

Zebra Fish As An Animal Model For Food Safety Research

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Abstract

The zebrafish (*Danio rerio*) has accomplished high ubiquity as a model life form of positive attributes established on an exceptional arrangement of properties as high fruitfulness, little size, fast improvement, and quick age time. Despite the fact that the farming of this species is ineffectively created rather than the logical meticulousness that is required, this species has incredible potential as a trial model, from embryology because of the optical lucidity of the undeveloped organisms and hatch lings, extracorporeal advancement of the incipient organisms, the investigations of cerebrum issue by the high closeness of the sensory system among zebrafish and human. Zebrafish information network (ZFIN) is used for collecting information on zebrafish parameters such as mortality, development etc.

Key words :Zebrafish, animal model, Zebrafish Information Network (ZFIN)

INTRODUCTION

Zebrafish (*Danio rerio*) has been used for the development of vertebrate and model organisms (to test the human disease, cancer, immunology) fig .1 [1]. The zebrafish is an animal model that helps in the overcome initial stages of bioactivity and also toxicity. It is the freshwater fish, mainly found in the artificial tanks (at home) aquarium and as well as in research. It has 70% of the orthologous gene from a human. Zebrafish has common cellular types and metabolic processes from vertebrates. There have a very short life cycle and produce hundreds of offspring per breeding couple per week. Zebrafish has external fertilization and development (small size and transparent embryos) [2]. Zebrafish is an unprecedented tool. Animal model for the effects of food additives on human and animal health and safety of new compounds. The study of food toxicology depends on nutrition by heterotrophic metabolism. It has advanced in molecular biology, cell culture techniques and computer and bioinformatics for identification and characterization of potential toxicants in the food [3] These fishes have a very short lifespan and high production of hundred offspring per breeding couple per week. The zebrafish are advantageous features for a valuable model to bioactivity in food research. [2].



Figure .1 Zebrafish (*Danio rerio*)

Zebrafish as the immunology and infectious diseases of their temporal separation between both innate and adaptive responses. The innate immune system is present after several weeks of fertilization (larvae should survive until the development of the immune system). The innate

immune system is detectable and active at the stage of embryogenesis. The adaptive immune system as morphologically and functionally mature after fertilization (4-6 weeks) [1]. It has early embryonic patterning, cell fate, and lineage determination. The model for zebrafish as gerontology and to determine the life span. Zebrafish as the life span approximately 3.5 years and a maximum of over 5 years. The zebrafish continue to increase the dense genetic map and growing collection of sequence tags and genome sequencing projects. The genetic mutants are used in large scale mutagenesis [4]. The term nutrition is commonly found in everyday language as a basic concept approach for nutrition varies widely among disciplines and researches. Human nutrition is implicated from epidemiological surveys studies mammalian species. Nutrition of domesticated agricultural animals and commercially important species. The aquatic organisms such as finfish and shrimp increase in response to aquaculture [5]. Amyloidosis is common systemic most commonly found in the plasma cell dyscrasia with clonal production of immunoglobulin light chain (AL-LC) protein [6]. Zebrafish is a significant model framework for the examination of vertebrate advancement [7] and a rising model framework for human disease. The model organisms have been used for toxicological and biomedical research include such as worms, flies and microcrustaceans, frogs, birds, and non-human primates. Zebrafish is the most important model and rapid development of genomic, transcriptomic, proteomic, and metabolomic tools. The fish is evaluated by the physiological, cellular, and molecular processes of human disease [8]. Zebrafish have become an ideal animal model for the development of a new gene in disease and drug screening due to its low cost. The development of a new drug with millimeter size and optical transparency, infection characteristics and at the level of in vivo multidimensional imaging using differential Contrast (DIC) and fluorescence microscopy. Zebrafish has an immune system including all lymphoid organs and immune cell types [9]. The basic nutritional requirements by using zebrafish the cost trials and duration of fish can be reduced. Zebrafish is omnivorous means more plants can be included in the diets of carnivorous (species such as Atlantic salmon) from figure 2 it will explain about

genetically modified feed for both organisms by the weight of the organisms GM feeds are observed and DNA sequences [10].

Toxicity

Zebrafish is a model of ecotoxicology. The test is done by embryos development stages. Fish toxicity has been complemented by tests at evaluating the possible mechanisms of tools for predicting chronic toxic effects [2].

Zebrafish Information Network (ZFIN)

Information on zebrafish parameters such as mortality, development hindrance, craniofacial distortions, yolk sac edema, pericardial edema, meningeal edema, fringe ischemia and interruption of erythropoiesis, captured gill improvement, disabled swim bladder expansion, modified apoptosis, a diminished number of neurons in the mind, hindrance of blade recovery, restraint of normal cardinal vein relapse, decreased heart size and ventricular stop, can be effectively gotten to [11].

