IOP Conference Series: Earth and Environmental Science

PAPER • OPEN ACCESS

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To cite this article: Faleh M. Al-Zaidy *et al* 2024 *IOP Conf. Ser.: Earth Environ. Sci.* **1371** 022014

The Effect of Two Types of Pesticides, Chemocis ULV and Chemocis D, on the Development, and Hatching of Eggs and Larvae of Common Carp *Cyprinus carpio (L.)*

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Abstract. This study investigates the effects of two aquatic pollutants, Chemocis ULV and Chemocis D, on the hatching rates and embryonic development of common carp eggs. The experiment employed three different concentrations (5, 10, and 15 ppm) of each compound, along with a control treatment, using the air-hatching technique. The results revealed a significant decrease in hatching rates at concentrations of 10 ppm for both pesticides, reaching 20% and 25%, respectively. The control treatment exhibited the highest hatching percentage, with 96% and 95% for each experiment. Conversely, hatching percentages declined with increasing pollutant concentrations, reaching zero hatching at 15%. The study identified an inverse relationship between egg-hatching time and pesticide concentration for both compounds. Furthermore, the analysis of distortions indicated that the lowest percentage occurred at a concentration of 5 ppm, while the highest was observed at a concentration of 10 ppm. This research contributes valuable insights into the adverse effects of Chemocis ULV and Chemocis D on common carp embryonic development and emphasizes the importance of monitoring and mitigating the impact of such pollutants on aquatic ecosystems.

Keywords. Chemocis ULV, Chemocis D, Common carp, Embryonic development.

1. Introduction

Fish have been considered among the most essential aquatic resources since ancient times, and humans in those periods paid great attention to the reproduction and raising of fish in limited water spaces, whether to use them as a primary food source or to achieve multiple production goals. Over 3 billion people worldwide depend on fish to obtain vital animal protein. The individual's share has increased the world's level of apparent consumption of fish in a significant way during the past few decades to reach 20.3 kg in 2017, and the initial data of 2018 and estimates for 2019 indicate an additional growth that will come to about 20.5 kg in 2019. This expansion in demand was driven by a combination of population growth, rising income, urbanization, a significant increase in fish production, and the development of more efficient distribution channels. Individual consumption is expected to reach 21.3 kg in 2028, confirming the role of fish crucial to food security and nutrition worldwide [1].

Pesticides are used in the agricultural sector to control and eliminate pests and insects [2], thus improving crop productivity and yields [3]. Although the use of these pesticides helps improve crop productivity and yield, it must be known that if these pesticides are used randomly, they will have negative consequences and can cause major environmental pollution. [4]. when water is polluted with these pesticides, it harms organisms that ingest or interact with it. [5] which creates adverse effects on the environment, and the result is fatal to living things if it is in high concentrations. However, if the concentrations are low and can accumulate long-term, it affects the liver, glands, and muscles and may lead to congenital disabilities [6].

Many studies have been conducted on the effect of pesticides and other toxic substances on the rate of survival, growth, development, and hatching of eggs and larvae of common carp fish, including [7-14]. The current study aims to investigate how different concentrations (5, 10, and 15 ppm) of these compounds affect the hatching success and developmental abnormalities in common carp embryos using the air-hatching technique. By analyzing the relationship between pesticide concentration and egg-hatching outcomes, and to provide insights into the potential environmental risks posed by these pollutants to aquatic ecosystems.

2. Material and Methods

Fertilized eggs of common carp (*Cyprinus carpio* L.) were provided through artificial insemination in the hatchery of the Marine Sciences Center at the University of Basrah. Glass bottles were used to turn the eggs using an air stream from below. The method was used in hatching operations to ensure the stability of the concentration of contaminated materials while changing half the amount of the solution containing the same concentration level every 24 hours, and eggs were hatched at 24°C. Internationally recognized insecticides were used in this study, namely the first article Chemocis ULV (Trade name), Deltamethrin 1.25% (Active ingredient), used to combat the cotton aphid insect *Aphis gossypii* on palm trees, 0.5 liters per Acre (Recommended dose) and manufacturer by Al-Furat General Company for Chemical Industries and the second Chemocis D (Trade name), Deltamethrin 0.5% (Active ingredient), used to combat the red palm weevil insect *Chrysomela amydraula* on palm trees, 10 grams per palm tree (Recommended dose) and manufactured by Al-Furat General Company for Chemical Industries purchased from local markets.

