

AITU SCIENTIFIC RESEARCH JOURNAL

Volume 2, Issue 1, 2024
(January-March)

Editor-in-Chief
Dr. Zahid Ali

ISSN:

2578-3882 (Online)

2578-3874 (Print)

2024

www.aitusrj.org



Screening of Bacterial Isolates from Spent Lubricating Oil Polluted Soil for Potential to Produce Biosurfactant

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ABSTRACT

Biosurfactants are surface – transitive biomolecules generated by microbes that have different capability in utilizing crude oil polluted soil, biosurfactants are better than chemical surfactants because of their cost effectiveness, complete degradability and environmentally friendly. The research focused in isolating, identifying and screening bacteria for potential of producing biosurfactants from spent lubricating oil polluted soil from automobile Mechanic Workshop Artillery Barrack, Kakuri, Kaduna, Kaduna state Nigeria. Soil samples were collected and processed. Bacteriological analysis of the soil sample was carried using standard methods. In all, fifteen (15) bacterial strains were isolated, identified and characterized following standard microbiological assay. The isolates include *Pseudomonas aeruginosa* (33%), *Bacillus subtilis* (20%), *Bacillus cereus* (27%), *Staphylococcus aureus* (13%) and *Escherichia coli* (7%) respectively with *Pseudomonas* having the highest occurrence while *Escherichia coli* had the least. The fifteen bacterial isolated were screened for potential of producing Biosurfactants using drop collapse, oil displacement as well as Emulsification activity (E-24) test. Nine isolates out of fifteen identified bacteria were positive for drop collapse test, displacement as well as emulsification activity (E-24) test. Isolate J12 had the highest emulsification activity of (43±0.2) followed by J6 (22±0.0) others are J9 (17±0.1), J15 (16±0.0), J2 (15±0.0), J10 (12±0.0), J13 (11±0.0), J1 (10±0.0) while no emulsification activity on J3, J4, J5, J7, J8, J11 and J14. For oil displacement method, J12 had the highest with (4.1±0.0) followed by J6 and J15 having (3.0±0.0) each. J9 and J2 had 2.5±0.0 and 2.0±0.0 respectively.

KEYWORDS: Biosurfactants, Analysis, lubricating oil, Screening and Bacteria

INTRODUCTION

One of the most prevalent forms of energy in the world, crude oil is made up of an intricate and dynamic combination of hydrocarbons, which mostly asphaltenes, naphthenes, aromatics, saturates, alkanes, and resins (Sakthipriya *et al.*, 2015; Pereira *et al.*, 2019; Jayasena and Perera, 2021). Environmental pollution caused by petroleum hydrocarbons has extensive and detrimental effects on public health, mental health, and the environment. Soil and water environments are frequently contaminated with oil hydrocarbons (OHC), polycyclic aromatic hydrocarbons (PAH), and other hydrophobic substrates, which frequently lead to severe environmental consequences (Ventriglio *et al.*, 2021; Ajibade *et al.*, 2021; Sumudumali, and Jayawardana, 2021). In addition to its inherent poisoning and cancer-causing potential, crude oil has the potential to bioaccumulate, biomagnify, and resist biodegradation, which can cause it to remain in soil environments for an extended period of time following an oil spill (Al-Hawash *et al.*, 2018; Naeem, and Qazi, 2020). Every year, about 2 million tonnes of crude oil enter marine environments as a result of sea-based activities (Zahed *et al.*, 2011). Natural gases, aromatic compounds, and heterocyclic hydrocarbons combine to form petroleum, a multicomplex mixture. Spent engine oil is frequently disposed of in Nigeria, particularly by auto mechanics, into gutters, water drains, and open fields. This oil, also known as waste engine oil or wasted lubricant, is typically collected after car and generator engines have been serviced and drained; the majority of the oil is then thrown into the ground. The used oil contains a comparatively high concentration of hydrocarbons, including extremely hazardous PAH (Wang *et al.*, 2014). heavy metals like iron, nickel, and lead These heavy metals may be linked to organic matter in the soil and retained as oxides, hydroxides, carbonates, and exchangeable cations. The presence of this used lubricating oil can alter the contaminated soil's chemical, physical, and microbiological characteristics. Environments contaminated by petroleum hydrocarbons must be cleaned up immediately. Furthermore, because different pollutants are constantly entering environments as a result of human activity, some remediation strategies—such as physical or chemical ones—are insufficient to completely decontaminate them. On top of this, these methods are typically expensive and time-consuming. Because of this, bioremediation has been widely advocated as an affordable, environmentally benign, and non-toxic biotechnology technique (Zaki *et al.*, 2015; Dangi *et al.*, 2019). Decontamination and reduction of pollutants from the anticipated contaminated environment through microbial activity is known as bioremediation, an important biotechnology technique. By making contaminants more bioavailable to oleophilic microorganisms living in contaminated aquatic and soil environments, biosurfactant—

an environmentally friendly and efficient compound with the characteristics of surfactants produced by certain microorganisms—can improve the process of bioremediation and accelerate the breakdown of petroleum hydrocarbons. Thus, a biosurfactant-optimized bioremediation procedure is essential (Ławniczak, 2013; Rylott, and Bruce, 2020).

The production of emulsifiers and biosurfactants is one fairly effective strategy for the bioremediation of such pollutants by microbial consortia (Jayasena and Perera, 2021). Biosurfactants are surface active metabolites that contain hydrophobic and hydrophilic moieties that reduce surface and liquid-liquid or solid-liquid interfacial tensions (Su-mudumali and Jayawardana 2021). They also improve the solubilization of hydrocarbons into water, which eventually leads to better degradation of these pollutants. Additionally, surface active compounds have applications in enhanced oil recovery, food processing, pharmaceuticals, etc. that can be profitably (Su-mudumali and Jayawardana 2021). Microorganisms that produce biosurfactants, specifically bacteria and yeasts, have been documented. These include species of *Bacillus*, *Lactobacillus*, *Streptococcus*, *Nocardioidea*, *Aeromonas*, *Serratia*, *Rhodococcus*, and *Candida*, as well as *Pseudomonas* (Chen et al., 2020). According to Saktikriya et al. (2015), these microbes are prevalent in soil and water contaminated by hydrophobic organic compounds, such as waste from refineries. There are currently very few commercially available biosurfactants, such as rhamnolipids, sophorolipids, and surfactin. Many synthetic, chemical surfactants primarily derived from petroleum are used to meet the massive market demand for surfactants; these surfactants are typically hazardous to the environment and nondegradable (Ventriglio et al., 2021). Furthermore, because of their selective action, capacity to degrade biologically, and stability at high temperature, pH, and salinity, biosurfactants are more effective and adaptable than many synthetic surfactants. The advancement of this field of study is crucial, particularly in light of the current environmental protection concerns. This study aims to screen microorganisms that produce biosurfactants for the purpose of bioremediating soil contaminated by discarded lubricating oil.

MATERIALS AND METHODS

Study site / Sample Collection

Lubricating oil polluted soil sample were collected randomly from four different automobile Mechanic Workshop Artillery Barrack, Kakuri, Kaduna, Kaduna state Nigeria. The soil samples were collected by digging ground 5cm deep which was collected using sterile spatula and was placed on sterile polythene bag and immediately transported to the laboratory for analysis.

Bacteriological Analysis of Spent Lubricating Oil Polluted Soil

Enumeration, Identification and Characterization of Bacterial isolates

One gramme (1g) of each polluted soil was inoculated in 100ml of mineral salt medium (MSM), which is composed of (K_2HPO_4 0.3g, $MgSO_4 \cdot 7H_2O$ 0.05g, Soluble starch 0.5g, Dextrose 0.5g, Sodium pyruvate 0.3g, Peptone 0.25g, Casamino acid 0.5g, distilled water 1L, pH 7.2) supplemented with 1% crude oil and incubated at 30°C for 72 hours. The process of enrichment and bacterial isolation was done according to Erum et al. (2012). Bacterial isolation was done by spreading 0.1 ml of each culture to the MSM agar plate containing 1% of crude oil. After 48 hours of incubation morphologically distinct colonies were selected and characterized based on cellular and biochemical characteristics including Gram's reaction, cell shape. Motility, aerobic growth, pigmentation, catalase, oxidase, urease, indole, coagulase, methyl red and Voges Proskauer, citrate utilization, starch hydrolysis and spore formation. The procedures outlined by Cowan and Steel (2004) were followed in conducting these experiments. For additional screening, the pure cultures were kept in a refrigerator (4°C) on nutritional agar slants.

Screening of bacterial isolates for biosurfactants producing potential

The ability of each bacterial isolate to produce biosurfactants was assessed by inoculating 10 ml of nutrient broth medium, centrifuging the mixture at 3000 rpm for 30 minutes, and then evaluating the supernatant using three different techniques: the drop collapse test, the oil displacement method, and the emulsification activity (E-24) test.

1. Drop collapse test

Each cavity of a glass cavity slide was filled with two microliters of crude oil; the slide was allowed to acclimatize to room temperature for an hour, after which 5 μ l of the bacterial culture supernatant was added to the oil's surface (test); in the control, inoculated medium was substituted for the bacterial culture supernatant; the shape of the drop on the surface was noted after a minute; cultures that produced biosurfactants and produced flat or less convex drops were scored as positive (+).

