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Evaluation of the effects of Hairdressing Saloon Effluent on the Survival of Juvenile African Catfish (*Clarias gariepinus*) and the Growth of Cucumber (*Cucumis Sativum*).

Abdullahi F. A [1], U.U. Uwais [2], S. Saidu [2], S. Zaky [2] and Yusha'u I.M [2]

1. Department of Biological Science, Faculty of life Sciences, Kaduna State University. Main campus, Tafawa Balewa way, P.M.B 2339, Kaduna State, Nigeria.

2. Department of biological sciences, Faculty of Life Sciences, Kaduna State University, Kaduna State, Nigeria.

Abstract

Hairdressing salons produce effluents that contain a variety of chemicals, including dyes, shampoos, and conditioners, which can enter urban waterways. These effluents pose potential risks to both aquatic ecosystems and agricultural environment. This research aims to investigate the effects of hairdressing salon effluents on the behavioral and survival of juvenile cat fish and the growth parameters of cucumber (*Cucumis sativus*). The study was conducted in botanical garden of Biological Sciences Department, Kaduna State University. Juvenile cat fish (*Clarias gariepinus*) were sourced from a certified supplier in Kaduna metropolis, while the *Cucumis* seeds were obtained from central market, Kaduna State. The juveniles were acclimatized in a quarantine tank for 7days and divide into 4 groups. In four water tanks, 10%, 30%, 50% concentrations of the effluent were added and 120 liters of non-effluent control. The divided juveniles were introduced to the various tanks and a temperature of 24 - 26℃, pH 6.5-7.5 were maintained and monitored. The irrigation treatments consisted of salon wastewater and tap water in a randomized complete block design (RCBD) in three replications. The waste water sample was analyzed for physio-chemical analysis at Kaduna state environmental protection authority (KEPA) using standard method while growth parameters were recorded up to 6 weeks after planting. The study observed a marked decrease in the survival rate and activity levels of juvenile cat fish as the concentration of effluent increased. High survival rate and increased activity was observed in the control group 100%, while survival rates for the low, medium, and high effluent concentration groups were 66.71%, 33.33%, and 0%, respectively. The stem girth and leaf area were not significantly affected by effluent during the period of evaluation but leaf numbers and plant length differ significantly from second week of growth. Some parameters (TDS = 840, Pb=0.24, Cd=0.46, Cu=1.63, Ni= 0.72) show concentration above the permissible limit. Raising awareness among salon owners and the general public about the potential environmental impact of hairdressing waste is essential. However, appropriate wastewater treatment and water management practices have to be followed to remove the toxic elements which could pose hazards to vegetable production and the environment.

Key words: Salon water, Juveniles, Catfish, Cucumber, Environment, Hazard.

Email Address : Fatima.ahmed@kasu.edu.ng (Abdullahi F. A *)

INTRODUCTION

The relationship between environmental health and human activities has garnered increasing attention in recent years, particularly concerning the impact of industrial and commercial effluent on aquatic ecosystems. Hairdressing salons, often overlooked in environmental assessments, contribute significantly to urban wastewater, which can adversely affect local water bodies [8]. Hairdressing salons generate various waste products, including chemical hair dyes, shampoos, conditioners, and other styling products. These substances can contain toxic compounds such as heavy metals, ammonia, and synthetic fragrances which can pollute water bodies and lead to the depletion of oxygen in the water, harming aquatic life and making the water unsuitable for drinking or irrigation [10]. When improperly disposed of, these chemicals can enter drainage systems and eventually contaminate local waterways, posing risks to aquatic life, particularly juveniles that are more vulnerable to environmental stressors [12].

The salon wastewater is composed of relaxer, conditioner, shampoo hair cream, steaming crème; they contain some chemical components which are toxic to plants while others are not. As a result of the lack of information on the nature of the pollutants in beauty hair salon wastewater, their release into water bodies poses several environmental, ecological and health and sanitation problems (Maifadi *et al*., 2020). Wastewater from salons can contain a variety of chemicals, including acids, alkalis, dyes, and relaxers. The ubiquity of microorganisms makes it easier for them to thrive in different habitats of which wastewater from hair dressing saloon have effects on the physicochemical and bacteriological properties of soil.

Nigeria battles with wastewater management; this is a major problem as Nigeria is counted among the developing countries which do not channel much attention towards efficient wastewater management [1].