Zebrafish model potentially used in the study of food allergy

The murine models have a few hindrances such as solid subjectivity, enormous fluctuation, significant expense, etc. Along these lines, it draws in expanding specialists to create other proper creature models for allergen location. Zebrafish is a significant vertebrate model broadly utilized to look into fields, for example, formative science, hereditary qualities, toxicology, and oncology. It is one of the four model life forms in natural research together with the mouse, organic product fly, and nematode worm. Lately, the use of zebrafish in the field of immunology has bit by bit been esteemed. The zebrafish's resistant framework has both shared characteristics and specificities contrasted and higher vertebrate creatures'. The investigation of the hematopoietic component of zebrafish demonstrated that human and zebrafish have very comparative cell arrangement in the invulnerable framework. Quite, the versatile invulnerable arrangement of zebrafish doesn't start to show up until 4 to about a month and a half after preparation, and zebrafish which just have intrinsic resistant capacity during the first 7th day stretch of life exists in early-stage improvement [1]. Since zebrafish incipient organisms are created in vitro and completely straightforward, it is a decent model for examining the natural insusceptibility of vertebrates, however, the immediate investigation on nourishment hypersensitivity is missing and needs far more examinations.

Zebra Fish as Cardiovascular Model

The *Danio rerio* has likewise been utilized as a model for the cardiovascular malady, inborn heart imperfections to arrhythmias and cardiomyopathies [12]. amyloidosis is an illness wherein bone marrow cells produce amyloid, an anomalous protein substance that aggregates in different organs, including the heart, making harm the heart muscle. Zebrafish treated with amyloidosis created cardiovascular

brokenness and apoptosis of cells, adding to untimely mortality from day 2 after treatment and the pinnacle was between days 5-7 [6]. The cardiovascular amyloidosis is portrayed by a low systolic circulatory strain, agreeing with the contractile brokenness found in zebrafish, equivalent to in people.

Zebra Fish as Agrochemical Agent

At the point when great horticultural practices are not followed intently, agrochemical build-ups can be found in nourishment. That prompts genuine general medical issues which can be both through an ecological presentation in the water or bioaccumulation in creatures. Numerous agrochemical items have just been tried with the zebrafish model, for example, glyphosate [13] concentrating the impacts of Glyphosate and Roundup, demonstrated that those substances could adjust both morphological and social parameters in zebrafish, subsequently recommending regular systems of lethality and cell reaction. In zebrafish hatchlings, those substances modified velocity and aversive conduct just as diminished visual separation. However, in zebrafish grown-ups, velocity was likewise diminished and impedance in memory and diminished forceful conduct was watched. carbonic anhydrase compound whose diminished movement leads to an expansion in CO₂ and respiratory acidosis in the entire body bringing about delivery Responsive Oxygen Species (ROS) in the gills. The expanded and raised nearness of ROS was ascribed to cause contortions due to the cell apoptosis. Moreover, [14]. watched neurotoxicity when zebrafish was in contact with glyphosate causing a progression of disturbances, for example, loss of depicted cerebrum ventricles and cephalic areas in incipient organisms, diminished quality articulation in the eye just as fore and midbrain districts. [15] likewise indicated that glyphosate caused changes to the atria and ventricle and diminished pulse, adjusted the vascular in the body, and articulation of *Mef2* in early myocardial antecedents. They presumed that glyphosate and the Roundup® details were formatively dangerous to the forebrain and midbrain, and that glyphosate influenced the cardiovascular framework in this manner being both formatively dangerous to the zebrafish heart... They found that harmfulness was a time just as fixation subordinate. Undeveloped organisms were more touch to demonstrated that the pesticide malathion decreased endurance and development in creating zebrafish, and presumed that both malathion's activity as an acetylcholinesterase inhibitor and the poisonous quality of its metabolites may be answerable for malathion's teratogenic consequences for fish improvement. Zebrafish which a biocide generally utilized in horticulture which is commonly applied preceding planting for the control of nematodes, soil pathogens, and weeds [16]. That agrochemical advanced acetylcholinesterase restraint also expanded the nourishment utilization rate.

Zebrafish as an inflammation and infection model

Horrendous aggravation examines are a significant part of zebrafish investigates. The foundation of invulnerable cell

transgenic lines, for example, neutrophils (MPO: GFP), early macrophages (fli-1: EGFP) and neutrophil/macrophage twofold transgenic lines (Lyz: EGFP/DsRED2) empowers the perception of incendiary and safe reactions in vivo. The fundamental technique is to follow the fiery conduct of resistant cells by fluorescence microscopy in the wake of removing the tail, needle therapy or laser incitement. Results have demonstrated that in the beginning time of zebrafish incipient organism improvement, macrophages and neutrophils take an interest in an intense fiery response. Neutrophils and macrophages react all the while to awful irritation however neutrophils move quicker and arrive at the site of twisted disease before macrophages show up. The macrophages at the injury start from the tissue, while the neutrophils are gotten from veins. Then again, zebrafish contamination models are normally utilized for the examination of bacterial and viral diseases. In these models, the disease site, time, and measure of contaminated microorganisms and infections are extremely significant affecting elements. Infused *Staphylococcus aureus* (*S. aureus*) into the eye, pericardial cavity, tail vein, fourth ventricle, yolk sac, and urothelium of zebrafish to build up numerous locales contamination models [17]. Dark worm baculovirus (SHRV) can likewise contaminate zebrafish incipient organisms and grown-up fish, bringing about an enormous number of mononuclear cells penetrating in the early stage, clogged fish gills, subcutaneous edema and drain. During this procedure, the declaration of interferon and were upregulated in both undeveloped and grown-up fish [18]. Concentrates additionally indicated that grown-up zebrafish is defenses less to irresistible hematopoietic putrefaction infection (IHNV), irresistible pancreatic corruption infection (IPNV), and spring viremia infection (SVCV), especially, the SVCV model has been utilized to consider the hereditary premise of the sickness [19].