A primary solution was prepared using a graduated Baker, and (5, 10, 15) milliliters of pesticide were added to each liter, and then the solution was supplemented to the full liter to obtain final concentrations of (5, 10, 15) ppm. These solutions were placed in glass vials with three replicates for each engagement and a control sample. Five grams of fertilized eggs from common carp fish were added to each bottle, as shown in Figure (1), and samples were taken every 4 hours to examine and evaluate the development of embryos in each of the tracks containing the eggs. After that, some eggs were preserved in formalin for future examinations.

Figure 1. Aerial egg-hatching bottles.

3. Results

Tables (1 and 2) show the hatching rates of eggs of common carp fish treated with the pesticides Chemocis ULV and Chemocis D. The eggs of the fish treated with concentrations of 5 and 10 ppm of the pesticides hatched 6 hours before the eggs of the control treatment. The control treatment achieved 95% and 96% of the hatching rates for both experiments. The current study results show that hatching rates decreased with increasing concentrations of pollutants, reaching 80 and 78% in the first concentration (5 ppm), respectively, and decreased to 25 and 20% in the second concentration (10 ppm). In comparison, no hatching occurred, and egg development stopped after 6 hours of incubation at a concentration of 15% reached the blastula stage and development reached the stage of germinal rings after 24 hours, while it reached the stage of particles and pigmentation of the eyes after 48 hours of Incubation of the eggs in the control treatment and the two concentrations of 5ppm and 10ppm for the two pesticides.

The Figure 2, show different stages of embryonic development of common carp eggs at a concentration of 5 ppm in both pesticides. Figure 3, show that the embryonic development of some eggs has stopped at the ten ppm concentration of the two pesticides. In comparison, Figure 4, show the absence of embryonic development in the eggs at the 15 ppm concentration of both pesticides.

The results of the study, following up on the embryonic development of carp fish eggs in the control treatment and five ppm concentration of both pesticides, showed that development usually occurred until the stage of embryo formation and hatching was reached and that the time required for hatching decreased from 72 hours for the control treatment to 66, 65, and decrease to 63, 62 hours at a concentration of 10ppm for the pesticides Chemocis ULV and Chemocis D, respectively.The statistical test results showed no significant differences between the control treatments and the 5 PPM concentration for both pesticides in the hatching percentage.

Table 1. Hatching rates of common carp eggs for different concentrations ± standard error percentage for the first treatment with the pesticide Chemocis ULV.

Treatment	Hatching time (hours)	Average hatching percentage ± Standard Error %
Control	72	95 ± 5.3
5 ppm	66	80 ± 6.2
10 ppm	63	25 ± 2.9
15 ppm	Not hatched	00 ± 00

Table 2. Hatching rates of common carp eggs for different concentrations ± standard error percentage for the first treatment with the pesticide Chemocis D.

Treatment	Hatching time	Average hatching percentage ± Standard Error %
Control	72	96 ± 4.6
5ppm	65	78 ± 4.8
10ppp	62	20 ± 2.1
15ppm	Not hatched	00 ± 00

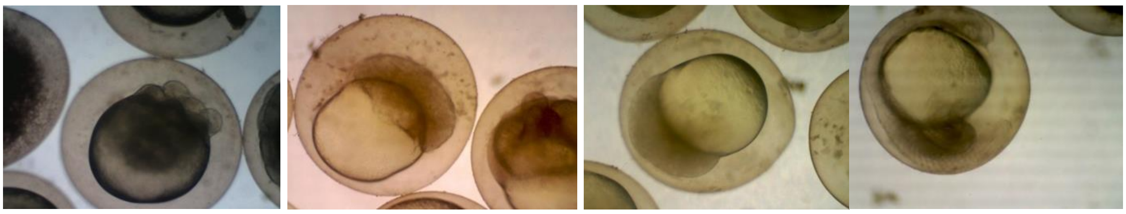

Figure 2. Show different stages of embryonic development of common carp eggs at a concentration of 5 ppm in both pesticides.

