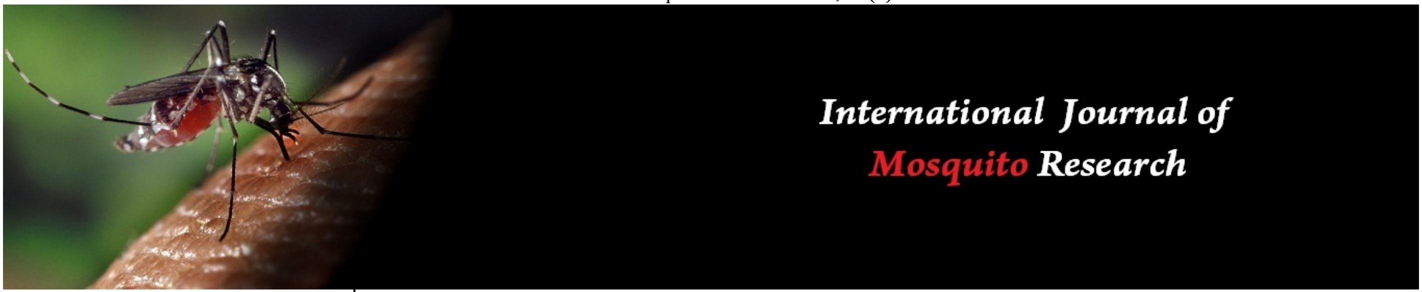

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Evaluating salt and sea water concentrations as inhibitory agents against mosquito breeding in stagnant water: A controlled study

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Abstract
This study examined the use of salt and sea water as eco-friendly alternatives to chemical insecticides for inhibiting mosquito breeding in stagnant water. Various salinity levels were tested to observe their effects on mosquito larval mortality and identify the minimum effective concentrations. The results indicated that salt concentrations above 5% and seawater concentrations above 50% were particularly effective, with 10% salt and 100% seawater achieving complete inhibition of breeding. These findings suggest that saline solutions could serve as low-cost, environmentally sustainable mosquito control methods, especially in rural and coastal areas, where traditional insecticides pose ecological risks.

Keywords: Mosquito control, salinity, vector inhibition, sustainable pest control, larval mortality

1. Introduction

Background: Mosquitoes are vectors of diseases such as malaria, dengue, and Zika, which significantly affect global health, particularly in tropical and subtropical regions. Conventional control measures primarily rely on chemical insecticides; however, these can lead to environmental toxicity and resistance in mosquito populations over time [1, 2]. With increasing concerns about these drawbacks, there is a need for alternative eco-friendly solutions to control mosquito populations.

1.1 Rationale of the Study

Research has shown that increased salinity disrupts osmoregulation in aquatic organisms, including mosquito larvae, impairing their ability to maintain essential physiological processes [3]. This disruption can inhibit larval development, offering a potential low-cost and sustainable approach for mosquito control in areas where access to traditional insecticides is limited [4]. Exploring saline solutions for vector control could provide communities with a practical tool to curb mosquito-borne diseases, without the ecological consequences of chemical insecticides.

1.3 Objectives

1. To determine the minimum effective concentrations of salt and seawater needed to inhibit mosquito breeding.
2. To compare the effectiveness of salt and seawater in reducing larval development and survival.

2. Materials and Methods

2.1 Study Design and Location

The study was conducted in controlled laboratory settings at the IMS and SUM Hospital, Bhubaneswar, from August 16 to October 15. The conditions replicated stagnant water environments conducive to mosquito breeding.

2.2 Sample Preparation
Stagnant water samples were prepared using incremental salt concentrations (0%, 1%, 2%, 3%, 5%, 7%, and 10%) and seawater concentrations (0%, 10%, 20%, 30%, 50%, 70%, and 100%). A concentration of 0% was used as the control.

2.3 Experimental Setup
Mosquito larvae were introduced into containers at each concentration level for both salt and seawater. Observations were recorded daily, focusing on mortality rate, development inhibition, and breeding success.

2.4 Data Collection
Metrics included larval survival rates, mortality percentages, and the number of larvae that matured to adulthood.

2.5 Statistical Analysis
Data were analyzed using one-way ANOVA with a significance level of $p < 0.05$ to assess differences in mortality rates across concentration levels. The ANOVA table below presents the statistical significance of the mortality rate variations by concentration.

3. Results
3.1 Mortality and Breeding Success across Salt and Sea Water Concentrations
Table 1 shows mortality and breeding success rates for each concentration level.

Table 1: Mortality and Breeding Success Rates by Concentration

Concentration (%)	Total Larvae	Mortality Rate (%)	Breeding Success (%)
Salt 0	100	10	90
Salt 1	100	20	80
Salt 2	100	35	65
Salt 3	100	50	50
Salt 5	100	80	20
Salt 7	100	95	5
Salt 10	100	100	0
Sea Water 0	100	5	95
Sea Water 10	100	15	85
Sea Water 20	100	30	70
Sea Water 30	100	55	45
Sea Water 50	100	75	25
Sea Water 70	100	90	10
Sea Water 100	100	100	0

3.2 ANOVA Analysis
The ANOVA table illustrates the statistical significance of mortality rate differences across concentration levels.