2. Oil displacement method

According to Hassanshahian (2014), the diameter of the clear zone, which develops after applying a solution containing surfactants on an oil-water interphase, was measured using the oil displacement method. In this experiment, a Petri dish measuring 90 mm in diameter was filled with 25 ml of distilled water, 100 μ l of crude oil was added to the water's surface, and then 10 μ l of the cell-free culture supernatant—obtained by centrifuging a broth culture that had been incubating for eighteen hours at 6000 rpm for thirty minutes—was added. After 30 seconds, the diameter of the oil as displaced by the cell-free supernatant and clear zone created was measured under visible light.

3. Emulsification activity (E24)

The emulsion index (E24) at 25 °C was used to measure the biosurfactants solution's emulsification activity, in accordance with Wang et al. (2014). After centrifuging an eighteen-hour broth culture at 6000 rpm for thirty minutes, two millilitres (2 mL) of crude oil was separately added to a test tube holding two millilitres (2 mL) of cell-free bacterial supernatant. The mixture was then homogenized by overtaxing it at a high speed for two minutes using a Stuart auto votex mixer. After the homogenized mixture was left to stand for 24 hours, measurements were taken of the mixture's overall height and the height of the stable emulsion layer. The results were used to compute the emulsion index (E24), which is as follows:

$$E24(\%) = \frac{\text{Height of emulsion layer} \times 100}{\text{Total height of solution}}$$

RESULTS AND DISCUSSIONS

A total of fifteen bacterial strains belonging to four genera were isolated and identified in this research as follows *Pseudomonas aeruginosa* (33%), *Bacillus cereus* (27%), *Bacillus subtilis* (20) *staphylococcus aureus* 13 % and *E. coli* 7 % respectively. The results showed that soil samples used harboured various bacteria as showed in table 1. Sixty percent (60) of the total bacteria isolated were gram positive while forty percent (40) were gram negative. Most of the bacteria isolated in this study were linked with the ability to produce emulsifiers which degrade oil polluted soil and water (Femi- Ola *et al.*, 2015). Several different genera of similar organisms were isolated by other researchers from spent lubricating soil samples (Al-Mailem *et al.*, 2017; Ebakota *et al.*, 2017). The results also showed that *Pseudomonas* and *Bacillus* are more dominant than other bacterial isolates this could probably be that both strains form spores and can withstand harsh environmental conditions this is similar to the findings of (Al-Mailem *et al.*, 2017). The frequency of occurrence of gram positive bacteria was higher than gram negative this could be as a result of their distinctive structure and strong cell envelope that can allowed them to proliferate more easily in harsh environmental conditions than gram negative bacteria. This is similar to the findings of (Ebakota *et al.*, 2017). The capacity to isolate significant number of certain bacteria from oil contaminated environment is generally interpreted as proof that these microbes are the active degraders of the contaminants in that ecosystem (Okerentugba and Ezeronye, 2003).

Table 1:

Morphological and Biochemical Identification of Bacterial Isolates in spent lubricating polluted soil

S/N	G/R	Cell shape	Aero grt	Pigments	Motility	Indole	Catalase	Coagulase	Spore	Oxidase	MR	VP	Citrate	Urease	Nitrate reduction	Glucose	Lactose	Maltose	Sucrose	Mannitol	Fructose	Galactose	Mannose	Starch hydrolysis	DNASE	Probable Organisms
1	+	R	+	-	+	-	+	-	+	-	-	+	+	-	+	+	-	+	+	-	+	-	-	+	-	<i>B. cereus</i>
2	+	C	+	+	-	-	+	+	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	<i>S. aureus</i>
3	+	R	+	-	+	-	+	-	+	+	+	-	+	-	+	+	-	+	-	+	+	+	-	-	+	<i>B.subtilis</i>
4	-	R	+	+	+	+	+	-	-	-	+	-	-	-	-	+	+	+	-	+	-	-	-	-	-	<i>E.coli</i>
5	-	R	+	+	+	-	+	-	-	+	-	-	+	-	+	+	-	-	-	+	-	+	-	-	-	<i>P. aeruginosa</i>

Key: Positive (+), Negative (-), Cell shape (Rod) or (Cocci), Gram's reaction (G/R), Methyl red (MR), Voges Proskauer (VG), Aero/grt, (Aerobic growth), B (Bacillus), S (Staphylococcus), E (Escherichia) and P (Pseudomonas)

Table 2:

Percentage Occurrence of Bacteria Isolate from Soil Sample

Bacterial Isolate	Frequency	Percentage (%)
<i>Staphylococcus aureus</i>	2	13
<i>Bacillus cereus</i>	4	27
<i>Bacillus subtilis</i>	3	20
<i>Escherichia coli</i>	1	7
<i>Pseudomonas aeruginosa</i>	5	33

All the bacterial isolates identified in this research were screened for biosurfactant production potential using three different methods (drop collapse, oil displacement and emulsification test E24) (Table 3). The results showed that 9 strains J1, J2, J5, J6, J9, J10, J12, J13 and J15 were positive to drop collapse test with *Pseudomonas aeruginosa* having (33%), *Bacillus cereus* (13%) and *Bacillus subtilis* and *Staphylococcus aureus* having 6.6 % each while 6 strains were negative (Table 3). The bacterial strains that showed the highest potential belonged to the genera *Pseudomonas* and *Bacillus* respectively (Table 3) these bacteria have been known to have ability to survive heavily hydrocarbon contaminated environments. These is similar to the findings of Adebajo, *et al.*, (2017). The level of emulsification activity E-24 and oil displacement was highest by bacterial strains J12 with 43 and 4.1cm followed by strain J9 which had 17 and 2.5cm respectively (Table 3).

Table 3:

Screening of bacterial isolates for potential of biosurfactant production

Strains	Biosurfactants production potential using various methods			Organisms
	Oil displacement (cm)	E 24	drop collapse	
J1	0.5±0.1	10±0.0	+	<i>Bacillus cereus</i>
J2	2.0±0.0	15±0.0	+	<i>Pseudomonas aeruginosa</i>
J3	-	-	-	<i>Bacillus cereus</i>
J4	-	-	-	<i>Escherichia coli</i>
J5	1.5±0.2	0.0±0.1	+	<i>Pseudomonas aeruginosa</i>
J6	3.0±0.0	22±0.0	+	<i>Pseudomonas aeruginosa</i>
J7	-	-	-	<i>Bacillus subtilis</i>
J8	-	-	-	<i>Escherichia coli</i>
J9	2.5±0.0	17±0.1	+	<i>Pseudomonas spp</i>
J10	1.8±0.1	12±0.0	+	<i>Bacillus cereus</i>
J11	-	-	-	<i>Bacillus subtilis</i>
J12	4.1±0.0	43±0.2	+	<i>Bacillus subtilis</i>
J13	0.6±0.2	11±0.0	+	<i>Staphylococcus spp</i>
J14	-	-	-	<i>Pseudomonas spp</i>
J15	3.0±0.1	16±0.0	+	<i>Pseudomonas spp</i>

The results presented in Table 3 the dispersion action shown changes in the dispersion possibilities of the various isolates studied; these variations suggest that the isolates have varying degrees of the biosurfactants activity, which is species-specific and had been previously demonstrated by (Al-Bahry *et al.*, 2013). The variation can also be attributed to different enzymatic activities exhibited by different isolates. The results obtained from emulsification activity in this present study is similar to the findings of (John *et al.*, 2020). For oil displacement zone formation, various bacterial isolates showed varying oil displacement zone formation with the highest produced by *Bacillus spp.* (4.1cm) similar results was showed by work carried out by Adna *et al.*, 2015) which gave oil displacement zone value of 25mm. these was similar with those obtained by Ibrahim *et al.* (2013); Elemba *et al.* (2015) respectively

CONCLUSION

In conclusion, the present study showed that spent lubricating polluted soil harbored the following bacteria *Pseudomonas aeruginosa*, *Bacillus*, *Staphylococcus*, *Escherichia coli*. The results also showed that spore forming bacteria like *Pseudomonas spp.* and *Bacillus spp.* are more predominantly present in oil polluted soil compared to others. The screening results showed that *Pseudomonas aeruginosa* and *Bacillus cereus* have the best Biosurfactants producing potential.

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Assessment of Dietary Pattern and Nutritional Status in Some Selected Primary Schools from Dutsin-Ma Local Government, Katsina State

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ABSTRACT

The dietary patterns analysis give a good impression of the food consumption habits within a certain population. Poor dietary habits of primary school pupils had been reported as a lifestyle change in school. The study aim is to determine the dietary habits and nutritional status of selected primary schools participated within Dutsin-Ma local Government. This study applied a cross-sectional survey observed in Dutsin-Ma community. The volunteered participant were 148 primary school children. Pre-tested questionnaire was used to determine the eating patterns of the children. The determination of nutritional status of the children used Anthropometric measurements (Height, Weight, Head and Waist circumference). The age group between 5-10 years of the three different school participants were 79.2%, 70%, and 76% which constitute the higher age percentage of the participants. Their breakfast composed of Tea/Pap and Bread (54.2%, 68% and 50%), and the higher Lunch percentage belong to the category of Rice/Spaghetti/Macaroni (62.5%, 80% and 96%), meanwhile, the highest dinner percentage (54.2% and 48%) belong to the category of Rice/spaghetti/Macaroni for the first (Girls primary school) participant and second (Federal University Dutsin-Ma (Fudma) staff school) participant while the category of millet/maize swallowed had the highest percentage of 64% for Yerima primary school. All the participants dairy product consumption was yoghurt (68.7%, 64% and 54%). The nutritional status of the participants were also evaluated which indicated that there was significant increase in mean height and head circumference for the male of both Yerima and Fudma staff school participant but the female had significantly increased mean weight and waist circumference. The study showed that the participants had partial or absent of milk, cheese, or butter intake, which are important sources of calcium and other essential nutrients. It is important that parents or guardian promote healthy eating habits of their children, which shall improve their health outcome.