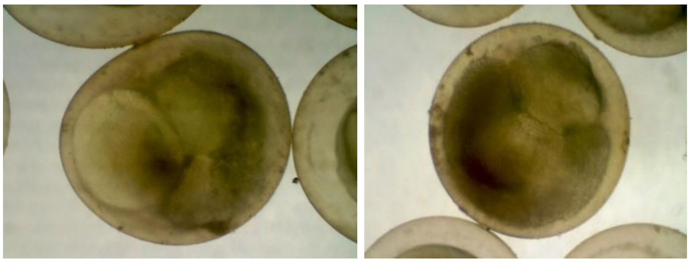

Figure 3. Show that the embryonic development of some eggs has stopped at the ten ppm concentration of the two pesticides.

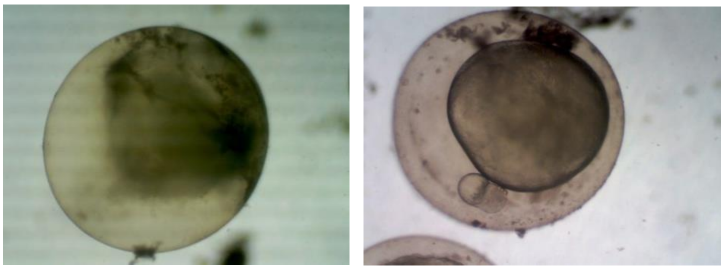

Figure 4. Show the absence of embryonic development in the eggs at the 15 ppm concentration of both pesticides.

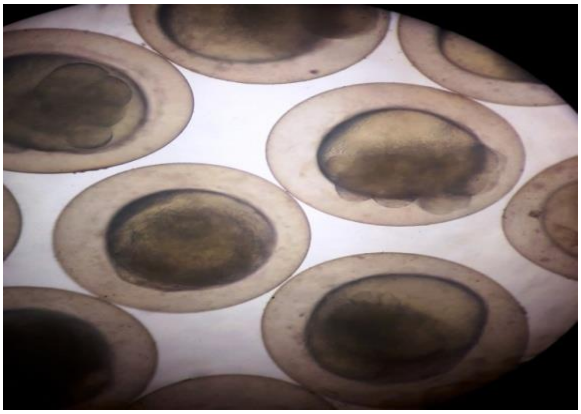

Figure 5. Embryonic development of common carp fish in the control treatment.

The results of the current study showed the occurrence of some abnormalities during the incubation of fish eggs at the different concentrations of the two pesticides used in the study, including the failure of the eggs to hatch despite the completion of embryonic development without the eggs hatching or half of the embryo emerging from the egg shell. At the same time, there was no development of the eggs. There were no hatching rates at the concentration of 15 ppm, and a large percentage of deformed embryos and significant deformation of the hatched larvae with the death of embryos before hatching (Fig. 6).

Figure 6. Most essential deformities in common carp larvae.

4. Discussion

The widespread use of pesticides in modern agriculture is of increasing concern due to environmental pollution and subsequent biodiversity loss and the use of synthetic pesticides and their entry into the environment has destroyed the aquatic ecosystem. In addition, synthetic pesticide usage has resulted in the development of resistant pests [9].

The results of the current study showed that there is an apparent effect of the pesticides Chemocis ULV and Chemocis D on hatching rates and time, as the pesticides accelerated the speed of egg hatching and the emergence of larvae, regardless of the type of pesticide. Still, the hatching rate decreased in both pesticides, especially at the concentration of 10 ppm, reaching 25 and 20%, respectively. While embryonic development stopped and was not completed at a concentration of 15 ppm for both pesticides, compared to the control treatment, in which the hatching rate was high and reached 95% and 96% for both pesticides, respectively, and the hatching time was within the normal limits for hatching common carp fish, which is 72 hours in optimal conditions at low temperature 24 C and this shows that the embryos are trying to exit the eggshell to get rid of the stress caused by pesticide concentrations. The pesticide may have contributed to a decrease in the oxygen level, which makes the embryo free from the egg. At the same time, the rates of embryonic development were high in the control treatment, and the hatching period was completed 72 hours in both experiments. Many researches and studies have indicated the negative impact of different types of pesticides on common carp fish, especially on the rate and speed of hatching, including Chromcova [8] studied the impact of NeemAzal T/S – toxicity on the early-life stages of common carp (Cyprinus carpio L.). They found that slow hatching on the first day and increased cumulative mortality in groups exposed to the insecticide also studied [9] on the effects of a cypermethrin-based pesticide on early life stages of common carp and Richterová, [10] on the impact of Cyhalothrin-based Pesticide on early life stages of Common Carp Where 95% deaths were recorded larvae exposed to 5 μg L^{-1} showed significantly reduced growth and delayed ontogenetic development compared to control and Li, [11,12] which found increased mortality rate, delayed hatching time, decreased hatching rate, decreased body length, and increased morphological abnormalities. This has been confirmed by other studies conducted on different species of fish. Singh [13], studied the toxic effects of two neem-based pesticides on the reproductive ability of zebrafish, and the results showed a significant decrease in hatchability: up to 21.69% in Nimbecidine and 26.99% in ultineem-treated fish.