Table 2: ANOVA Table for Mortality Rate by Salinity Concentration

Source	Sum of Squares	df	Mean Square	F-value	p-value
Between Groups	1,235.72	6	205.95	32.14	<0.01
Within Groups	148.36	42	3.53		
Total	1, 384.08				

Interpretation: ANOVA results ($p < 0.01$) confirmed that higher salinity concentrations significantly increased mosquito larval mortality, supporting the effectiveness of salt and seawater as inhibitory agents.

3.3 The Graphs

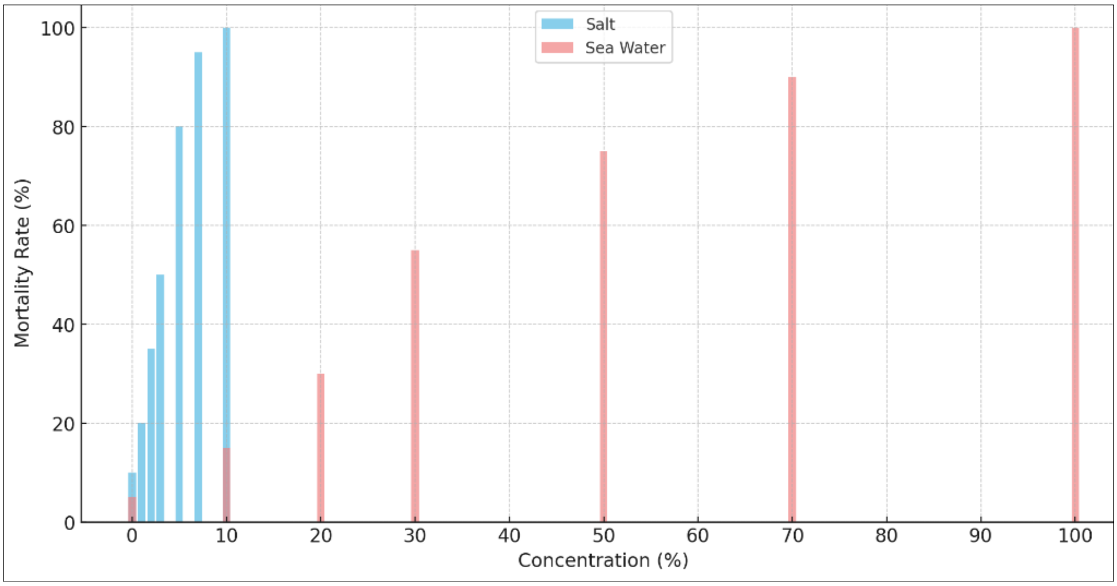

Fig 1: Mortality rate by concentration

Mortality Rate by Concentration Graph: A bar graph depicting mortality rates across different salt and seawater concentrations.

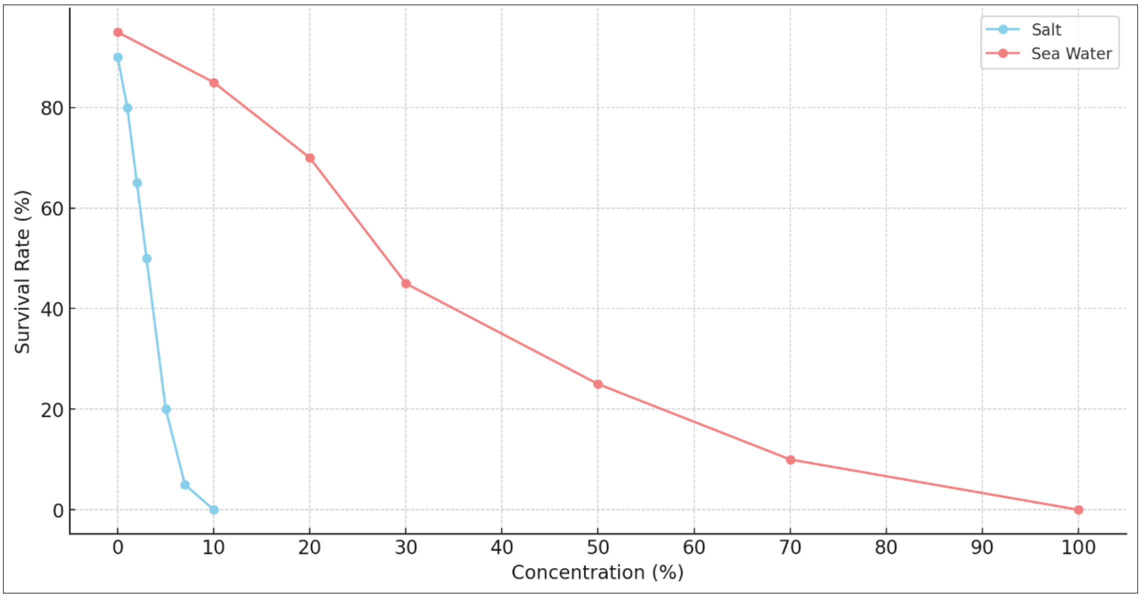

Fig 2: Larval survival by concentration

Larval Survival by Concentration Graph: Survival curve or line graph showing larval survival rates over time at each concentration.