[1]have reported increased chemical and biological oxygen demands in hair dressing salon effluent contaminated soil. Furthermore, a toxicological evaluation of surfactants and detergents which are major ingredients of cosmetics by USEPA (1997) and Environmental Canada (1999) hinted that surfactants and detergents cause endocrine disorders in fish and wildlife. The effluents contain chemicals which could alter soil and water physical and chemical properties [6]. The survival of juvenile aquatic organisms, such as fish and amphibians, is crucial for maintaining biodiversity and ecological balance. Early developmental stages of these organisms are often more sensitive to pollutants due to their developing physiological systems and smaller body size, making them more susceptible to toxic exposure [3]. Studies have shown that exposure to contaminated water can lead to reduced survival rates, impaired growth, and developmental anomalies in juveniles [20], [21]. Consequently, understanding the specific effects of hairdressing salon effluents is critical for assessing the broader implications of urban waste management practices on aquatic ecosystems. Wastewater can have a positive effect on soil and eventually plant growth, due to its being rich in organic matter and nutrients [9], [13].

Recent research has highlighted the urgency of addressing wastewater pollution from small commercial entities like hairdressing salons. For instance, a study by [22] revealed that salon effluents contained concentrations of pollutants exceeding safe limits established for aquatic life. Similarly, [17] emphasized the need for stricter regulations and better waste management practices to mitigate the impacts of salon discharges on local water bodies.

The discharge of hairdressing salon effluents poses significant risks to juvenile aquatic organisms, with potential implications for biodiversity and ecosystem health. This study seeks to quantify these effects, contributing to the broader discourse on pollution and urban water management.

MATERIALS AND METHODS

The study was conducted in a controlled setting in botanical garden of department, Kaduna State University (KASU). Biological Sciences This is located at latitude 10031’ north and longitude 70026’and altitude of 6.14 meter above the sea level.

The university located approximately on Latitude 10.5586° N and Longitude 7.4408° E in the city of Kaduna, Nigeria (Abubakar, 2023).

Source and Transportation of Juvenile Catfish

Juvenile fishes were used as the model organism due to their sensitivity to pollutants. The fishes were sourced from a certified supplier to ensure health and genetic uniformity, and they were transported to botanical garden of Biological Sciences Department, Kaduna State University in bags filled with water from their original tank, maintaining appropriate temperature and oxygen levels.

Acclimatization of Juveniles

Upon arrival at the botanical garden, the fishes were placed in a quarantine tank with conditioned water (temperature and pH matching supplier conditions). Water parameters (temperature, pH, and salinity) were gradually adjusted over the first three days to match those of the experimental tanks. Fish behavior and health status was monitored during acclimatization, observing for signs of stress (e.g., erratic swimming, surface gasping). Acclimatization lasted for 7 days.

Pre-experimental Monitoring

Before treatment, the initial health of the juveniles was assessed by measuring: Average weight (g), Standard length (cm), General physical appearance (colour, fin integrity, and overall activity level).

Source of cucumber seeds

The seeds of cucumber were sourced from central market, Tudun Wada Kaduna State. The waste water which is the test material was obtained from the Maryam salon located at No: 3 lodge layout, Tudun Wada, Kaduna State. A Randomized Complete Block Design was used for growth of the cucumber seed in three (3) replication. Growth parameters were recorded in 5 weeks (Weekly).

Collection of Hairdressing Salon Effluent

Saloon effluent was sourced from multiple hairdressing salons in the study area to ensure a representative sample using sterilized sampling bottles. Effluent was collected directly from the salon sinks and treatment areas in sterile containers, filtered to remove solid particles and was stored in dark containers at 4°C until analysis.

The sample was put on ice and transported to the Kaduna environmental protection authority (KEPA) biochemical laboratory where the sample was analysed.

Treatment of Juveniles and planted cucumber with Hairdressing Salon Effluent

Control and Treatment Groups:

Sixty juveniles cat fish were divided in to four groups of 15 juveniles each; the treatment groups

were:

i. Control (no effluent)

ii. Low concentration (10% effluent)

iii. Medium concentration (30% effluent)

iv. High concentration (50% effluent)

For Cucumber: i. Control (no effluent: normal water)

ii. Effluent concentration (50% effluent: across the 3 replicates)

Volume of Water Used

i. Control group: 120 liters of water, 0 liters of effluent.

ii. Low concentration group (10%): 108 liters of water, 12 liters of effluent.

iii. Medium concentration group (30%): 84 liters of water, 36 liters of effluent.

iv. High concentration group (50%): 60 liters of water, 60 liters of effluent.

