove: It capturing their food using the cilia to help funnel the particles on one side of the cell is their depression is knowns as the oral groove.

NUTRITIONAL COMPOSITIONS

Infusoria is a widely variety of nutritional rich encompass of making ideal for fish.

Table1:

Components of Weight	**Approximate value**
Protein	58%
Fat	32%
Ash	3%
Caloric value	6.6kcal/g
Moisture content	80-90%

Essential amino acids: Infusoria is rich essential amino acids are lysine, arginine and these are critical protein synthesis.

Fatty acids: It contains polyunsaturated fatty (PUFA) like omega-3 and omega-6.
Vitamins: It provide antioxidants such as vitamin C is enriched for ascorbic acid to enhances for immunity and stress resistance.
Vitamin B complex supports to metabolic activity.
Minerals: Calcium and phosphorus are important for skeletal development.
Iron and magnesium are a formation of vital blood for enzyme function.

Enrichment potential of Infusoria

Infusoria an great carrier of vital nutrients in aquaculture systems can bioencapsulated with nutrients such as Highly unsaturated fatty acids (HUFA) are essential for brain and eye is development n fish larvae. They can also be enriched vitamins such as vitamins C is boosts immunity and improves overall fry health. Aquatic organisms are improving in gut health in natural probiotic delivery systems. Infusoria are not only a natural live feed but also perform as an efficient nutritional delivery vehicle for early- stage fish and aquatic larvae.

Biological characteristics of Infusoria

Infusoria a collective term for microscopic aquatic protozoans is possess many differences in biological characteristics that highly suitable for use in aquaculture especially as a live feed for newly hatched fish fry.

Diversity: Infusoria a wide variety of species such as paramecium, Euplotes, stentor, colpoda and vorticella are these organisms tiny in size, shape, locomotion and feeding habitats an ecologically diverse group. This diversity insures a balanced and flexible live feed for different types of aquatic larvae.

Microscopic size: Most Infusoria range in size from 50 to 300 microns is ideal for intake by newly hatched fry and small fish. Their small size of ingestion to easy digestion by larvae with tiny mouth.

Reproduction: Infusoria primarily reproduce through binary fission a type of asexual reproduction under optimal condition are often doubling their population within a few hours confirm a continuous to food source for larval fish.

Environment: Infusoria are sensitive environmental factors such as temperature, pH, oxygen levels and light. They thrive in slightly acidic to neutral PH (6.5-7.5) is moderate temperature (22-28ºC) and oxygenated water is monitoring these factors confirm stable culture

Feeding Behaviour: Infusoria feed on bacteria, algae and organic debris present in the water an important part of microbial loop in aquatic ecosystems to helping excess organic matter and preventing bacterial overgrowth.

Adaptability: Infusoria culture media to adapt various and environmental condition. They can survive in both natural and artificial environments in suitable to controlled aquariums.

Benefits of these strategies

Infusoria is an aquatic microscopic organism as food sources for newly hatched fish fry or tiny aquatic larvae. These cultured requires maintaining health and survival supports fry without damaging water quality. To effective optimal condition culture and harvesting smoothly maintain production to preventing contamination of common issues like nutrients reduction.

Cost-Effectiveness: Infusoria cultured uses is low cost and household items like banana peel, jars these are commercial for live foods.

Reliability: These cultured carefully harvesting to supply food for delicate fry.

Fry survival: It provide rich nutrients and survival rates increasing growth due to small size organisms overtaken in proper feeding.

Flexibility: The larger breeding process for hobbyists for small.

Table2: "Factors that influences the growth rate of Infusoria culture" maintaining an optimal range of PH temperature and DO:

S NO	parameters	Methods	Obtained Range	Maintained Range
1	pH	pH indicator	6.5-8.0	6.8-7.5
2	Dissolved oxygen	Winkler' s aizde method	3-5mg/L	4-5mg/L
3	Temperature	Electrometric method	25ºC to 29ºC	26ºC-28ºC

pH (indicators)

pH levels tested in the infusoria culture is ranges in this research is typically ranging from6.8 to 7.5. such as range is where infusoria culture grow and multiply.PH condition beyond that range can affect growth and overall health. A stabilized Ph condition would thus be crucial in properly controlling cultures. pH monitoring and control are needed to create culture optimal conditions in cultures. The pH of infusoria culture medium has significantly bearing as the environmental condition to influence growth, activity and survival in microorganisms. In this current culture pH was monitored daily using both strips for rapid estimation and calibrated for digital pH meter for precise measurements. The pH range observed during the entire culture ranged from period 6.5 to 8.0. The initial decreases in pH usually are noted in the initial days, because decomposition and fermentation of banana peel as an organic acid that temporarily reduces. This process releases organic acids that temporarily reduce the pH of the water and its formation a little in acidic environments.