KEYWORDS: Nutritional status; Dietary habit; Participant, Dairy product, Pupil.

INTRODUCTION

A child's early nutrition has been linked to their intellectual development, growth, and well-being. It has also been shown to protect them against illnesses that could impair their ability to study and function (Olumakaiye, et al., 2023). Children in school need to eat enough food to stay healthy. From the standpoint of health promotion, children's food and drink intake during school hours can have a substantial effect on their overall health and well-being (Martinchik, et al., 2020). Due to the fact that diet has an impact on both the appropriate development and growth of young people as well as the maintenance of good health into old age, children and teenagers are the most susceptible group to the effects of poor nutrition (Srivastava, et al., 2012). The most prevalent problems among school-age children include excessive food consumption, a lack of diversity in foods and dishes, low nutritional value foods and beverages (such as cakes, fast food, and sugary drinks), and inadequate consumption of cereal items that include grains, fish, vegetables, and fruits (Budhathoki, et al., 2019). Healthy eating practices during childhood encourage optimal growth, health, and intellectual development in addition to reducing acute health difficulties such impaired ability to learn and work (Onifade et al., 2019). Around 22.1% of people in Nigeria are under the age of 21, making up a sizeable fraction

of the global population, particularly in developing nations (Onifade et al., 2019). Among other behavioral risks, such as poor eating habits, are the main causes of morbidity and mortality in children (Maloney, et al., 2022).

METHODOLOGY

Study design and sample size

A cross-sectional study were carried out in Dutsin-Ma Local Government Area of Katsina State, Nigeria. The sample size was calculated based on the prevalence of a similar study with a similar population. A total sample size of 148 school pupils between the ages of 5-15 years attending public primary school.

Inclusion and Exclusion Criteria: Those who were eligible for inclusion into this cross-sectional study were a cohort of 148 mixed gender, 99 girls (48 in girl primary, 26 in Fudma staff school, 25 in Yerima primary), and 49 boys (24 in Fudma staff school, 25 in yerima primary) aged 5-15 years drawn from girl’s primary school Dustin-Ma Katsina State, Fudma staff school and Yerima Primary school Dutsin-Ma. The pupils whose ages could not be ascertained, those outside the age bracket of 5-15 years and those who did not give their consent were excluded.

Sampling procedure

In this procedure, a random sampling method were applied in selecting the respondents from three (3) different schools where the study conducted. The primary schools randomly selected in the Local Government Dutsin-Ma were Yerima Primary school, Girls primary school and Federal University Dutsin-Ma staff school.

Data collection

The questionnaire was self-administered for data collection by the guardians of the children. The participant were guided as they filled the questionnaires with related information of the study. The participants voluntarily participated without any pressure, and required information was given to the interviewers. The response rate from the volunteers was a good, as all questionnaires were filled and returned. The primary school student's anthropometric measurements—mean weight, height, head circumference, and waist circumference—were taken on the spot. A bathroom scale and measuring tape were used to determine the subject's height and weight. The students were weighed while standing straight on the scale and wearing loose clothing. With their feet contacting the wall jointly, they measured their height by standing up against the wall and marking it. The mid-upper-arm circumference tape was used to measure the mid-arm circumference.

Ethical Approval: Ethical clearance was obtained from the Ethics Committee at the primary schools Dustin-Ma local Government, Katsina State.

Data Analysis: The data obtained was analyzed with SPSS version 24 software for frequency distribution, mean, cross tabulation and Chi square test to examine relationships between variables.

RESULTS

The below table indicated the eating pattern of the school pupil. Majority (79.2) of the student were between the ages of 5-10 years. It describe the eating habits of girls in Dustin-Ma primary school, which states that the number of students that took tea/pap and bread, those that ate rice/spaghetti/macaroni and those that ate millet/maize swallow for breakfast, lunch and dinner. The table also shows the frequency and percentage of students that consume dairy products such as butter, cheese and yoghurt.

Table 1: Eating habits of Girls primary school Dustin-Ma

Variables	Frequency	Percentage%
Age (years)		
5 – 10	38	79.2
11 – 15	10	20.8
Breakfast		
Tea/pap and bread	26	54.2
Rice/Spaghetti/Macaroni	15	31.3
Millet/Maize swallowed	7	14.5
Lunch		
Tea/pap and bread	0	0
Rice/Spaghetti/Macaroni	30	62.5
Millet/Maize swallowed	18	37.5
Dinner		
Tea/pap and bread	2	4.2
Rice/Spaghetti/Macaroni	26	54.2
Millet/Maize swallowed	20	41.6
Dairy products		
Butter	3	6.3

Cheese	6	12.5
Yoghurt	33	68.7
None	6	12.5

Table 2 shows the variables and parameters of the nutritional status of girls in Dustin-Ma primary school such as the mean of the body weight, the mean of the height, the mean of the head circumference and the mean of the waist circumference.

Table 2: Nutritional status of girls in Dustin-Ma primary school

Variables	Parameters
Body weight (kg)	23.63 ± 4.52
Height	47.59 ± 7.02
Head circumference	19.93 ± 2.22
Waist circumference	20.61 ± 0.92

Table 3 shows the majority 70% of the participants are 5-10 years of age and 30% of them are 11-15 years. 68% of the children took meal three times daily, 26% take more than 3 times, 6% took two times, majority of the children eat three times daily.

Table 3: Eating pattern of Federal University Dutsin-Ma staff school pupils

Variable	Frequency	Percentage %
Age (years)		
5-10	35	70
11-15	15	30
Number of meals daily		
Once	0	-
Twice	3	6
Thrice	34	68
More than thrice	13	26
Breakfast		
Tea/Pap and bread	34	68
Rice/spaghetti/Macaroni	16	32
Millet/maize swallowed	0	-
Lunch		
Tea/Pap and bread	3	6
Rice/spaghetti/Macaroni	40	80
Millet/maize swallowed	7	4

Dinner

Tea/Pap and bread	10	20
Rice/spaghetti/Macaroni	24	48
Millet/maize swallowed	16	32

Dairy products

Milk	12	24
Cheese	3	6
Yoghurt	32	64
None	3	6

The below table provided the nutritional status of the pupils, there was a lot of variation in height, weight and ages of the children. The average weight and waist circumference for the male children is significantly less than female category, meanwhile male height and head circumference are significantly higher than the female category.

Table 4: Mean age, height, weight, waist and head circumference of respondent

Gender	Years	Height (inches)	Weight (kg)	Head circumferences	Waist circumference
Male (n = 24)	11.5 ± 0.74	53.6 ± 0.81	23.2 ± 0.48	20.1±0.87	22.5±0.55
female (n = 26)	9.5 ± 0.91	50.8 ± 0.92	25.7 ± 0.53	19.8±1.92	24.5±0.67
Mean Total (n= 50)	10.5 ± 0.33	52.2 ± 0.44	24.45 ± 0.55	19.95±0.59	23.5±0.82

Table 5 shows variables of age, number of meals daily, breakfast, lunch, dinner and dairy product intake of the pupils with its frequencies. The highest percentage age participant is 5-10 years, about 80% ate thrice and they consume more yoghurt than other dairy products.

Table 5: Eating pattern of Yarima primary school Dutsin-Ma

Variable	Frequency	Percentage %
Age (years)		
5-10	38	76
11-15	10	20
16-20	2	4
Number of meals daily		
Once	2	4
Twice	5	10
Thrice	40	80
More than thrice	3	6
Breakfast		
Tea/Pap and bread	25	50
Rice/spaghetti/Macaroni	15	30

Millet/maize swallowed	10	20
Lunch		
Tea/Pap and bread	0	-
Rice/spaghetti/Macaroni	48	96
Millet/maize swallowed	2	4
Dinner		
Tea/Pap and bread	1	2
Rice/spaghetti/Macaroni	17	34
Millet/maize swallowed	32	64
Dairy products		
Milk	13	26
Cheese	7	14
Yoghurt	27	54
None	3	6

Table six shows mean deviation variables of gender, years, height in inches, weight in kilograms, head and waist circumference of the children. There was a lot of variation in height, weight and ages of the children. The average weight and waist circumference for the male children is significantly less than female category, meanwhile male height and head circumference are significantly higher than the female category.

Table 6: Mean age, height, weight, waist and head circumference of respondent

Gender	Years	Height (Inches)	Weight (Kg)	Head Circumferences	Waist Circumferences
Male (n=25)	10.5±0.94	47.3±0.61	25.5±0.82	22.5±0.98	20.5±0.52
Female (n=25)	8.7±0.1145.5±0.84	28.5±0.95	21.5±1.25	24.3±0.61	
Mean Total (n=50)	9.6±0.3246.4±0.42	27.0±0.45	22.00±0.59	22.4±0.88	

5.1. DISCUSSION

Findings from the study revealed that (Table 1) comprises the age group of female students, those within the range of 5-10 years (79.2%) and 11-15 years (20.8%). The eating habits of participants in girl's primary school Dustin-Ma using frequency and percentage, stated that the percentage number of students that took tea/pap and bread for breakfast are 54.2%, rice/spaghetti/macaroni are 31.3% and millet/maize swallow are 14.5%. For lunch no student took tea/pap and bread, but rice/spaghetti/macaroni were 62.5% and millet/maize swallow were 37.5%. For dinner, tea/pap and bread 4.2%, rice/spaghetti/macaroni 54.2% and millet/maize swallow were 41.6%. For dairy product consumption, butter was 6.3%, cheese 12.5%, yoghurt 68.7% and none consumption of dairy products was 12.5%. The children consumed more yoghurt than other dairy products. Table 2 shows the variables and parameters of nutritional status of the participant. The body weight, height, head and waist circumference indicated average value. In this research targeting 48 participants, the limited evidence suggests that the dietary intake patterns in school-going girls, aged 5–15 years shows that they have poor dietary habits and inadequate nutritional status. The low intake of dairy products and proteins, coupled with high intake of carbohydrates has resulted in the imbalance of their diet. The high prevalence of underweight and micronutrient deficiencies indicates that the participants are not getting the essential nutrients required for growth and development (Perin, *et al.*, 2019).