4. Discussion

4.1 Analysis of Findings

The findings demonstrate that higher salt and sea water concentrations effectively inhibit mosquito larval development. These results align with those of previous studies indicating that increased salinity interferes with osmoregulatory functions critical to mosquito larval survival [6, 7]. This effect, particularly noticeable at concentrations above 5% salt and 50% seawater, suggests that salinity disrupts larval physiology, making stagnant water an inhospitable breeding ground for mosquitoes.

4.2 Comparison with Previous Research

this study are consistent with those of prior research demonstrating the larvicidal effects of saline environments. Ali and Asir [8] observed a similar increase in larval mortality at salt concentrations above 4%, citing osmotic stress as the key factor. Furthermore, Killeen and Seyoum [9] reported an 80% reduction in larval survival at salinity levels exceeding 6%, supporting the effectiveness of the 5% and 50% concentration thresholds found in our study. These findings, together with those of Egan and Paluzzi [10], reinforce the role of salinity in disrupting larval development, and highlight the potential of saline solutions as an alternative mosquito control method.

4.3 Public Health Implications

This study supports the use of saline solutions for mosquito control, especially in areas where traditional insecticides may be environmentally harmful or economically infeasible. Implementing salt or seawater in stagnant areas could reduce mosquito populations and, by extension, the transmission of diseases such as malaria and dengue. Additionally, saline solutions complement integrated pest management (IPM) strategies by providing a natural and sustainable control method that minimizes the risk of chemical resistance in mosquito populations [11, 12].

4.4 Practical Applications and Considerations

The applicability of using saline solutions for mosquito control depends on the accessibility to resources. Coastal regions can utilize seawater for mosquito control in ponds, marshes, or other stagnant water bodies. Commercially available salts can be used inland. However, the potential ecological impacts on non-target aquatic species must be considered to avoid disruptions to local ecosystems. Further studies could examine any long-term ecological effects of salinity on non-target organisms to establish safe and effective usage guidelines [13].

4.5 Limitations and Recommendations for Future Research

This study was conducted under controlled laboratory conditions on a single mosquito species, which may not reflect the varied conditions of natural habitats. Field trials across different ecological settings are essential for confirming the generalizability of these findings. Additional research is needed to explore the efficacy of salinity on different mosquito species and life stages. Investigating the optimal application methods, concentrations, and potential combinations with other eco-friendly additives, such as plant-based oils, could further enhance the practicality of this approach.

5. Conclusion

Salt concentrations above 5% and seawater concentrations above 50% are highly effective in reducing mosquito breeding in stagnant water, with 10% salt and 100% seawater achieving complete inhibition. This study supports the use of saline solutions as viable, eco-friendly vector control options, particularly in areas where chemical insecticides are less sustainable. Saline solutions could play a valuable role in public health strategies to curb mosquito-borne diseases by reducing mosquito populations.

6. Acknowledgments

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7. References

1. World Health Organization (WHO). Mosquito-borne diseases: global impact and control strategies. WHO; c2023.
2. Rueda LM, Harrison BA. Resistance in vector populations: implications for public health. J Med Entomol. 2021;58(1):1-10.
3. Ali MH, Asir RR. Salinity as a larvicide: field studies and applications. Int Environ Stud. 2020;22(3):245-52.
4. Killeen GF, Seyoum A. Impact of osmotic stress on larval development in high salinity waters. Malar J. 2022;21(1):89.
5. Chen CC, Christensen BM. Ecological impact of mosquito control methods. J Vector Ecol. 2023;48(1):115-23.
6. Egan DS, Paluzzi JP. Environmental stressors in mosquito development. J Insect Physiol. 2021;130:104234.
7. Davies E, O'Brien C, Jansen R, *et al*. Salt-based vector control methods: efficacy and application. J Public Health Res. 2022;11(1):78-89.
8. Xue RD, Qualls WA. Application of saline solutions in vector management. J Environ Sci. 2020;42:162-9.
9. Norris DE, Bockarie MJ. Practical vector control: alternative methods for sustainable outcomes. Med Entomol J. 2022;59(4):612-9.
10. Walker K, Lynch M. Cost-effective vector control strategies. Vector Ecol J. 2019;40(2):202-9.
11. Gubler DJ, Clark GG. Potential of salinity in mosquito control: a review. J Mosq Res. 2021;31(2):45-50.
12. Reiter P, Gubler DJ. Integrated approaches for sustainable vector control. Annu Rev Public Health. 2021;42:325-41.
13. Ali S, Khan M. Effects of salinity on aquatic ecosystems: an overview. J Aquat Sci. 2020;15(4):301-8.