Temperature (Electrometric method)

The ideal temperature for infusoria cultivation is usuallybetweenranges 26ºC to 28ºC. In this temperature range, the metabolic rate and reproduction rate of microorganism in infusoria culture remain optimally maintained. Changes in natural conditions as reflected in higher temperature result in a small increase in temperature growth of cultured infusoria. Temperature outside the range can retard its metabolism that can harm its health and reduces total productivity. Having a constant temperature at this optimal range is a necessary condition for the health and efficiency of infusoria culture.

Discovered oxygen (Winkler'sazide method)

For culturing infusoria, Oxygen discovered (winter azidemethod) the optimal dissolved oxygen (DO) level infusoria the production, maximum respiration and survival rate of microbes in infusoria. In initial stages of fermentation, the protozoans and microbial bacteria resulted in rising oxygen levels reducing the DO. As cultured microbial community aged, DO increased in infusoria. Optimum aeration is ensured at the levels of oxygen as this continuous to preserve a healthy productive culture environment.

Using infusoria as a feed source for guppies

Using infusoria as a feed source for guppies has several implications for their health & well-being. Infusoria culture serves as an excellent natural food for newly hatched guppy fry, which are too small consume in traditional fish food. Infusoria is high nutritional value essential for the early development of fry. Infusoria being tiny & soft bodied are perfectly sized for digestibility & energy costs-various food sources, which may inform optimal feeding strategies for guppies. Infusoria are rich in protein, lipids & micronutrients required for the cellular growth of fish fry. Their small size is ranging from 50 to 300 microns makes them highly bioavailable & easily digestible for newly hatched guppies. They also help in establishing a balanced gut microbiome in fry, which is important for digestion & immunity development. Infusoria culture requires expensive inputs are common banana peel can used making it as cost-effective & eco-friendly method. This is especially beneficial for small scale & beginner aquarists conducting research with limited resources.

Initial fry stage & weight observation

Fig1: Checking guppy fry weight

At the start of newly hatched guppy fry is experimental period were observed to have initial body weight of 0.09 grams. This stage in development early of fry as their nutritional requirements are high. Proper feeding during this period with live feed is easily digestibility food like infusoria its supporting growth, enhancing immunity & improving survival rates. It's evaluating the feeding strategies use of infusoria as a natural live food source.

Result

"Using infusoria itis including paramecium& other protozoans as a food source for guppies fry did not cause any deaths during the study indicating it is safe and does not negatively harm the overall health & well-being of guppies fry".

Infusoria culture exhibited robust growth under optimal conditions of PH (6.8-7.5) temperature (26-28^{o} C), and dissolved oxygen (4-5 mg/l). growth rates of infusoria were highest when these conditions were maintained consistently. Guppy fry feed with infusoria a showed improved survival rates & faster growth in both length & weight & highs activity levels compared to fry feed with powdered the results confirm that infusoria are highly efficient & nutritious live food source for guppy fry it providing a practical alternative or supplement to commercial starter feed. Infusoria cultures is proper management of crucial for maximizing their benefits as a food source. Maintaining stable environmental parameters & harvesting cultures at a peak density to ensures high nutritional value & feeding effectiveness of infusoria in feeding experiments. Using infusoria as a high-quality food source for guppy fry is highlights the importance of maintaining optimal culture conditions to support culture density &fry health regular restarting of culture every 1-2 weeks to prevented excellent & nutrient depletion to ensuring a healthy & dense infusoria population. Cultures were largely free from contamination due to reflection culture methods, although occasional contamination to required corrective actions, such as re-inoculating with fresh media. The improved growth rates of guppy fry fed infusoria to suggest that they provide high nutritional value, possibly due to their rich protein, lipid content & balanced micronutrients. This aligns with studies indicating that live microfauna such as infusoria are among the best starter nutritious food source for small aquatic organisms. The superior growth in the infusoria fed group compared to the control group indicates infusoria more efficiently & absorbed guppy fry its digestibility leading to better utilization nutrients early to improve development in early stage. The Infusoria culture experiment yielded a highly diverse aquatic community containing like Protozoa, Rotifers, Crustaceans, Aquatic worms, Insect larvae and Nematodes. The diversity indicated that organic substrate of banana peel and aquarium water provides suitable nutrients levels for multi-trophic development. Cultured infusoria during the experimental period guppy fry fed is better growth, survival and activity compared to the control group liquid fed.