Zebra Fish As Regenerative Medicine

In the research facility, it has been recorded that the life span of zebrafish may surpass five years [20]. The assortment of age information for the wild fish populaces encourage examinations of physiological ages among wild and research center, which would be valuable in contemplates including maturing [21]. The examination of zebrafish has become a scaffold between the cell and the natural improvement because of its quick advancement. The gastrulation is finished inside ten hours after treatment, driving some to conjecture that zebrafish can turn into a perfect creature model to consider cell and sub-cell [22], including regenerative prescription. The zebrafish completely recovers the heart muscle within a couple of weeks [23], along these lines it has been utilized in examines recovery. This species, as a model for heart harm, gives a way to manage the pursuit of cell types and pathways that may aid the recuperation of recovery of cardiovascular patients [24]. The zebrafish has various highlights that make it an astounding model for exploring on maturing: numerous relatives and their short life expectancy comparative with different vertebrates, the

zebrafish takes just 30-40 minutes to their undeveloped organism be watched and controlled, 72 hours to become hatchlings and 90 days is a grown-up; the quick development rate combined with its life span is a potential relationship to look into on maturing [25]. The blend of high development rates and quick change in a grown-up body has a few negative relationships, for example, diminished safe ability, exhaustion of vitality saves and diminished future. It is proposed that expanded oxidative pressure and mitochondrial harm lipids during the primary month of life zebrafish can decide the momentary life [26].

Transgenic Food:

The relevance of zebrafish use is also valuable for:

- the need to modernize the registration process of new agrochemical molecules;
- understanding the potential of the zebrafish model in toxicological studies (acute and chronic), and the possibility of biotechnological advances obtained from its use;
- advancing the current urgency of safer and more advanced products reaching the market rapidly
- understanding of economic benefits for toxicological screening with the zebrafish model.

Advantages and Disadvantages of Zebrafish in Research Field

The *Danio rerio* has developed as a brilliant model for examining in various regions, among them pharmacogenetics, nervous system science and embryology. The primary reasons are the simple access to all phases of advancement, the optical lucidity of incipient organisms and hatchlings that permits see in real-time improvement, notwithstanding high hereditary, effectively controlled and homologous physiology with people, particularly in the focal sensory system. Its little size empowers high stockpiling, needn't bother with enormous foundation offices, as in mouse creature houses. The expense of utilizing zebrafish is not exactly the mouse; every year, making mice is around multiple times bigger contrasted with the zebrafish [27]. The ageing time of the species is short (a quarter of a year), and you can make numerous duplicates in a constrained space (100 grown-ups in a tank of 8-12 L). Another bit of leeway is the fast generation and bounteous (for a solitary bring forth, the female delivers around 100 eggs), and high (80-85%) homology to human quality (Howe et al., 2013). The straightforwardness of the zebrafish undeveloped organism encourages the investigations in hereditary improvement programs since it is conceivable to screen and control its advancement without challenges. Moreover, fast improvement appears to break in under three days and become full-grown in 90 days, which makes the pursuit increasingly quick. Among the different preferences of toxicology examines in zebrafish, some previously referenced, and separated from these, the undeveloped organisms can live a couple of days after preparation without outer force. The medication promptly diffuses over the skin and gills and infiltrate orally

following 72 hours after treatment, not requiring the dynamic utilization of medications. Additionally, both the hatchlings and the grown-up zebrafish are utilized as formats, bringing about the articulation "in two models". The absence of information about the hereditary qualities of their ancestries impedes this exploratory model. Also, still, the strains that are known are not institutionalized, in differentiated, species, for example, the mouse, the lines are now entrenched [28]. Notwithstanding, because of investigation of the PubMed on zebrafish, found that the productions on this species became 15% from 2004 to 2013.

CONCLUSION

Zebrafish as the immunology and infectious diseases of their temporal separation between both innate and adaptive responses. The innate immune system is present after several weeks of fertilization (larvae should survive until the development of the immune system). The innate immune system is detectable and active at the stage of embryogenesis. The *Danio rerio* has likewise been utilized as a model for the cardiovascular malady, inborn heart imperfections to arrhythmias and cardiomyopathies. amyloidosis is an illness wherein bone marrow cells produce amyloid, an anomalous protein substance that aggregates in different organs, including the heart, making harm the heart muscle.

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