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Guppy fish (*Poecilia reticulata*) and its use in scientific research
- a short narrative review -

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Abstract: *For many years, the Guppy fish (Poecilia reticulata) has been a new model organism in the family of laboratory animals used especially in the field of behavioural ecology and evolutionary biology. This short narrative review is trying to summarize some of the guppy fish uses, from its early discovery and its use as an aquarium pet fish to modern specialized use as a laboratory animal in various applications. This review-type study highlights important advances in our knowledge of life-history evolution under diverse pressure from predators and partner selection, particularly the complex interaction between the use of males as ornamental fish and the use of females for their reproductive capabilities. The paper also discusses the specie's significance in genomic and ecotoxicology studies, where its short period of time between new generations and environmental sensitivity, can offer precious information for tracking aquatic health status. This overview shows the guppy fish continued status as a flexible tool for answering basic biological issues by combining these several research streams.*

1. Introduction
The guppy (*Poecilia reticulata*) is a highly adaptable freshwater fish increasingly used as a laboratory model for ecology, reproduction and ethology. Originally popular as an ornamental pet due to its vibrant colors and rapid reproduction, its biological profile, including live-bearing reproduction and short gestation, makes it ideal for stable research colonies.

2. Material and method
A systematic literature search was conducted across multiple electronic databases such as: MEDLINE (PubMed), Google Scholar, Web of Science, MDPI and ResearchGate.
For the search strategies were used specific Boolean operators: AND, OR, NOT, and keywords such as: guppy, aquarium fish, ecotoxicology, laboratory animals, model organism, *Poecilia reticulata* and guppy fish.

3. Housing, Husbandry and Welfare
Proper care is essential for scientific rigor. Guppies require a temperature of 24-28°C, a stable pH and controlled population densities, to prevent stress. All the research must adhere to the 3Rs principle (Replacement, Reduction, Refinement), European and national ethical regulation to minimize pain and ensure reproductible results.

4. Guppies in Ecotoxicology
They can be used as a sentinel indicators for aquatic health. They are used to study the effects of heavy metals, microplastic and endocrine disruptors. Even low concentrations of pollutants cause measurable changes in their behavior, reproduction and liver health.

Fig. 1 – Female Guppy
https://cdn.shopify.com/s/files/1/0151/9016/3510/files/Blog_-_Guppy_Fish_Care5.webp?v=1745513010

Fig. 2 – Male Guppy – Green cobra variety
https://universalaquatics.co.uk/wp-content/uploads/A-POEG-093-RGB.webp

Fig. 3 – Male Guppy – Elephant ear variety
https://coburgaquarium.com.au/cdn/shop/products/GuppyMaleElephantEarSnakeskin_large.jpg?v=1661930382

Fig. 4 – Male Guppy – black variety
https://www.swelluk.com/media/catalog/product/b/l/black_male_guppy.png?width=810&height=810&store=default&image-type=image

Fig. 5 – Male Guppies – different varieties
https://flipaquatics.com/cdn/shop/files/undefined-685ab744088543e245ff2c5_600x.jpg?v=1762536993

Fig. 6– Male Guppy – Red variety
https://universalaquatics.co.uk/wp-content/uploads/full-red-guppy-male-tropco.jpg

5. Behavioral ecology and evolutionary biology
Guppies are classic models for studying natural and sexual selection. Research in Trinidad show how predation pressures drive rapid evolution in traits like offspring size and maturation speed. They also provide insights into group dynamics, such as shoaling cohesion and collective decision-making.

6. Genetics, Physiology and Biomedical research
Guppy fish is a growing model for genomic studies and biology of aging. Their internal fertilization allows for detailed research into sperm competition and reproductive dysfunctions. They bridge the gap between complex ecological reality and molecular accessibility.

7. Trends, limitations and future perspectives
Current trends show a move towards integrating molecular biology with field ecology. While guppies lack the extensive genetic tools as zebrafish, they offer unique ecological realism.
Future progress require better standardization of husbandry protocols across international laboratories.

Table 2. Main advantages and disadvantages of Guppies (*Poecilia reticulata*) as a laboratory model

Advantages	Disadvantages
Small body size and low maintenance cost	Lower molecular standardization than zebrafish
Rapid maturation and high reproductive output	Fewer transgenic resources available
Live-bearing reproduction allows direct juvenile observation	Behavioral results can be socially variable
Strong sexual dimorphism useful for mate choice studies	Less internationally harmonized protocols
Hardy and adaptable under laboratory conditions	Husbandry often underestimated due to perceived hardiness
Suitable for multigenerational experiments	Embryological accessibility limited

Table 1. Comparative Characteristics of Guppy, Zebrafish and Japanese Medaka as laboratory fish models

Characteristic	Guppy (*P. reticulata*)	Zebrafish (*Danio rerio*)	Medaka (*Oryzias latipes*)
Reproduction	Live-bearing	Egg-laying	Egg-laying
Fertilization	Internal	External	External
Main strengths	Behavioral ecology, ecotoxicology, reproductive biology	Developmental genetics, transgenics	Developmental toxicology, carcinogenesis
Sexual dimorphism	Very pronounced	Moderate	Moderate
Molecular toolkit	Moderate	Extensive	Extensive
Social behavior complexity	Very high	High	Moderate
Embryo accessibility	Limited	Excellent	Excellent
Ecological realism	Excellent	Moderate	Moderate
Maintenance cost	Low	Low	Low

Conclusions
The guppy fish occupies a strategic niche in modern science as it bridges the gap between the laboratory and the natural world, offering a model that is both logistically manageable and ecologically relevant.
As research moves toward integrative models that prioritize welfare and environmental realism, the guppy's role is expected to expand further into genomics and chronic toxicity studies.
Future research will combine guppy behavior with genetic data. To succeed, scientists must standardize how they raise the fish and stop underestimating their complex welfare needs.

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