The infusoria fed to fry increasing in both length and weight, particularly during the first weeks when their mouths were too small to productively consume larger particles of dry feed. Infusoria fed survival rates were also higher (96%) compared to the control (84%), it's indicating that infusoria provided a suitable and digestible live food source during early -stage development. The treatment appeared fry active more and displayed brighter coloration to propose improved overall health.

These observation of infusoria cultured under optimal water quality conditions such as temperature, PH, dissolved oxygen to serve as an effective to starter feed is significantly enhancing the growth and survival of guppy fry

Observation of Infusoria

Infusoria are observed under microscopic examination as minute, single -celled microorganisms are free living aquatic microscopic organisms primarily ciliates, flagellates and metazoans are characterized by motile cilia or flagella, visible internal vacuoles and complex feeding mechanisms typically inhabiting decomposing organic infusion in freshwater.

Paramecium

Fig2: Paramecium

This image show paramecium is a genus of unicellular, ciliated protozoa commonly found in freshwater environments, particularly those rich in decaying organic matter. They characteristics include in cilia, shape, nutrition, reproduction. The slipper- like shape and the presence of thousands of cilia covering their body, which they use covering their body, which they use for movement and feeding

Aquatic Oligochaeta Worm

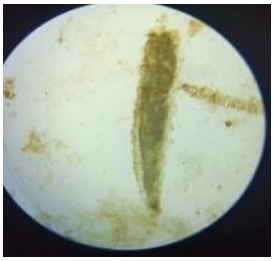


Fig3: Aquatic Oligochaeta worm

Aquatic Oligochaeta Worms are small and often found in fresh water orsemi- terrestrial environments. They characteristics are segmented bodies like annelids, as they have segmented bodies with repeating units have few setae compared to polychaetes, they have a reduced number of bristles. The parapodia are absence in lack of paired lobed appendages many use for locomotion in polychaetes. Many aquatic oligochaetes have a clitellum; a thickened band used in reproduction

Daphnia magna

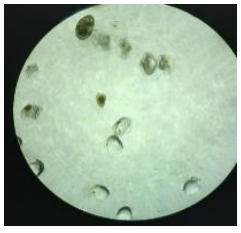


Fig4: Daphniamagna

The image appears to show Daphnia embryos or larvae, specially resembling those of water flea. The distinct transparent and oval- shaped structures are consistent with the early development stages of theses.Daphina are a genus of small planktonic crustaceans often referred to as water fleas due to their

characteristics swimming style. They habitat are commonly found in various freshwater environments are crucial role in aquatic ecosystems as a food source for organisms

CyclopsStrenuss

Fig5: Cyclostrenuss

The image like show cyclops sternums is a common freshwater copepod belonging to subclass copepoda. They are small planktonic crustaceans, usually less than 2mm in size. Cyclops due to their single median eye. It acts as primary consumers in freshwater food chains, feeding on algae and protozoa. Serve as feed for fish fry and other aquatic organism. In aquaculture cyclops species are considered valuable as live feed for fish fry.

Tubifex

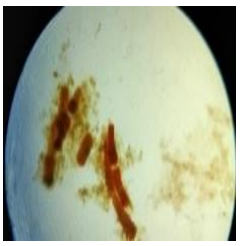


Fig6: Tubifex

The image appears to show Tubifex also known as sludge worm. Tubifex is a species of segmented worm its belonging to the family Tubificidae. The image appears to show red-coloured filamentous structure likely a type of algae or microorganism it could potentially be a species of red algae or a similar microorganism that exhibits such as identification involves analysing the morphological characteristics of specimen can include shape, colour, size and internal structures.

