

**PHYSICOCHEMICAL ANALYSIS, TOXICITY
ASSESSMENT AND NUTRITION SOURCE POTENTIAL
OF SUGARCANE DISTILLERY SPENT WASH**

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Degree of Master of Science

Department of Civil Engineering

University of Moratuwa

Sri Lanka

May 2022

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Dissertation submitted in partial fulfillment of the requirements for the Degree of
Master of Science in Environmental Management

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DECLARATION

“I declare that this is my own work, and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning, and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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ACKNOWLEDGEMENT

This compiled sum of work is not just an effort of a single person. I would like to express my gratitude and appreciation to the following people and institutions for supporting me in completing this research project.

I express my sincere gratitude to my supervisor Prof. Jagath Manatunge, Professor in Environmental Engineering, Department of Civil Engineering, University of Moratuwa, for providing me with his excellent guidance, support and encouragement from the initial to the final level of the research. I am thankful to my external supervisor, Mr. K. M. Sudesh Ruvinda, Lecturer in Zoology, Department of Zoology and Environmental Management, University of Kelaniya, for providing me with immense support and motivation facilities from the initial to the final level of this research work. I am also grateful to the Head of the Department and non-academic staff of the Department of Zoology and Environmental Management, Faculty of Science, University of Kelaniya, for allowing me to access the laboratory and conduct laboratory studies.

I convey my deep gratitude to the Deputy General Manager and Mr. Ravindra Hettiarachchi (Production Manager) of Pelwatta Distilleries Limited for providing me with the immense support to collect wastewater samples whenever necessary for the production process details to make this study a success.

I express my great appreciation to Mr. J. I. P. Perera (Chemist), Mr. D. M. P. T. Dissanayaka (Assistant Director) and Ms D. M. D. S. Dassanayaka (Lab Assistant) of Uva Provincial Office, Central Environmental Authority for providing me with the assistance to carry out the laboratory analysis and sampling.

I am also grateful to Mr. S. Thennakoon (Assistant General Manager), Mr. H. A. K. Amarakoon (former Assistant General Manager, Laboratory Service) Ms. Nishanthi Wijesinghe (Chemist), Ms. Chamila Edirisingha (Lab Assistant) and Ms. Tharika (Trainee) of National Water Supply and Drainage Board for the facilities they have provided to conduct laboratory analysis.

I want to express my sincere gratitude to Mr. Nuwan, Ms. Semini, Ms. Thilini, Ms. Asanka, Mr. Mahesh, Ms. Madusha, Ms. Nadeera, Mr. Priyantha and

Mr. Amitha. They have represented various disciplines and were willingly helpful in making this study a success.

Last but not least, my deepest gratitude goes to my family, my husband, mother, father, and brother, for giving me a good studying environment and for the support rendered to me in numerous ways.

ABSTRACT

Sugarcane molasses-based ethanol industries in Sri Lanka generate large volumes of high strength spent wash, causing severe environmental issues. The potential toxicity of spent wash on biological systems and the possibility of using it as a nutrition source in agriculture has been given less attention in Sri Lanka. The present study was conducted to assess the physicochemical characteristics of the raw spent wash and possible cytogenotoxic effects of diluted spent wash using a plant-based bioassay with *Allium cepa* (common onion). Further, to evaluate the potential of raw spent wash as a liquid nutrition source to improve the growth of commonly grown vegetable variety, tomato (*Solanum Lycopersicum*).

Selected physicochemical parameters of raw spent wash collected from the distillery industry of Lanka Sugar Company (Pvt) Ltd, Pelwatta, were evaluated using APHA (2017) standard procedures. Toxicity assessment was carried out after exposure of *Allium cepa* bulbs to diluted spent wash (1:8) along with aged tap water (negative control) following standard protocols. The tomato crop experiment was conducted as an open field experiment using agricultural guidelines provided by the Department of Agriculture with certified organic fertilizer as positive control and tap water as a negative control. Growth morphometric attributes of the plants and fruits were monitored for 60 days. The data were statistically analyzed using univariate statistical methods.

The physicochemical analysis revealed that the spent wash is highly acidic with high EC (21.93 ± 0.09 mS/cm), COD ($92,101 \pm 0.33$ mg/L), BOD ($26,116 \pm 2.33$ mg/L) TSS ($4,076 \pm 0.55$ mg/L), TDS ($68,656 \pm 0.13$ mg/L), Nitrate (255 ± 0.04 mg/L) and phosphate (38 ± 0.07 mg/L), and contained heavy metals viz. Cd, Cu, Ni, Zn, As and Mn and K in trace amounts. Significantly decreased root growth was found in *Allium* roots exposed to diluted raw spent wash with the highest root growth delay (92%) after two days of exposure compared to the negative control ($p < 0.05$). The mitotic index did not show any difference in all exposure conditions. Significantly increased nuclear abnormalities, including micronuclei, nuclear buds, binuclei and condensed nuclei, were observed in root tip meristematic cells of diluted spent wash compared to the negative control ($p < 0.05$). Among growth-related morphometric attributes of tomato plants treated with different spent wash doses (0.5, 1.5, 2.5, 5.0, 7.5 and 10 mL), shoot lengths, the number of leaves and number of buds and flowers were found to have less significant variations. In contrast, other treatment categories recorded significantly reduced fresh fruit weight compared with the positive control ($p < 0.05$). Measured fresh fruit weight was more favourable toward high-end doses. However, this should be confirmed by repeated scientific studies. Results of the experiments reflect that the raw spent wash may have a cytogenotoxic effect, and the spent wash may use as a nutrition supplement by mixing with other organic ingredients. Further experiments for different crops, soil testing, and frequent biological effects monitoring are recommended to verify the spent wash's nutritional use and toxic effects.

Keywords: Sugarcane molasses, Spent wash, Bioassay, Cytogenotoxic, Growth morphometric attributes

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LIST OF ABBREVIATIONS

DOA	-	Department of Agriculture
SLSI	-	Sri Lanka Standard Institution
CEA	-	Central Environmental Authority
ANOVA	-	Analysis of Variance
ATW	-	Aged Tap Water
PC	-	Positive Control
MI	-	Mitotic Index
DAT	-	Days after transplanting
BOD	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
TSS	-	Total Suspended Solids
TDS	-	Total Dissolved Solids
EC	-	Electrical Conductivity
BMDE	-	Bio Methanated Distillery Effluent
DSW	-	Distiller Spent Wash
TMD	-	Tonnes of Molasses per Day
TCD	-	Tonnes of Cane per Day

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