Meals consumed by the pupils (Table 3) majorly consisted of carbohydrate (rice, spaghetti, macaroni, millet and maize swallow) which alone is not enough for a complete and balanced nutritional status as there were little to no traces of vitamins, proteins and animal sourced foods (fish, meat and eggs). Only 4% ate once daily, 10% ate twice a day, 80% ate thrice, 6% ate more than thrice. For the breakfast, tea, bread and pap 50%, rice, spaghetti and macaroni 30%, millet or maize swallow only 20%. For lunch, tea was 0%, rice, spaghetti and macaroni 96%, millet or maize swallow had (64%), Dinner had 2% for tea, 34% for rice and spaghetti and 64% for maize or millet swallow. Dairy products such as milk had 26%, cheese 14%, yoghurt 54% and none for 6%. The mean ages, heights, weights, head circumference and waist circumference from the tables in the results showed a high level of underweight and amongst the pupils. Healthy eating during childhood is important for growth and development (Onifade *et al.*, 2016; Pabayo *et al.*, 2012). Food likes and dislikes play an important role in food choices, especially in children (Scagiloni *et al.*, 2011).

Result from the table 5 indicated that a higher percentage (76%) of the children between the age of 5-10 were participated in the study. The percentage number of meals daily was found to be 80% for those that were eating thrice a day, breakfast, lunch, and dinner. About 4% ate once, 10% twice and 6% more than thrice. For the breakfast, about

half (50%) of them took Tea/Pap and bread, some percentage 30% and 20% preferred rice/spaghetti/ macaroni or maize/millet swallowed for the breakfast. For lunch, majority of the participant (96%) preferred rice/spaghetti/macaroni with little percentage of 4% that preferred millet/maize swallowed for the lunch. Majority preferred taking millet/maize swallowed for the dinner about 64%, while more than quarter (34%) of them ate rice/spaghetti/rice with little percentage (2%) that took Tea/Pap. This study showed a typical Hausa eating habit, that majority preferred Tea/Pap for breakfast, Rice/spaghetti/macaroni for lunch, and swallowed for dinner. The nutritional status of the participant indicated that, the mean height and head circumference of the male were higher than female. The mean weight and waist circumference of female were higher than the male. This indicated that the male side of the participant were taller than the female participant while the female weighed more than the male participant. Previous studies have also revealed that eating breakfast is associated with more healthful food choices and higher diet quality (Sjoberg *et al.*, 2003) while breakfast skippers were found to have lower diet quality and increased energy intake from snacks (Dubois *et al.*, 2008). Although a higher proportion of all the primary school children who participated in this study ate breakfast, lunch and dinner. Growing kids have the tendency to develop an attitude of hard to please with meals especially during the early childhood. Sometimes, meal choices influences eating pattern of children during early years. Good eating pattern is an important factor of child growth and development (De Cosmi *et al.*, 2017).

CONCLUSION

The majority of the participants do not consume foods that promote good health, as most of their meals are inadequate for growth and proper body maintenance. Such meals are not taken within the appropriate times of meals and their nutritional practices are not hygienic. Therefore, recommend that various interventions are put in place to sensitize parents and caregivers on how to become better for the health and development of their children. The study found an association between eating pattern and nutritional status.

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Chemical Composition and Analgesic Effects by Acetic Acid Induced Writhing and Hot plate method of Combined Hydro-ethanol Leave Extract of *Kigelia africana* and *Guiera Senegalesis* In Mice

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ABSTRACT

Some traditional plants are usually used in some part of developing countries for the management of pain. An ache is a common experience observed by the patients, and patient anxiety is a form of warning signal. This work aimed at finding the chemical compositions, antibacterial and analgesic properties of combined hydro-ethanol leave extract (CHELE) of *K. africana* (KA) and *G. Senegalesis* (GS) in mice. Antimicrobial screening of combined hydro-ethanol extracts of KA and GS screened against the *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Salmonella spp* and Ciprofloxacin used as a standard control. The mice were grouped into 4 and administered with acetic acid intraperitoneal and kept in separate transparent cages for observation of abdominal writhing compared to control group (G). G1 Normal control, G2 treated with standard drug (piroxicam 20mg/kg), G3 received extracts at dose of 250 mg/kg bw and G4 received extract at dose of 500mg/kg bw. Plant extract possess significant analgesic activity by decreasing number of writhing made compared to control group. Percentage of inhibition in G3 treated with 250mg/kg significantly increases (31.48%) compared to G2 with inhibition percentage of 1.85%, so also does G4 extract administered at 500mg/kg, which inhibits writhing percentage by 48.14%. In hot plate method, the administration of piroxicam, combined extracts (250mg/kg and 500mg/kg bw) at 120 and 180 minutes after first (30 minutes) and second jumping (60 minutes) decreased the time in seconds. The mice withstand the heat when compared with the control group. CHELE treated at provided doses showed significant decrease in number of writhes compared to the control group. At higher dose (500mg/kg) the combine extract has the highest effect. Preliminary phytochemical analysis of CHELE record the presence of alkaloids, saponins, glycosides, balsams, tannins, volatile oil among others. The CHELE resulted in notable activity for the used bacterial strains as compared to ciprofloxacin. *S. aureus*, *pseudomonas* and *Salmonella spp* shown highly sensitive strains while *E. coli* show none. Gas chromatography–mass spectrometry (GCMS) displayed twenty nine (29) compounds in the combine leave extracts of KA and GS. The antibacterial and analgesic activity might be due to the chemical compositions of the combine extracts of KA and GS, and play a role in pain relief.

KEYWORDS: Chemical Composition, Analgesic Effects, Combined Hydro-ethanol

INTRODUCTION

Certain disorders that occur commonly in patients that experience pain like hyperalgesia, allodynia and hyperesthesia (Mamun-or-Rashid *et al.*, 2017). A number of compounds that possessed analgesic properties so far were isolated from different plant origin, that led scientists to uncover this therapeutic side with better pharmacokinetic and Pharmacodynamics profile with newer molecule (Mamun-or-Rashid *et al.*, 2017).

The plant *Kigelia africana* is a family member of Bignoniaceae popularly known as the sausage tree. The plant has huge fruits, which hangs from long fibrous stalks (Cragg and Newmann, 2001). The root and stem bark of *k. africana* proved to potentially have anti-diabetic, antioxidant and antibacterial properties (Abdu *et al.*, 2020; Said *et al.*, 2019).

The plant remedies are also used to treat some ailment like, hemorrhoids (Oliver-Bever, 2004). *Guiera senegalensis* is a Family member of Combretaceae popularly known as *Sabara* in Hausa. *G. senegalensis* is a shrub of the savannah region of west and central Africa (Umma *et al.*, 2023). *GS* grow with lower rainfall and very lightly dry soils, predominantly found in Western Africa, indigenous to Nigeria, Cameroun and widespread to East Africa in Egypt and Sudan (Umma *et al.*, 2023). *GS* is used widely in traditional medicine for the cure of many diseases. In Nigeria, the leaves and root extract of *GS* were scientifically proved to manage or cure dysentery, diarrhea, gastrointestinal pain, rheumatism, and fever among others. Some phytochemical compounds found in *GS*, might be attributed to the important biochemical properties in the plant.

METHODOLOGY

Collection and Extraction of Plant Leave: The *G. senegalensis* and *K. africana* samples were collected from Safana Local Government Area, Katsina State, Nigeria. Four hundred grams (400g) of the combined sample was extracted with 50% hydro-ethanol (50/50 v/v) by cold maceration for 1 week in order to ascertain maximum extraction with constant stirring. In order to remove the mac, the extract was filtered, then evaporated to dryness at 50°C, over a water bath. The extract would be stored and freshly prepared when required for an experiment.

Animals: The experimental animals used were forty (40) adult wister mice weighing between 20-30g of either sex, 5-6 weeks both sexes used during the study. The mice were purchased from animal houses of ABU, Zaria, Nigeria. The mice were kept and monitor at the separate cages at Federal University Dutsin-Ma, animal house. The mice were kept at normal conditions with standard feed and acclimatized for 1 week before the experiments.

Part 1 group (writhing method) consist of 20 mice which was grouped into 4 with 5 mice each while part 2 group (Hot plate method) were also grouped into 4 with 5 mice in each category.

Chemicals/Drugs: The Chemicals supplied in the experiment were of an analytical grade. This include Distilled water, Normal saline, Ethanol, Piroxicam (Hovid), and Acetic acid.