Caddisfly pupa

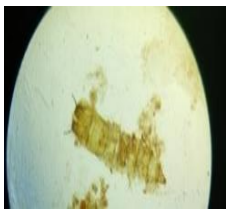


Fig7: Caddishfly pupa

The image appears to be caddisfly undergoes complete metamorphosis progressing through egg, larval, pupa and adult stages. The pupal stage in an aquatic phase where the insects develop within a protective case or cocoon often constructed by the larva. During this stage, the pupa develops the features of the adult caddisfly before emerging from the water as a winged adult

Planarian

Fig8: Planarian

This appears to be a planarian is a type of free- living flatworm they are fascinating organism especially famous for their remarkable regenerative abilities is a tiny fragment of their body can regrow into a complete organism. They features are body structure, nervous system, digestive system, reproduction, habitat.

Springtail

Fig9: Springtail

The image appears to Springtails (Sminthurusviridis) are tiny arthropods of the order Collembola and family Sminthuridae. They live in moist and decaying organic matter. Due to their small size, soft bodies and high protein content, they are used as live feed as fry, especially during early growth stages.

Rotifer

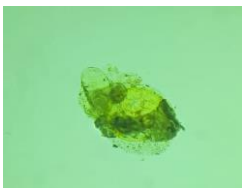
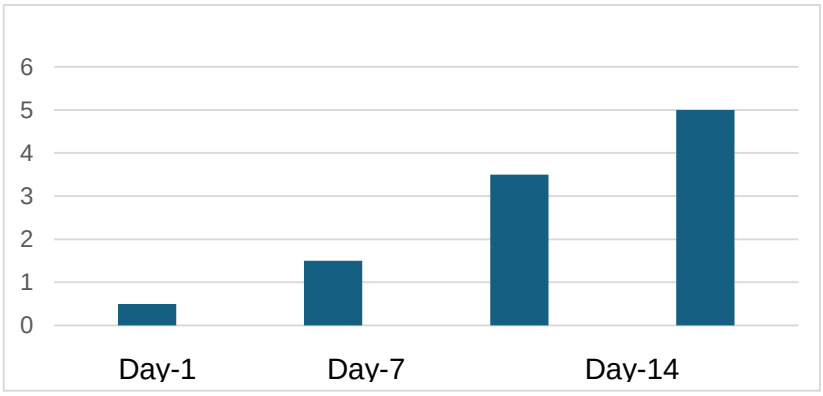


Fig10: Rotifer

This image shows a rotifer likely belonging to the genus Brachionous such as Brachionousplicatilis planktonic organisms found in variousaquatic environments including freshwater. They are characterized by ciliated corona used for feeding and locomotion and a protective outer shell called a lorica.

GRAPH: GROWTH OF GUPPY FRY



Growth rate depends on feeding, water quality and stocking density.

Day1: Fries are very small and transparent, feeding mainly on yolk reserves or finely crushed food.
Day7: Growth increase in size, fry become more active and start feeding on micro foods.
Day14: Growth becomes faster body shape develops clearly, and they start resembling miniature guppies.
Day21: Fries reach a visible juvenile stage with better coloration and stronger swimming ability

Fig11: Larval stage

Fig12: Growth larval stage

Discussion

During the cultivation and microscopic examination of infusoria samples, the cultures consistency showed a variety of protozoans organisms belonging to variety of protozoans organisms as paramecium, Euglena, and vorticella. The clear visibility of active motile protozoans under the microscopic indicated healthy

culture conditions and adequate nutrient availability. The absence of foul Odor or cloudy stagnant water during the early stages suggested proper maintenance and balanced microbial activity in the medium. During the study on the growth pattern of infusoria, serval observations were made regarding both the water quality parameters and the density of protozoan populations. Cultures initiated with plant- based material such as banana peel is decomposing, which became visible as whitish haze in the water within 24-48 hours.

Infusoria appeared in a range of shapes elongated spindle form (paramecium), pear shaped (Euglena). Most organisms measured between 50-300 micrometres in length, making them easily visible at low magnification under the compound microscope. The density of organisms peaked around the third to fifth day, after which a gradual decline was noted if no fresh organic material was added. The most frequently observed movement patterns included smooth gliding, rapid darting and spiral swimming motions. Sessileprotozoans such as vorticella displayed distinctive contractile stalk retraction in response to disturbances. Colouration varied from transparent to faintly green photosynthesis forms, while non-photosynthetic forms remained colourless. Water quality measurements showed a slight increase in turbidity as cultures matured, accompanied by a mild drop in dissolved oxygen, likely due to bacterial decomposition of the plant material. Cultures kept indirect sunlight had higher densities of photosynthetic infusoria compared as those in dimly lit conditions.