Exposure Procedure

Juveniles were introduced into their respective tanks containing the specified concentrations of salon effluent. Tanks were maintained at consistent temperature (24- 26°C), pH (6.5- 7.5), and dissolved oxygen levels and the tanks were monitored daily for water quality, ensuring conditions remain optimal.

All necessary nutrients were added to the cucumber plants.

DATA COLLECTION

Survival Rate Assessment

The number of juveniles alive and dead in all tanks was recorded daily for 14 days after exposure to effluent treatment. Percentage of survival rate was calculated as:

$$\text{Survival Rate (\%)} = \frac{\text{Number of Organisms Survived}}{\text{Initial Number of Organisms}} \times 100$$

Evaluation of Physical Appearance and assessment of Behavior

A visual assessment of physical health was conducted, scoring on a scale of 15 (1 = poor, 5 = excellent) based on: Coloration (vibrancy and uniformity), Swimming, Feeding, Jumping.

The stem girth, leaf area, leaf numbers and plant length were measured weekly for the cucumber plants.

Data Analysis

Data was analysed using Microsoft Excel version 2010 and ANOVA. Descriptive statistics were used to summarize the findings and results were presented in tables and charts.

Stem height, stem girth and percentage of germination were recorded during the growth of the cucumber plants.

RESULTS AND DISCUSSION

Physico-Chemical Parameters of Salon Effluents.

Table 4.1 shows the physicochemical parameters of salon effluents. The result shows physico-chemical parameters (pH level, dissolved oxygen, temperature, ammonia and turbidity) of different concentrations of hairdressing salon effluent.

Table 4.1 Physico-Chemical Parameters of Saloon Effluents

Parameters	units	Control (no Effluent)	Low conc. (10% Effluent)	Medium Conc. (30% Effluent)	High Conc. (50% Effluent)	National Limit
pH		**7.0**	**6.5**	**6.0**	**5.5**	**6-9**
DO	**Mg/l**	**5.5**	**4.5**	**3.5**	**2.5**	**4.0**
Temperature	**℃**	**25.0**	**24.5**	**24.0**	**23.0**	**Ambient**
Ammonia		**0.02**	**0.05**	**0.10**	**0.15**	**2.0**
Turbidity	**NTU**	**5**	**12**	**20**	**30**	**5**
TDS	**Mg/l**	**200**	**2000**	**7000**	**12000**	**500**
EC	**mV**	**394.34**	**286.22**	**198.46**	**112.50**	**1000**

Table 4.2 shows the effects of hairdressing saloon effluent on the behavioral activities of juvenile fishes; the study shows that the activity level of juvenile fishes decreases as the concentration of the effluent increases. The control group shows an increase in activity, while the higher concentrations lead to a decrease in the activity level.

4.2: Effect of Hairdressing Salon Effluent on the Behavioral Activities of Juvenile Fishes

Water Sample	Behavioural Activities (Score 3-1)			
	Skin Discoloration	**Swimming**	**Feeding**	**Jumping**
Control (No Effluent)	1	3	3	3
Low Concentration (10% Effluent)	2	2	2	2
Medium Concentration (30% Effluent)	3	1	1	1
High Concentration (50% Effluent)	3	1	1	1

Score: Key 1 = Mild 2 = Moderate 3 = High

Table 4.3 shows the effects of hairdressing saloon effluent on the survival of juvenile fishes; the study shows that the survival rate decreases as the concentration of the effluent increases, with the highest survival in the control group and the lowest survival in the high concentration group. The control group having a survival rate of 100% followed by the low concentration group having 66.71% survival rate; then the medium concentration having 33.33% survival rate and lastly the high concentration having 0% survival rate.

Table 4.3: Effect of Hairdressing Salon Effluent on the Survival of Juvenile Fishes

Replicate	**Number of Juveniles at Start**	**Number of Juveniles Dead**	**Number of Juveniles Survived (End of Study)**	**Survival Rate (%)**
Control (No Effluent)	15	0	15	100 %
Low Concentration (10% Effluent)	15	5	10	66.71 %
Medium Concentration (30% Effluent)	15	10	5	33.33 %
High Concentration (50% Effluent)	15	15	0	00.00 %

Table 4.4: Germination percentage of different water type irrigated plant

Germination percentage of salon wastewater irrigated plant	70%
Germination percentage of tap water irrigated plant	85%