Preliminary Phytochemical Analysis: The screenings for phytochemical components were carried out as reported in the work of Sisidharan *et al.*, (2011). Standard methods were used to know the nature of phytochemicals present in the hydro-ethanol extract of *K. africana* and *G. senegalensis*. Phytochemical analysis carried out according to standard procedures detects the presence of secondary metabolites like alkaloids, saponins, tannins, glycosides, Balsams, volatile oil, among others.

ANALGESIC STUDIES

Acetic Acid (AA) Solution: For the preparation of AA solution, about 0.7 ml AA was diluted with 100 ml distilled water.

Standard Sample: Preparation of piroxicam at the dose of 20-mg/kg-body weight, 10 mg of piroxicam capsule was taken and a suspension of 10 ml was made.

Acetic-Acid Induced Abdominal Writhing in Mice: The writhing method adopted in the study was described by Gaertner *et al.*, (1999). Twenty (20) wister mice were grouped into 4 with 5 mice in each cage. Group 1 was the normal control treated with 1ml/kg normal saline, Group 2 another control administered piroxicam (10mg/kg i.p), group 3 orally administered CHELE 250mg/kg and group 4 orally administered 500mg/kg respectively. Administration of 1% AA solution (0.1ml i.p) was done after 30 minutes to the four groups. Five minutes after the administration of AA, the number of writhes was counted for 10 minutes.

Percentage inhibition of writhing inhibition was calculated in relation to the control as follows:

$$\% \text{ inhibition} = \frac{\text{inhibition (control)} - \text{inhibition (extract)}}{\text{inhibition (extract)}} \times 100$$

Test in Mice (Hot plate method): The method employed and adopted by Wilson *et al.*, (2003), with some modifications. The pain threshold was used to select the mice, and all the mice would be placed at temperature of 45 ± 1°C singly on the hot plate. The mice responded within 2 sec were selected. Group 1 administered normal saline 30 minutes prior to the pretreatment. Piroxicam for group two, test sample extract for group three and four. The animals were placed individually on hotplate and time taken to react to the heat by the mouse either by licking paws or jumping away from the hotplate was noted. The experiment was repeated after 60, 120 and 180 minutes respectively and the reaction time was noted.

The percentage protection against thermal pain:

$$\% \text{ protection against thermal pain} = \frac{(\text{test mean} - \text{control mean})}{\text{control mean}} \times 100$$

Statistical Analysis: The data expressed as Mean ± Standard Error of Mean. The results were analyzed by Analysis of Variance (ANOVA). The significance level at P< 0.05.

RESULTS

Qualitative Phytochemicals of *Kigelia africana* and *Guiera senegalensis* extracts.

Table 1. Qualitative analysis of phytochemical parameters of combined hydro-ethanol extracts of *K. africana* and *G. senegalensis*.

Parameters	<i>Kigelia africana</i> + <i>Guiera senegalensis</i>
Alkaloid	+++
Flavanoids	+
Tannins	+++
Anthraquinone	+
Saponins	+++
Steroids	+
Glycosides	++
Balsams	++
Volatile oil	++

KEY: +++ Highly Present; ++ Moderate; + partial present

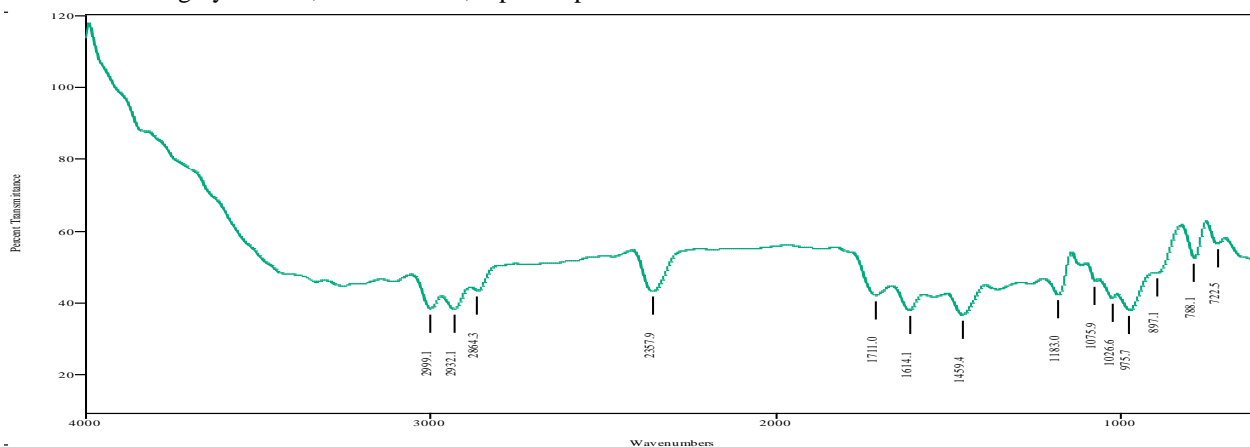


Figure 1: Fourier Transform infrared spectroscopy (FTIR) of the combined hydro-ethanol extracts

Table 2: GS-MS analysis of the combined extracts of *K. africana* and *G. senegalensis*

NO.	RT	NAME OF COMPOUND	MF	AREA	QUALITY
1	5.567	Furan-2-carbohydrazide, (1-methylhexylideno)	C ₁₂ H ₁₆ N ₂ O ₂	4.16	38
2	6.34	5-Deoxypyridoxal	C ₈ H ₉ NO ₂	0.23	87
3	6.558	1,3-Butadiene-1-carboxylic acid	C ₅ H ₆ O ₂	0.19	43
4	6.843	4-Phenylsemicarbazide	C ₇ H ₉ N ₃ O	0.48	44
5	7.019	4,6-Dimethyl,1,3-nitro-2 (1H)-pyridin one	C ₇ H ₈ N ₂ O ₃	0.21	43
6	7.522	Hydroquinone	C ₆ H ₆ O ₂	0.50	46
7	7.65	Butanedinitrile	C ₄ H ₇ N	0.89	46
8	8.017	Methyl 4-pentynoate	C ₆ H ₁₀ O ₂	2.03	47

9	8.778	Bicyclo[3.1.1]heptane,2,6,6-trimethyl-[1R(1.alpha.,2.beta.,5.alpha.)]	C ₁₀ H ₁₈	6.20	48
10	9.009	1,6-Heptadiene, 2,5,5-trimethyl	C ₁₀ H ₁₈	3.10	52
11	9.300	Dodecanoic acid, 10-methyl-,methyl 1 ester	C ₁₄ H ₂₈ O ₂	8.58	74
12	9.626	Butane, 1-(ethenylthio)	C ₆ H ₁₂ S	5.97	50
13	10.46	Heptadecanoic acid, 16-methyl-,methyl ester	C ₁₉ H ₃₈ O ₂	10.46	58
14	11.188	Tert-hexadecanethiol	C ₄₈ H ₉₉ AuS ₃	17.69	50
15	11.914	Eicosane	C ₂₀ H ₄₂	2.27	74
16	12.145	Tetradecanal	C ₁₄ H ₂₈ O	3.24	51
17	12.457	Methoxyacetic acid,tetradecyl ester	C ₁₇ H ₃₄ O ₃	1.59	56
18	12.898	2-amino-4-azido-5-[3,4,5-trimethoxybenzyl]pyrimidine	C ₁₄ H ₁₉ N ₄ O ₃₊	17.59	91
19	15.994	oleic acid	C ₁₈ H ₃₄ O ₂	0.89	84
20	16.795	oleic acid	C ₁₈ H ₃₄ O ₂	0.40	95
21	16.999	2-methyl-z-z-3, 13-octadecadiol	C ₁₉ H ₃₆ O	0.10	94
22	17.148	oleic acid	C ₁₈ H ₃₄ O ₂	0.05	64
23	17.501	1-octadecanesulphonylchloride	C ₁₈ H ₃₇ ClO ₂ S	2.98	87
24	13.842	1-chloroeicosane	C ₂₀ H ₄₁ Cl	0.87	96
25	13.985	2,6,10-dodecatrien-1-ol, 3,7,11-trimethyl	C ₁₅ H ₂₆ O	2.56	55
26	17.177	(Z)-9,17-octadecadienal	C ₁₈ H ₃₂ O	0.029	94
27	27.1343	Stannane,tetraethyl-	C ₁₈ H ₂₀ Sn	0.131	91
28	28.1515	3-(3,4-dimethoxyphenyl)propylamine,PFP	C ₁₁ H ₁₇ NO ₂₀	17.167	41
29	28.7466	1H,3H-furo[3,4-c]furan,1,4-bis(3,4dimethoxyphenyl)	C ₂₂ H ₂₆ O ₇	13.053	93

KEY: = RT (Retention Time), MF (Molecular Formula).

Table 3: Antibacterial assay of combined leave extract of *K. africana* and *G. senegalensis* and their zone of inhibition.

Bacteria	Hydro-ethanol combined extract	Standard drug (ciprofloxacin)
Escherichia coli	-	11.2mm
Staphylococcus aureus	12mm	10mm
Salmonella spp	7mm	9mm
Pseudomonas aeruginosa	9mm	9mm

KEY: = (-) No Inhibition

Table 4: Results showing Number of Writhing and percentage inhibition of *K. africana* and *G. Senegalensis* extracts at different doses against standard drug

Group	Dose	Writhing	% Inhibition
NC	0.1ml	13.50 ± 0.87 ^a	-
Piroxicam	20mg/kg	13.25 ± 1.25 ^a	1.85%
CHELE (250mg/kg)	250mg/kg	17.75 ± 1.89 ^b	31.48%
CHELE (500mg/kg)	500mg/kg	20.00 ± 1.08 ^b	48.14%

Keys: NC = Normal control. CHELE= Combined hydro-ethanol extract of leave extract. Values are mean ± SEM (n = 5). Values with different superscripts within a row differ significantly from each other (P < 0.05).