Although no immediate decline in culture health was observed during the study period, prolongated neglect without replenishing the organic substrate led to a reduction in protozoans' density. This indicates that infusoria cultures require periodic maintenance to sustain peak productivity. Theseobservations clearly demonstrate that infusoria cultivation is a practical and efficient method for producing live feed freshwater aquaculture. The results stress the importance of maintain optimal culture conditions, including water quality, light exposure and regular organic matter addition, to ensures consistent availability of high-quality protozoan populations for feeding guppy fry fish.

Overall, this study to supports the use of banana peel is based infusoria culture as cost -effective and easily maintaining and high nutritional adequate live feed for guppy fry. Itcontainsculture into small scale or ornamental fish breeding operations can improve fry survival to accelerate growth and reduces dependency on commercial starter feed.

Infusoria are generally accepted as the first natural live food of fish larvae because they are very small size, easy to culture and highly nutritious. In this current research, guppy fry thrived and grew better if fry was supplied infusoria in the first few days post- hatching. This finding is in agreement with previous descriptions.

Live food organisms like infusoria, as cited by Dhert (1996), a bound with the crucial proteins, lipids and micronutrients needed in the early stages of ornamental fish fry development.

Kibria et al. (1997), natural availability of live foods greatly increases fry survival and growth performance in the rearing tanks.

Anitha et al. (2015) illustrated the fact that paramecium caudatum is an excellent guppy fry starter food with a higher survival rate compared to artificial food.

Chakrabarti et al. (2011) highlighted the fact that live matter feeding such as infusoria minimizes cannibalism and stress in fish larvae and promotes healthy growth.

Matinez-Cordova et al. (2018) also emphasized the ecological function of microbial- based live feeds and their potential to serve as aquaculture substitutes for formulated diets in a sustainable manner.

Conclusion

Based on the results obtained from the study on culturing infusoria and analysing Its impact on the growth rates of guppies *(Poecilia reticulata)*it can be argued that use are microscopic creatures that act as live foods to many aquatic animals. It has small, soft bodies, prolific and high nutritious and plentiful, Infusoria serve as prefect starter diet for easily fish larvae and generally acted as their source food for newly hatched fry, to ensuring better digestibility and faster development in their early growing stages. The resulted paramecium, Tubifex, Daphnia magna, Aquatic Oligochaete Worm, Springtail, Fungus spores, Planarian, CyclopsStrenuss are highlighting thesignificance ofthe conclusion of live micro foods suchas infusoria in ornamental fish hatchery operations to enhance fry health, growth performance and survival outcomes.

References

1. Leeuwenhoek, A. van. (1677). “Letter on animalcules in water. ”PhilosophicalTransaction of the Royal Society, **12,** 821-831.
2. Muller, O.F. (1763). Animalcula Infusoria fluviatilia et marina. Copenhagen: TypisMolleri.
3. Ehrenberg, C. G. (2838). DieInfusions their chenalsvollkcommeneOrganismen. Leipzig: Leopold Voss.
4. Dujardin, F. (1841). Histoire naturelle des zoophytes: Infusoria. Paris: Roret.
5. Adl, S.M., Bass, D., Lane, C. E., Lukes, J., Schoch, C.L., Smirnov, a., …Zhang, Q. (2019). Revisions to the classification, nomenclature, and diversity of eukaryotes. The Journal of Eukaryotic M ICROBIOLOGY**, 66**(1), 4-119.
6. Pritchard, A. (1841). History of the infusoria: Living and fossil. London: Whittaker and Co.
7. Siebold, C. T. von, &Goldfub, G.A. (1845-1848). Lehrbuch der vetrgleichendenAnatomie. Lepizig: Leopold voss.
8. Definition of INFUSORIAN. WWW.merriam-webster.com. Archived from the original on 2023-02-16. Retrieved 2023-02-16.
9. Sharpe, Shirlie (December 22,2018). “How to Culture Your Own Infusoria at Home” Archived 2019-08-18 at the Wayback Machine. The Spruce pets. Retrieved August 28, 2019.
10. Allen, G.H., &Nemenz, H. (1964). Feeding and growth of fry of the guppy (Poecilia reticulata) in relation to different live feeds. Journal of the Fisheries Research Board of Canada, 21(1), 127-135.
11. Arul, V., &Subramanian, S. (2012). Infusoria: A natural live feed for fish larvae in aquaculture. Aquaculture Asia, 17(2), 27-29.
12. Dahanukar, N., & Raut, R. (2010). Influence of live food on the growth of ornamental fish fry. Indian Journal of Fisheries, 57(4), 63-68.
13. Kumar, P., & Pandey, A.K. (2018). Role of live food organisms in aquaculture. International Journal of Fisheries and Aquatic Studies, 6(2), 430-436.
14. Lavens, P., &Sorgeloos, P. (1996). Manual on the production and use of live food for aquaculture. FAO Fisheries Technical Paper, No. 361. Rome: Food and Agriculture Organisation of the United Nations.
15. Lim, L.C., Dhert, P., &Sorgeloos, P. (2003). Recent developments in the application of live feeds in the freshwater ornamental fish culture. Aquaculture, 227(1-4), 319-331.