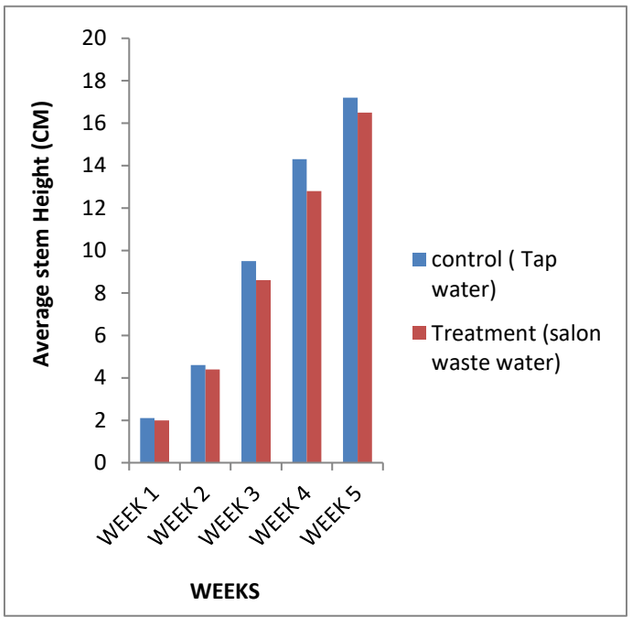

Figure 1: Bar chart showing average stem height of cucumber plant in cm

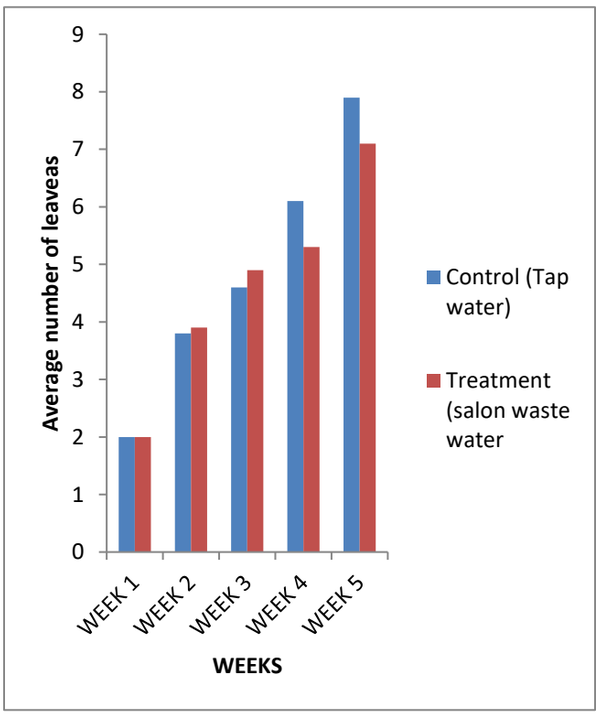

Figure 2: Bar chart showing average stem girth in cm

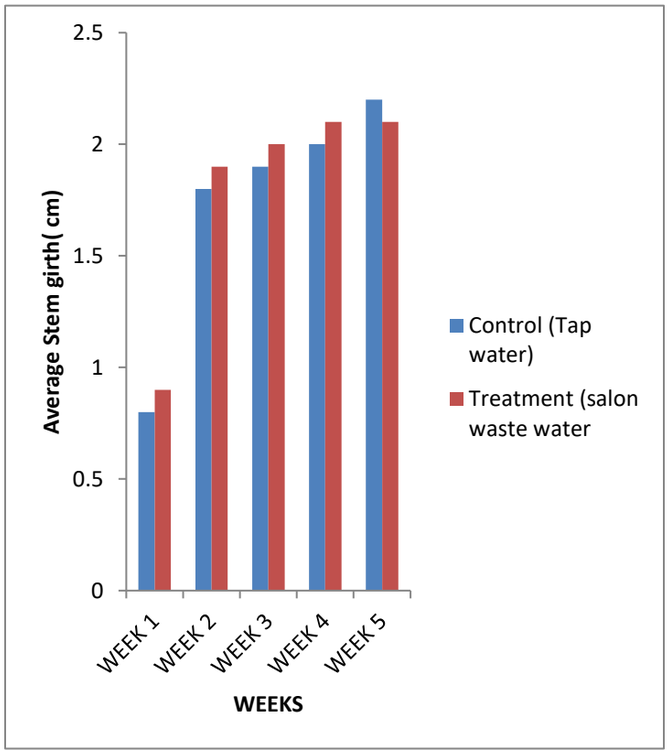

Figure 3: bar chart showing average stem girth in cm

DISCUSSION

The study investigated the impact of hairdressing salon effluent on the survival, growth, and behavioural activities of juvenile fish. The findings demonstrate a clear relationship between the concentration of the effluent and the negative outcomes observed in these aspects of juvenile fish life. Specifically, the study found that survival rates, growth rates, and behavioural activities were all significantly compromised as the concentration of effluent increased.