Embryonic and larval deformities are among the problems facing aquaculture worldwide because of their economic impact [14]. The current study showed some deformities during the incubation period of fish eggs at different concentrations of pesticides and that most of these deformities occurred at 10 ppm concentrations, it reflects the effect of these concentrations on the eggs and larvae of common carp fish, including the failure of the eggs to hatch despite the completion of embryonic development or the exit of half the embryo from the eggshell and the death of the larvae before completing their exit from the egg. The difference in pesticide concentrations has had an apparent effect on the occurrence of these deformities. It occurred in newly hatched common carp larvae at 5 and 10 ppm concentrations in the two pesticides. [15] indicated that deformities occur during the embryonic stages and beyond, and their causes are attributed to many factors, such as environmental disturbances, malnutrition, genetic malformations, injuries, and non-inheritable congenital disabilities, among others. Among other factors, there is a group of environmental factors responsible for causing deformities in fish embryos and larvae, such as temperature, salinity, pH, egg density, mechanical and thermal shocks, water pollution, radiation, low dissolved oxygen levels, and others [16,17]. In addition, some deformities may be attributed to genetic causes [18]. It is noted that the rate of embryo deformities, especially the exit of half of the embryo through the eggshell, has increased with increasing concentration, in addition to the death of embryos inside the egg, and that many studies indicate that deformities in fish embryos within the average level are less than 10% [19]. it may reach 90% with increasing environmental stress, especially in aquatic environments with a high level of pollution [20].

Conclusions

The study confirms the deleterious effects of Chemocis ULV and Chemocis D on embryonic development and hatching rates of common carp eggs. Both pollutants showed significant reductions in hatching rates, with the most pronounced effects observed at higher concentrations. The findings suggest a critical concentration threshold for both pollutants, particularly at 10 ppm, where the hatching rates notably decreased. This indicates a threshold beyond which the adverse effects on common carp embryonic development become more pronounced.In conclusion, this study provides significant insights into the adverse effects of Chemocis ULV and Chemocis D on common carp embryonic development, highlighting the importance of proactive measures to mitigate the impact of aquatic pollutants on freshwater ecosystems.