16. Radhakrishna, S., & Philip, R. (2015). Live feed culture and its role in larval rearing of ornamental fishes. Journal of Aquatic Biology & Fisheries, 3, 36-43.
17. Hunt, B.P. (1953). The life history and ecology of paramecium and associated infusoria in relation to fish fry feeding. Transactions of the American Microscopical Society, 72(1), 16.
18. Ling, S.W., &Mercian, A.M. (1978). Culture and utilization of freshwater infusoria for larval fish rearing. The Progressive Fish-Culturist, 40(1), 11-14.
19. Kohler, C. C., & Lewis, W. M. (1993). Culture of infusoria for larval fish rearing: practical methods for hatcheries. Illinois Natural History Survey Technical Report.
20. Sipa Uba-Tavares, L.H. (1994). Infusoria culture using plant-based media for aquaculture. Revista Brasileira de Biologic, 54(4), 639-644.
21. Khan, M. A., & Abidi, S.A.H. (2004). Use of infusoria and rotifers as live feed for ornamental fish larvae. Pakistan Journal of Biology Sciences, 7(12), 2070-2073.
22. EI-Sayed, A.F.M. (2006). Tilapia Culture. Wallingford: CABI Publishing. (Chapter on larval feeding and live food production, including infusoria).
23. Anuraj. A, J Raymond Jani Angel, Venkatesh R Thakur, T Sivaramakrishna, A K O Ratheesh, Arun Jyothi Baruah, KirubasankarR. & Dam Roy S. (2015). Live food organisms in aquaculture. CLARI, Port Blair, P 23.
24. Beers, C.D. (1928). Rhythms in infusoria, with special reference to Didiniumnasutum. Journal of Experimental Zoology, 51(4), 485-493.
25. Barad, M. M., Bhatt, A, J., Singh, V. & Sarman, V. (2017). Live Feed-Importance, constraints, and prospects in the Aquaculture production system. Editorial Board, 6(8), 1.
26. Das, P., Mandal, S. C., Bhagabati, S.K., Akhtar, M.S, & Singh, S. K. (2012). Important live food organisms and their role in aquaculture. Frontiers in aquaculture, 5(4),69-86.
27. Eryalcm, K.M. (2018). Effects of different commercial feeds and enrichments on biochemical composition and fatty acid profile of rotifer (Brachionusplicatilis, Miller 1786) and Artemia franciscana. Turkish Journal of Fisheries and Aquatic Science, 18(1),81-90.
28. Ghorbani, V. R., ShenavarMasouleh, A. R., Alipour, A. R, & Yeganeh, H. (2019). Effects of Artemia nauplii enrichment with a bacterial species (Weissiellakoreensis) on growth performance and survival rate of stellate sturgeon larvae (Acipenser stellatus). Survey in Fisheries Sciences, 5(2),1-10.
29. Mondal, A., Joysowal, M. &Chirwatkar, B. (2018). Importance of Live Feed in Agriculture. International Journal for Scientific Research & Development, 6(3), 656-658.
30. Mukai, Y., Sani, M. Z., Mohammad-Noor, N.& Kadowaki, S. (2016). Effective method to Culture infusoria, a highly potential starter feed for marine finfish larvae. International Journal of Fisheries and Aquatic Studies,4(3),124-127.
31. Chapman, F.A. (2015). Culture of infusoria for Feeding Fish Fry.University of Florida IFAS Extension, Publication #FA-105.