The study observed a marked decrease in the survival rate of juvenile fish as the concentration of effluent increased. The survival rate in the control group was 100%, while survival rates for the low, medium, and high effluent concentration groups were 66.71%, 33.33%, and 0%, respectively. These results suggest that hairdressing salon effluent is toxic to juvenile fish, with more severe concentrations leading to higher mortality rates.

This finding is consistent with previous studies showing that wastewater from various sources, including domestic and industrial effluents, can have detrimental effects on aquatic life. For instance, research by [15] on the impact of sewage effluent on fish survival found a similar decline in survival rates as the concentration of pollutants increased. In that study, fish exposed to higher concentrations of effluent showed reduced survival, likely due to the accumulation of toxic chemicals and poor water quality. The presence of substances like heavy metals, dyes, and chemical residues from hairdressing products in the effluent could have contributed to the mortality observed in the high concentration group.

The decrease in survival rates could be attributed to several factors, including reduced oxygen levels, the introduction of harmful chemicals, and altered water chemistry due to the effluent. The study also aligns with the findings of [7], in their study of the effect of hair dressing salon effluent on the juveniles of African Catfish (*Clarias gariepinus*) were It was concluded that hair dressing salon effluents had some negative effect on histopathology and behavioural responses of juvenile *Clarias gariepinus*. Therefore, it is recommended that the effluent should be properly treated before being discharged into the environment

[4] similarly concluded that effluents containing chemicals like ammonia and surfactants can create an inhospitable environment for aquatic organisms, leading to a higher rate of mortality.

The study also examined the impact of hairdressing salon effluent on the behavioral activities of juvenile fish. The results showed that as the concentration of effluent increased, the activity levels of the juvenile fish decreased. The control group exhibited increased activity, while the higher concentrations of effluent led to a significant decline in activity levels.

This decline in activity can be attributed to the stress caused by the toxic components in the effluent. Increased concentrations of pollutants in the water can lead to respiratory distress, which may result in lethargy or decreased movement. [19] noted that aquatic organisms exposed to toxic effluents often exhibit abnormal behavior, including reduced locomotion, disorientation, and stress-induced inactivity. In this study, the decreased activity observed in the juvenile fish likely reflects the physiological stress they experienced due to exposure to harmful chemicals in the effluent.

Other studies have similarly documented the impact of wastewater on fish behavior. [5] found that fish exposed to polluted water displayed changes in swimming patterns, reduced exploration, and slower response times to external stimuli. These behavioral changes are often linked to the negative effects of contaminants on the nervous and muscular systems of fish, resulting in reduced activity levels. The findings of the current study reinforce the notion that the pollutants found in hairdressing effluent can interfere with the normal behavioral patterns of juvenile fish, thereby reducing their chances of survival and reproduction.

The findings of this study align with broader research on the effects of pollution and effluent on aquatic organisms. Studies on the impact of various industrial and domestic effluents

Furthermore, the study found a marked reduction in the behavioral activities of juvenile fish exposed to higher concentrations of effluent.

The control group exhibited increased activity, while higher concentrations of effluent resulted in decreased activity levels. This behavioural change is indicative of stress and physiological disruptions caused by the toxic substances in the effluent.
As fish are highly sensitive to changes in water quality, the observed decrease in activity could be a direct result of impaired respiratory function or nervous system disruption due to exposure to harmful chemicals. The results of this research are consistent with previous studies on the impact of various pollutants and effluents on aquatic organisms.

The use of salon wastewater for irrigation of cucumbers did not adversely affect the leaf number and stem girth as compared to tap water. There were some negative effects on plant height and germination rate which can be ascribed to the wastewater components. Appropriate wastewater treatment and water management practices will have to be followed to allow the reuse of untreated salon wastewater for irrigation. Review of the data from the analysis of salon facilities in the study indicates that the liquid waste can be characterized as only slightly more “industrial strength” than typical domestic waste. Product industries should start producing products that are not considered hazardous. Attempts should be made to treat salon effluents before disposal as it would help reduce organic and inorganic substances present.

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