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Impact of Acute Lead Exposure on Cognitive Abilities in *Drosophila melanogaster* Larvae

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INTRODUCTION & AIM

Metals are universal constituents of ecosystems and play a significant biologically essential function. Heavy metals are inherent constituents of our ecosystem. While their presence is crucial for life, an excessive amount of them in our body can lead to severe and sometimes fatal health problem (Wu et al. 2016).

Pb, along with other heavy metals, is introduced into the human body via dermal contact, inhalation of contaminated dust particles, and ingestion of Pb-contaminated food, water, and vegetation, all of which are products of anthropogenic activities that disperse heavy metals in the natural environment (Tchounwou et al. 2012; Wani et al. 2015).

Lead (Pb) is a toxic metal that is not required for any physiological function in the body, and it is a severe threat to the nervous system. Nevertheless, the processes through which Lead influences neurotoxicity and neuronal sensitivity, especially for senses, are not fully understood. Pb primarily affects the nervous system, and its toxicity appears to be most pronounced in the developing brain (Chibowska et al. 2016).

Drosophila melanogaster, a fruit fly, are highly valued in laboratory settings due to their low maintenance requirements and brief generation interval, genomic studies suggesting up to 75% of human genes being conserved, could be used as useful model system to study the neurotoxic effects of Lead.

Applying genetic tools, behavioral assays, and neuroanatomical techniques, the research on the influence of lead on Drosophila olfaction provides valuable insights into the neurotoxic consequences of lead on sensory processing and behavior in various species.

Our aim was to establish Drosophila as a potential model organism to study the toxic effects of heavy metals on humans. The larvae of Drosophila melanogaster allowed us to examine how acute Lead exposure induced disruption in the olfactory response.

METHOD

Fly maintenance and breeding Of the wild-type flies of the Oregon R+ strain we were keeping them in cornmeal medium, and they were kept at the 25 0C temperature in a BOD (Biochemical oxygen demand) incubator under a 12 h light/dark cycle.

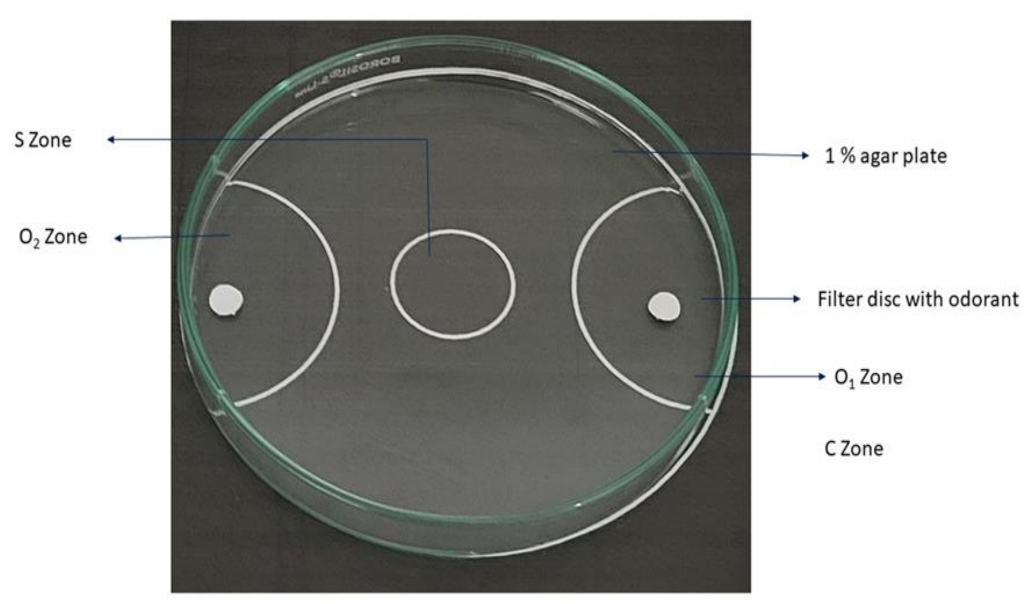
The larvae were treated with Lead acetate Pb(C2H3O2)2 with a purity of 90% (molecular weight 379.23 g/mol). Various amounts of Lead acetate solution were prepared using a 5% sucrose solution as the solvent.

The ethyl acetate (EA) odorant of the highest grade and the mineral oil diluent were acquired from Sigma-Aldrich. The treatment and behavioral studies were carried out in glass Petri dishes with a diameter of 90 mm that were acquired from Borosil.

The early third instar larvae were isolated from the cornmeal media using PEG-6000. Concentrations of Lead acetate ranging from 5 mM to 50 mM were diluted in a 5 percent sucrose solution.

The early third instar larvae of Drosophila melanogaster were exposed to varying concentrations of Lead, with a control set of larvae not being t treated with Lead. After the exposure, their olfactory response towards ethyl acetate was measured using larval plate assay.

Larval Plate Assay



$$RI=\frac{Number\ of\ larvae\ in\ zone\ 1\ (O1)+Number\ of\ larvae\ in\ zone\ 2\ (O2)}{Total\ number\ of\ larvae\ (O1+O2+C)}$$

RI – Response Index

RESULTS & DISCUSSION

The investigation examined the impact of lead (Pb) exposure on larval olfaction, particularly in response to ethyl acetate (EA) odor. It was observed that as the concentration of lead treatment increased, the olfactory response in larvae gradually declined.