Table 5. The effect of combine hydro-ethanol extract of KA and GS on hot plate reaction time test in mice

Treatment kg/mg	Reaction Time Sec			
	First jump (30 min)	Second jump (60 min)	Third jump (120 min)	Fourth jump (180 min)
Control	0.1633 ± 0.22 ^a	0.9133 ± 0.35 ^a	0.5100 ± 0.72 ^a	0.6533±0.44 ^a
Piroxicam 20mg/kg	0.2433 ± 0.15 ^a	1.0667 ± 0.67 ^b	0.8033±0.10 ^a	0.7733±0.14 ^a
CHELE (250mg/kg)	0.1633 ± 0.88 ^a	1.8600 ± 0.14 ^b	1.0433±0.21 ^b	0.9833±0.18 ^a
CHELE (500mg/kg)	0.2867 ± 0.27 ^a	1.3667 ± 0.27 ^b	1.1433±0.23 ^b	0.8300±0.20 ^a

Values are ± SEM (n=5). Values with different superscript in the same column represent significance different (p<0.05).

DISCUSSION:

The preliminary phytochemical screening of combined hydro-ethanol leave extracts (CHELE) of *K. africana* (KA) and *G. Senegalensis* (GS) detected the presence of some secondary metabolites that are highly present (alkaloids, tannins and saponins), moderately present (glycosides, balsams and volatile oil) and partially present (flavanoids, anthraquinones and steroids). Some of These phytochemical constituents possess different pharmacological properties like saponins, glycosides, alkaloids among others were found to have anti-inflammatory, anti-allergic effects, antimicrobial, anti-nociceptive, antioxidants, anticancer, antidepressant, antidiarrheal and hepatoprotective effects (Soetan *et al.*, 2006; Akkol *et al.*, 2007; Singh *et al.*, 2010 and Yassin *et al.*, 2013).

FTIR analysis was detected in the above spectrum: sp² -hybridized CH bonds (2999.1-2357.9 cm⁻¹), sp³ -hybridized CH bonds (1711.0-1459.4 cm⁻¹). Absorption bands due to the nitro group: 1183.0 and 722.5 cm⁻¹. The nitro group is conjugated with the benzene ring because they were at lower wave numbers than usual. These absorptions usually determine the nature of the functional group present in the compound being considered by the spectrum. Many functional groups require the presence of several characteristic absorptions. Result from the GC-MS analysis showed 29 compounds detected in the CHELE of KA and GS. The compounds are coming from carbohydrate, lipids and nucleic acid. Some of the compounds present are Furan-2-carbohydrazide, (1-methylhexylideno), 5-Deoxyypyridoxal, 1,3-Butadiene-1-carboxylic acid, 4-Phenylsemicarbazide, 4,6-Dimethyl,3-nitro-2 (1H)-pyridin one, Hydroquinone, Butanedinitrile, Methyl 4-pentynoate, Methyl 4-pentynoate, 1,6-Heptadiene, 2,5,5-trimethyl, Heptadecanoic acid, 16-methyl-,methyl ester Eicosane, oleic acid, 2-amino-4-azido-5-[3,4,5-trimethoxybenzyl] pyrimidine among others. The compounds detected were 29 and oleic acid present in 3 different areas of 0.89, 0.40 and 0.05. These compounds might act mutually, trigger to protect the organ damage during oxidative stress, by either inhibiting or scavenging free radicals such as superoxide anion radical (O₂⁻), hydroperoxyl radical (HOO[·]), hydrogen peroxide (H₂O₂), hydroxyl radical (OH[·]). Compounds like oleic acid, 2-methyl-z-z-3, 1,3-octadecadiol, 1-octadecanesulphonylchloride, 1-chlorooleic acid, benzene, carbonic acid, as part of their functional groups and might help in satisfying the free radicals by donating the electron.

The antibacterial properties of CHELE against bacterial strains *E. coli*, *Salmonella spp.*, *P. aeruginosa*, and *S. aureus* found that the CHELE exhibit different remarkable antibacterial properties. CHELE showed no activity on *E. coli* and observed maximum activity on *S. aureus*, *P. aeruginosa*, and *Salmonella spp.* Standard antibiotic drug (ciprofloxacin) was used to compare these results. The plant stem bark so also the root and fruits extracts of KA using microtiter plate bioassay, possesses good antibacterial properties (Said *et al.*, 2022 and Owolabi *et al.*, 2011).

In the mice writhing assay, the CHELE significantly (P < 0.05) decreased the acetic acid induced abdominal writhing in mice. The group that was treated at the highest dose of 500mg/kg bw showed highest percentage inhibition of about 48.14% when significantly compared the inhibition of 1.85 % by Piroxicam (20mg/kg). The visceral pain model is acetic acid induced abdominal writhing model used generally for screening plants and new agents for analgesic activities (Gene *et al.*, 1998; Aliyu and Sama'ila, 2015). The non-specific nociceptive model is also associated with acetic acid test (Bighetti *et al.*, 1999). Pain mediators release like prostaglandin and cytokines occur when administration of intra-abdominal injection of AA, that might be cause for the pain inducement (Ikeda *et al.*, 2001).

In Table 5, the CHELE observed in mice by model of hot plate showed a significantly ($P < 0.05$) increased analgesic activity in all the extract and standard drug treated groups at the second jump (60 minutes) when compared with the normal control (group 1). Then, at third jump (120 minutes) and fourth jump (180 minutes) the effect of CHELE dropped. Standard drug treated group showed significantly ($P < 0.05$) much reduction at 180 minutes. At dose of 250 mg/kg with reaction time of 60 minutes has the highest protection.

CONCLUSION

It can be concluded that, CHELE of KA and GS possess a dose dependent analgesic activity and antimicrobial properties. Because of the chemical compounds detected and bioactive secondary metabolites with significant analgesic and anti-microbial properties can justify its use in pain.

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Examining the Leadership Abilities of Head Teachers in Public Sector Primary Schools at Karachi Pakistan

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ABSTRACT

The objective of this study was to examine the administrative abilities of head teachers in public sector primary schools in the Korangi district. The study design employed was a descriptive survey utilizing closed-ended questions. The study population comprised 95 public primary schools (N=95). The survey had a total of 215 participants, with 95 being head teachers and 120 being teachers of both genders. The study utilized the Simple random sample technique to gather data from school head teachers and teachers in four municipalities of District Korangi. The study included a self-designed questionnaire to obtain data on administrative skills. The findings indicate that gender does not determine conceptual, human, and technical capabilities. However, the successful execution of administrative skills and talents is heavily influenced by the level of qualification and experience. The study findings revealed that elementary school teachers expressed dissatisfaction with the performance of their head teachers. Most teachers and head teachers were uninformed about their obligations and held negative views regarding their head teacher's administrative capabilities. Furthermore, the study's findings revealed that a significant number of head teachers exhibit a distinctively autocratic and negligent demeanor, which poses obstacles in their relationships with instructors. Head teachers should demonstrate proactive leadership by addressing internal conflicts and fostering positive relationships to effectively harness the potential of their human resources. Head teachers should organize in-service training programs to enhance their technical proficiency and inspire them to cultivate their skills at all levels. Concrete recommendations were derived from the study findings.

Keywords: Leadership Abilities, Administrative, Head Teachers, Primary level

INTRODUCTION

This study aims to examine the significant drop in the standard of government schools in Karachi, which were once highly effective just ten years ago. It is distressing to watch this decline. The majority of primary schools in Karachi are not adhering to the fundamental principles necessary to guarantee high-quality education. The majority of schools in the Korangi district are experiencing several issues that have been commonly identified in studies. These issues include inadequate governance and administration, subpar infrastructure, political interference, insufficient number of qualified teachers, lack of staff punctuality, absence of basic amenities, and an unfavorable learning environment. It is necessary to assess the administrative skills of the head teachers in a methodical and structured manner. Consequently, a researcher has undertaken the task of analyzing the administrative capabilities of head teachers at public sector primary schools in the Korangi area. Currently, there is a lack of research conducted on this highly significant topic. The effectiveness of administration can be assessed by the presence of a conducive learning process. A head teacher is an individual who holds a position of leadership and authority within a school. The head teacher assumes responsibility for the teaching of all students, the supervision of staff, the establishment of educational goals and direction, and the formulation of school policies. Ultimately, head teachers are accountable for ensuring the efficient operation of a school rather than actively instructing in classrooms. Head teachers effectively guide, inspire, and oversee personnel by assigning tasks, establishing expectations, and assessing staff performance. This work necessitates robust engagement with both internal and external stakeholders, both within and outside of

the institution (Ahmad, Ali, & Sewani, 2021). The head teachers in Government schools lack administrative advice and practical experience, as their appointment is based only on seniority. This also leads to a disparity between their instructional and managerial responsibilities. The appointment of head teachers, at all levels, is primarily based on seniority rather than on suitable expertise. Consequently, they administer their schools through rigorous assessments. Consequently, they transform into individuals who merely patch up issues instead of effectively resolving them. Memon (2000) asserts that head teachers bear the ultimate responsibility for ensuring the efficient operation of a school. The head teacher ensures the high standard of academic performance. While the head teacher may have extensive expertise, their primary responsibility is to provide educational guidance and leadership, rather than actively teaching in classrooms. Qutoshi and Khaki (2014) demonstrate that head teachers effectively lead, inspire, and oversee personnel by assigning roles, establishing tasks, and assessing staff performance. This job necessitates robust engagement with all stakeholders, both within and outside of the institution. The head teacher is considered a change agent responsible for overseeing and motivating others to attain objectives. Head teachers have advanced qualifications, extensive years of experience, and significant exposure to academic and professional training. The primary responsibilities of the head position encompass leadership, supervision, and management. As facilitators or change agents, individuals should possess strong administrative skills and decision-making abilities. They must be prepared, equipped, and dedicated to meeting the requirements of children, addressing the concerns of parents and teachers, and tackling the various challenges posed by the community in terms of learning, economic, public, and cultural aspects.