References

[1] FAO (Food and Agriculture Organization of the United Nations). (2020). Summary on the state of world fisheries and aquaculture resources. 26p
[2] Al-Halafi, M. A. (2005). The effect of pesticides on the environment of the marshes and rivers of Southern Iraq, Meso.potamica, Volume 20, Issue 1, pp. 89-81.
[3] Abdel Hamid, Z.H. (2000). Human and Environmental Concerns, Kanza Jarzeb Publishing, p.506.
[4] Alavanja M. C. R.; Dosemeci M.; Samanic C.; Lubin J.; Lynch C. F. ; Knott C.; Barker J.; Hoppin J. A. ; Sandler D. P. ; Coble J.; Thomas K.; and Blair A. (2004). Pesticides and lung Cancer Risk in the Agricultural Health Study Cohort. Am J Epidemiol;160 (9):876–885.
[5] Belson M., Kingsley B., and Holmes, A. (2007). Risk Factors for Acute Leukemia in Children: A Review Centers for Disease Control and Prevention, National Center for Environmental Health, Division of Environmental Hazards and Health Effects, Health Studies Branch, Atlanta, Georgia, USA Vol. 115, No1, Environmental Health Perspectives.
[6] Rusiecki, J. A.; Roos, A. D.; Lee, W. J., Dosemeci, M.; Lubin, J. H.; Hoppin, J. A.; Blair, A.; and Alavanja, M. C. R.(2004). Cancer Incidence Among Pesticide Applicators Exposed to Atrazine in the Agricultural Health Study. Journal of the National Cancer Institute, Vol. 96, No. 18, September 15, 2004 .1375- 1382.
[7] Svoboda, M.,; Luskova, V.,; Drastichova, J. and Ilabek, V. (2001). The effect of diazinon on hematological indices of common (Cyprinus carpio L.). ACTA VET. BRNO 2001, 70: 457–465.
[8] Chromcova, L.;Blahova, J.; Zivna, D.; Plhalova, L.; Casuscelli, F.; Tocco, di.;. Divisova, L.; Prokes, M.; Faggio , C.; Tichy, F.; and Z. Svobodova, Z. (2015). NeemAzal T/S toxicity to early-life stages of common carp (Cyprinus carpio L.). Veterinarni Medicina, 60, 2015 (1): 23–30.
[9] Tyor, A. K. and Harkrishan (2016). Effects of imidacloprid on viability and hatchability of embryos of the common carp (Cyprinus carpio L.). International Journal of Fisheries and Aquatic Studies 2016; 4(4): 385-389.
[10] Richterova, Z.; Machova, J.; Stara, A.; Tumova, J.; Velisek, J.M. Sevcikova, M.; and , Z. Svobodova, Z. (2015). Effects of a cypermethrin-based pesticide on early life stages of common carp (Cyprinus carpio L.). Veterinarni Medicina, 60, 2015 (8): 423–431.
[11] Jaffar, N. S. and Rabee, A. M. (2016). Acute Effects of the Chlorpyrifos Pesticide on Common Carp (Cyprinus carpio L., 1758). Iraqi Journal of Science, Vol. 57, No.3A, pp: 1680-1687.
[12] Li, B.; Chen, J.; Du, Q.; Wang, B,; Qu. Y. and Chang, Z. (2019). Toxic effects of dechlorane plus on the commoncarp (Cyprinus carpio) embryonic development Toxic effects of dechlorane plus on the common carp (Cyprinus carpio) embryonic development. Henan Normal University. https://orcid.org/0000-0001-5241-8482.
[13] Singh PK, Ansari BA (2010): Effect of neem-based formulations (Nimbecidine and Ultineem) on the sparing success of zebrafish Danio rerio (Cyprinidae). Bioscan 5, 669–672.
[14] Boglione, C., E. Gisbert, P. Gavaia, PE. Witten, M. Moren, S. Fontagn and G. Koumoundouros.(2013). Skeletal Anomalies In Reared European Fish Larvae and Juveniles. Part 2: Main Typologies, Occurrences, and Causative Factors. Reviews in Aquaculture 5: 121-167.
[15] Al-Harbi, A.H. 2001. Skeletal Deformities in Cultured Common Carp Cyprinus Carpio L. Asian Fisheries Science 14: 247-254.
[16] Kjørsvik, E., A. Mangor-Jensen, I. Holmefjord, J.H.S. Blaxter and Southward (1990). Egg Quality in Fishes. Advances in Marine Biology. Academic Press, Pp. 71-113.
[17] Wiegand, M.D., J.M. Hataley, C.L. Kitchen and L.G. Buchanan.1989. Induction of Development Abnormalities in Larval Goldfish, Carassius auratus L., Under Cool Incubation Conditions. Journal of Fish Biology. 35: 85–92.

[18] Mair G.C. 1992. Caudal Deformity Syndrome (CDS): An Autosomal Recessive Lethal Mutation in the Tilapia, Oreochromis niloticus (L.). Journal of Fish Diseases 15: 71-75.
[19] Klumpp, D.W. And H. Von Westernhagen.1995. Biological Effects of Pollutants in Australian Tropical Coastal Waters: Malformations and Chromosomal Aberrations in Developing Fish Eggs. Marine Pollution Bulletin, 30, 158-165.
[20] Gercken, J., L. Förlin And J. Andersson .2006. Developmental Disorders In Larvae of Eelpout (Zoarces viviparus) From German and Swedish Baltic Coastal Waters. Marine Pollution Bulletin, 53, 497-507.