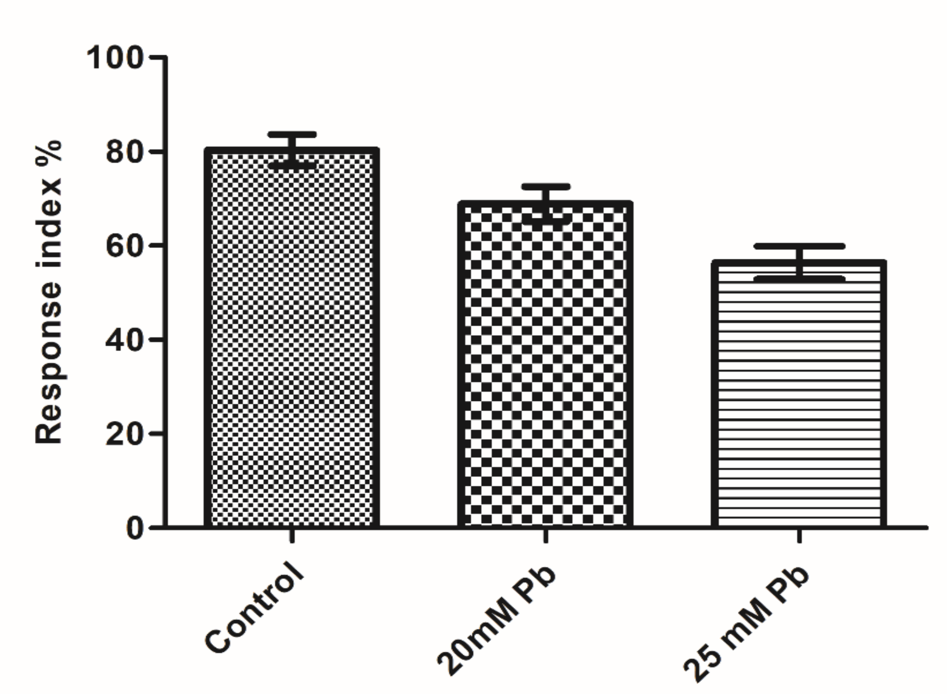


Fig. The average olfactory response index I (RI-I) of untreated (Control) and Lead (Pb)-treated larvae (exposed to 20 mM and 25 mM concentrations) is represented. The decrease in larvae response to odor is evident from the bar graph with the error bar representing mean ± S.D. The One-way ANOVA analysis of the statistical significance of the difference in olfactory responses of larvae resulted in ($P < 0.0001$; R square = 0.90).

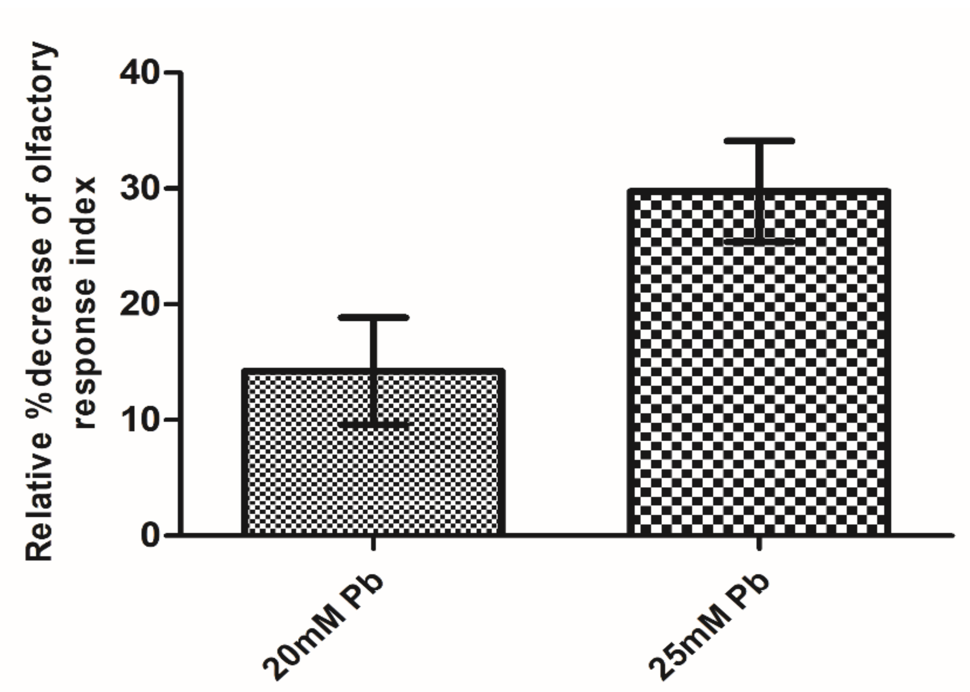


Fig The bar graph represents the relative percentage decrease in the olfactory response (RI-I) of arsenic-treated larvae at 20mM and 25mM concentrations with respect to untreated larvae (Control). Student t-test analysis was performed to determine the statistical significance of the mean olfactory response with the one-tailed P value < 0.0001.

The outcomes of this study give solid evidence of lead exposure's negative effects on olfactory behavior in Drosophila melanogaster. In a series of carefully planned studies, we revealed that lead exposure affects numerous elements of olfactory perception and discrimination in fruit flies, offering information on the neurobehavioral effects of ambient heavy metal pollution.

CONCLUSION

Our findings emphasize the necessity of investigating the impacts of environmental contaminants like lead on sensory processing and behavior in model species such as Drosophila melanogaster. By understanding the processes behind lead-induced olfactory impairment, we may develop ways for reducing the health concerns associated with heavy metal pollution in the environment while also protecting the sensory function of people and wildlife.

FUTURE WORK / REFERENCES

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