The administration of an institution must strive for optimal outcomes. The administrator is responsible for designing, implementing, and enhancing the academic programmes. The main component of the institution is responsible for providing guidance and facilitating the growth of others in conjunction with itself. It encompasses more than just the administrative role. An administrator is entrusted with numerous obligations that necessitate proficiency in management, academic knowledge, and other relevant skills. The ability to make sound decisions is crucial for excelling in this role. An excellent headmaster demonstrates optimism, confidence, and adeptly maintains positive relationships with people while overseeing the work of instructors. An effective administrator maintains strong communication and fosters a supportive relationship with the pupils. This may address the issue of discipline since it allows the pupil to become acquainted with their headmaster. A competent headmaster possesses exceptional social skills. The head teacher assumes the position of an educational leader in order to address challenges, enhance the skills of the staff, and create a conducive environment for teaching and learning. Efficient governance enhances the individual's rapport with educators and the community, thereby fostering school advancement. The entire management of the school is dependent on the head teacher, meaning that the success or failure of the school is in their hands. Head instructors establish objectives and goals in accordance with national objectives, and delegate responsibility to staff members based on their specialization and expertise. According to Westman and Keith (2010), head teachers fulfil their responsibilities of overseeing, administering, making decisions, managing, and establishing educational improvements in schools. Pakistan has three main educational systems: public, private, and religious. These systems cater to the educational requirements of its population, which is approximately 200 million.

Government schools consistently encounter several issues related to inadequate resources and substandard conditions and education. Most school head teachers mostly operate as passive recipients of governmental decisions rather than actively contributing to the development of quality education in schools. A majority of Pakistani youngsters enroll in government schools as a result of their poor household finances. Khan (2010) highlighted the fact that Pakistani school administrators lack a comprehensive grasp of their role, mostly due to the absence of professional development programmes. They limit themselves to administrative duties rather than actively engaging in educational processes within schools, such as overseeing, professional development programmes, or enhancing the curriculum. Typically, head teachers are expected to fulfil both their academic and administrative responsibilities concurrently. Inadequate proficiency, ambiguous job responsibilities, and insufficient professional knowledge lead to unsatisfactory results. Similarly, primary schools are managed by head teachers who are promoted based on their seniority. According to Kandasamay and Bleton (2004), there are three essential qualifications that an individual must have in order to become the head teacher of a public school. 1. Pedagogical expertise 2. Duration of service 3. Excellent Annual Confidential Reports (ACRs).

Khan (2012) argue that school heads, who are selected based on seniority from the teaching staff, lack fundamental leadership abilities. The recruitment of head teachers neglects the development of management and interpersonal skills, resulting in a reduced capacity to make effective judgments due to inadequate training. Warwick and Reimers, (1995) classified Pakistani school principals as individuals who lack administrative skills and are unaware of their roles and responsibilities. Memon (2000) stated that Pakistan lacks well-defined government

policies that priorities the role of school heads and their professional growth. Therefore, head teachers have a limited comprehension of important ideas such as the formulation of a vision, involving others in decision-making, distributing authority, evaluating and assessing, teaching techniques, engaging parents and the community, and other educational and leadership matters. Khan (2010) expressed disapproval of the managerial abilities of head teachers in Pakistan. Typically, head instructors possess a bachelor's and master's degree. The majority of head teachers lack professional expertise. Khan (2000) highlighted that in Government primary schools in Sindh, the promotion of head teachers is primarily based on seniority and the possession of sufficient Annual Confidential Reports (ACRs), with around 85 percent of head teachers being promoted through this criteria. The head teacher writes ACRs (Annual Confidential Reports) for instructors by observing several aspects.

The head teachers in the public sector lack both administrative training and managerial skills. Their primary emphasis is on management rather than academics, leading to an imbalance between their teaching and administrative responsibilities. Typically, elementary school head teachers are appointed without undergoing any induction or orientation process. Consequently, they acquire skills and techniques through practical experiences while on duty. It enables them to excel at resolving issues rather than merely identifying them, (Dinham, 2005). Researchers have proposed that there exists a substantial disparity in the selection criterion for head teachers in Pakistan compared to other nations. It is imperative to ascertain the specific information, abilities, and strategy required for head teachers to achieve success as school leaders and managers. In the present day, the tasks of administration and management have become more intricate and varied. Consequently, schools want capable, well-structured, and dedicated Head teachers who can effectively address the demands of the 21st century. Qutoshi & Khaki (2014) suggested that substantial modifications are necessary in educational administration to enhance the efficiency of the system. Acknowledging the importance of educational leadership, many mechanisms have initiated a series of educational reforms. Therefore, it is necessary to make efforts to comprehend the responsibilities of head teachers and ascertain the specific information, abilities, and attitude required to become an efficient school administrator and successful management (Ahmad & Hamid, 2021).

LITERATURE REVIEW

In Pakistan, education serves as a vehicle for enacting national development. The National Education Policy has established aims and objectives for Pakistan's educational advancement. A key role that head teachers play in accomplishing these aims and goals. As an administrator, manager, and leader, the head of school holds a special position and uses school resources to further institutional objectives (Khan, et al. 2020). In Pakistan, school management has not received enough attention in the past few years. It is becoming increasingly clear that we need better educational pioneers as we struggle to advance in our shift towards change. Due to this lack of investigation, chiefs and strategists are unable to comprehend the full scope of the challenges facing Pakistani school heads (Mansoor, 2015). In Pakistan, the National Education Policies also emphasized the value of professional development for school employees. Through school clustering and other strategies, the National Education Policy 1998–2010 advocated for the institutionalization of in-service training for educators, teacher trainers, and educational administrators in order to boost the efficacy of the professional development system. Khan (2012). However, the National Education Policies highlighted the need for reform in all domains, including professional development, pre-service training and qualification standardization, teacher salary, career advancement, and status, and governance and management of the teaching workforce.

Head teachers are now spending more time in study halls than in offices due to a significant shift in the past few decades in the conventional responsibilities of administrators, with student learning and accomplishment remaining the primary objectives. Education is a profession that requires administrators just like any other. The academic environment is changing quickly these days, and qualified school administrators who possess the abilities to overcome significant obstacles and improve student achievement are becoming an increasingly crucial component of this paradigm change. Over the past few decades, numerous modifications have been made to school management. The head teacher's job used to be solely administrative, but it has since expanded and become more demanding. Teachers are undoubtedly the most visible individuals in the classroom, but head teachers are ultimately in charge of creating the ideal learning environment. In order to achieve the advancements and progressions needed in public schools, there are a few standard characteristics that apply, even though the stated tasks of head teachers vary depending on the school level they oversee. We now hold them more accountable than ever for the development and upgrading of an environment that supports individual understudy learning and advancement due to the advancements in teaching methodologies. Through research, head teachers have a significant impact on the success of schools. While this impact is not directly related to the head teacher's role, it is indirectly related to the actions, instructions, and policies the head teacher implements in the classroom to meet the objectives of education.

Contemporary school principals should possess a high level of knowledge and demonstrate professional and administrative competence. The government should allocate resources to support principals by sponsoring their attendance at conferences and providing opportunities for professional development. This will not only promote their professional growth but also serve as an incentive for their performance. Additionally, principals should collaborate with teachers to define objectives, as their involvement in the decision-making process will enhance their commitment to achieving these objectives, (Ogundele, et al., 2015)

The position of head teacher leadership has evolved in tandem with school administration's rising complexity and power in response to everyday, higher-level learning objectives. These days, the head teacher is in charge of overseeing all parties involved, including students, parents, instructors, board members, and policy makers. According to Mangin (2007), the head teacher serves as a liaison between the community and the school, providing the necessary financial, human, and intellectual resources to provide the frameworks necessary for efficient teaching and learning. The way a school is run has a significant impact on its character. The mechanism that allows an organization or establishment to be managed is called organization. It is therefore a system or arrangement for the efficient operation of any association, including educational institutions. The board receives direction, oversight, and authority over all matters pertaining to schools from the instructive organization. Direction is provided by the authorities within the educational system and the community, and control and organization function as teaching tools. Sidhu (1996–). A school's principal is thought to possess abilities in personnel utilization, curriculum development, management, and coordination. They also oversee all major activities carried out in the school. In the sphere of education, management plays a crucial role. The accomplishment of established objectives and goals is not feasible in the absence of coordination and management by all parties involved in the field of education. The foundation of both student growth and school improvement is the administration of the school. In instructional leadership, teachers receive support in their pedagogical techniques and problem-solving abilities. The institution's head promotes, encourages, and lets teachers acquire new skills in order to meet the social and intellectual demands of the pupils. It is the fundamental responsibility of the head of the school to be involved in the teaching and learning process; to observe teachers in action and assist them in improving instruction; to set and communicate the goals of the school; to direct and assess instruction; to organize educational programs; to monitor the educational progress and improvement of the students; to ensure instructional time; to maintain high standards; to provide teachers with encouragement or support; to advance proficient improvement; to create and implement scholarly standards; and to provide learning with motivating forces. The instructional administration views the head teacher as the institution's leader (Ahmad, Sewani, & Ali, 2021; Ahmad, Thomas, & Hamid, 2020).

The management, control, and instruction of the educational programs, peaceful consideration, discipline, appraisal assessment, asset distribution, costing and planning ahead, staff liaison, and the application of commonsense skills necessary in long-term strategies of association, such as judgment, arrangement, correspondence, handling conflicts, holding meetings, etc., are all components of school organization. These tasks can be broken down into the following categories: planning, organizing, supervising, and evaluating the educational establishments. The head of the school's operations should ensure that these lead to efficient instruction and learning outcomes in the classroom. As a result, the head of a school serves as a coordinator, administrator, regulator, facilitator, and problem solution. According to Kelechukwu (2011), the head teacher is the administrator and occupies a crucial role in the school. He is the employees' and students' personal manager. In addition, he oversees finances and is responsible for communicating with the government and stakeholders. Head teachers oversee a variety of responsibilities, including staff and student administration, curriculum development, instruction, school finances, planning, and other general duties. He is a standard-setter, someone who takes the lead in encouraging teachers and students to have high expectations of their performance (Imran, et al., 2023; Khoso, Oad, & Ahmad, 2023). According to Amina (2022), leadership styles propounded by different scholars have been evolving. Therefore, providing quality leadership amid crises and pandemics gives rise to the exploitation of new ways of leadership style. The literature on this topic provided an overview of school organization and its importance to head teachers in particular. Schools' administrative duties cannot be disregarded. Although the field of studying school policies is new, it will continue to grow as more schools are established. Examining school policies has grown crucial since schools need skilled management to oversee employees and achieve goals. Educational objectives cannot be achieved if there is no authority or if the organization is unable to manage the resources entrusted to it. Implementing educational policy correctly calls for capable administrators who can make efficient use of both human and material resources.

METHODOLOGY

The survey research strategy was implemented. Surveys are employed because of their significant advantages, such as being a study conducted in the field and the convenience of approaching a large number of respondents. Conducting the task is straightforward given the scarcity of resources in terms of time and money. Research can easily engage in direct connection with study respondents and collect data without squandering valuable resources. Survey research involves gathering data from a subset of persons by asking them questions, as described by Check and Schutt (2012). The survey research strategy is commonly employed to analyze and investigate human behaviors in the fields of Social Sciences, Education, and Psychology (Dixon, et al., 2016). The study primarily examined the administrative abilities of head teachers in public sector primary schools located in the Korangi region of Karachi. The technique is valuable for examining, comprehending, and evaluating the efficacy of administrative abilities of head instructors.

FINDINGS AND DISCUSSION

The vast majority (96%) of primary school teachers believe that head teachers do not effectively manage staff attendance for timeliness. 58% of primary school teachers reported that head teachers do not regularly visit classrooms to observe current teaching and learning activities. According to 63% of primary school instructors, head teachers are often negligent in overseeing the lesson plans created by the teachers. Primary school teachers report that, in the majority of cases (51%), head teachers do not assess teacher observations and fail to provide them with essential guidance for improvement. (88%) Teachers from public sector primary schools report that head teachers are typically hesitant to delegate certain responsibilities to their staff. According to 62% of instructors in public sector primary schools, head teachers generally lack faith in evaluating the preparation and execution of the curriculum. (63%) Primary school instructors believe that head teachers frequently neglect to regularly evaluate staff performance. Based on the findings of a survey conducted among 63% of primary school teachers, it is commonly observed that head teachers often fail to acknowledge the factors that drive motivation among their staff and children. The user's text "(60%)" remains unchanged. Primary school instructors reported that head teachers often fail to ensure that staff members are working collaboratively. The majority (83%) of primary school teachers believe that head teachers lack the technical skills to effectively allocate existing finances based on the priority of really important expenses. Approximately 61% of primary school teachers reported that head teachers generally lack sufficient training in maintaining the cash book, as well as handling supporting vouchers and bills. (68%) Primary school instructors often assert that head teachers are often permissive in procuring funding from sources other than the government for the purpose of enhancing the school.

According to 61% of primary school instructors, head teachers frequently neglect to ensure the orientation of new students in their school. Approximately 55% of primary school instructors believe that head teachers generally show a lack of interest in consulting with students. (50%) Teachers from public sector primary schools assess that head teachers typically possess a conventional mindset and do not foster the development of innovative ideas from teachers. Approximately 56% of primary school teachers report that head teachers often fail to make essential decisions for school improvement. Approximately 55% of primary school teachers believe that head teachers tend to avoid frequent meetings for the purpose of making decisions. Approximately 53% of primary school teachers report that head teachers frequently neglect to involve staff members in decision-making and matters that affect them. (52%) Teachers from public sector elementary schools claim that head teachers fail to cultivate a positive rapport with the community and stakeholders. Approximately 57% of primary school teachers typically organize Parent-Teacher Meetings (PTMs) and actively seek input and guidance from parents. The percentage is 71%. Teachers from public sector primary schools report that a majority of the head teachers do not engage the community in school programmes. Approximately 54.2% of head teachers in elementary schools do not value the efforts made by their workers. Primary school instructors report that head teachers are often hesitant to publicly praise staff initiatives and prefer to provide private criticism, according to 64% of respondents. (53%) Teachers from public sector elementary schools think that head teachers lack the ability to effectively manage difficult situations.

According to the perception of 55% of primary school teachers, head teachers typically exhibit biased attitude during conflicts. According to the perspective of 56% of primary school teachers, head teachers generally struggle to establish trust between instructors and students. Primary school teachers, according to 61% of them, believe that head teachers do not generally exhibit the behaviours that they demand from others. According to 55% of primary school teachers, head teachers often display biased behavior and do not provide equal opportunity to all staff members. Additionally, 55% of teachers from public sector primary schools report that head teachers frequently neglect to ensure the effective execution of government policies. According to 58% of primary school teachers, head teachers typically neglect their obligation to offer essential amenities for pupils and staff. According

to 66% of primary school teachers, head teachers are unsuccessful in creating a conducive learning atmosphere. Approximately 52% of primary school teachers report that head teachers demonstrate a general lack of concern when it comes to safeguarding school resources. The majority (69%) of primary school teachers report that head teachers fail to assume responsibility for the development of new instructional content. According to a primary school teacher's opinion, around 54% of head teachers typically lack interest in the cleaning and maintenance of school assets. Approximately 53% of primary school teachers believe that head teachers generally neglect their duty to foster a culture of accountability. Approximately 59% of primary school teachers report that the school's objectives have not been properly articulated, primarily by the head teachers. Primary school instructors report that 53% of head teachers have failed to manage and follow the timetable. (62%) Teachers from public sector elementary schools believe that head teachers do not consistently provide monthly assessments. Approximately 64% of primary school instructors hold the belief that head teachers demonstrate negligence when it comes to assessing students' exercise books. Approximately two-thirds (66%) of primary school teachers report that head teachers lack a solid foundation of expertise in disciplinary practices.

CONCLUSIONS

This study was conducted by reviewing relevant literature and administering questionnaires to determine the fundamental administrative skills possessed by head teachers in public sector primary schools. The findings revealed that a significant majority of head teachers lack the essential administrative skills that are vital for school development. The latest research revealed that male and female head teachers possess equivalent administrative abilities. Head teachers with higher levels of professionalism, qualifications, and overall experience tend to possess superior administrative skills compared to those who are less qualified, less educated, and less experienced. The study aimed to observe the various administration abilities of head teachers, such as conceptual, human, and technical skills, in public sector primary schools located in the Korangi district.

RECOMMENDATIONS

Head teachers in today's educational system must possess a high level of knowledge, expertise in both management and professional matters, as well as practical skills in order to support government initiatives and effectively implement policies. Teachers were found to believe that their head teachers do not fulfill the majority of their duties. Primarily, their efficiency was subpar. To enhance their efficiency, individuals must fulfill their allocated obligations. Due to the limited scope of this small-scale study, it is challenging to provide definitive recommendations. However, the following proposals are proposed to enhance school management and improve the quality of education. A head teacher must possess both knowledge and skills. Therefore, it is necessary for the government to arrange training sessions, refresher courses, and seminars to increase their professional abilities. In order to enhance the quality of education and ensure the appointment of competent individuals, it is advisable to promote experienced experts as head teachers. Appointing someone as a principal only based on their experience is akin to jeopardizing the success of an institution. While expertise is valuable, the selection process for a head teacher should include a set of specific criteria. The government should provide training to head teachers both before they start their job and throughout their service in order to enhance their competencies. The government should ensure accountability and implement checks and balances for all the responsibilities and job descriptions of their head teachers. In order to enhance intrapersonal interactions between head teachers and teachers, it is important to recognize that a head teacher cannot effectively operate independently without the collaboration of instructors. The head teacher should collaborate with teachers to clearly articulate the objectives and ensure their successful attainment, as teachers have actively contributed to the decision-making process about these aims. The Head teacher should prioritize academic matters by minimizing the time spent on secretarial and administrative tasks. Head teachers are advised to actively engage the local community and many stakeholders through Corporate Social Responsibility (CSR) in order to enhance the school facilities. It is advisable to convene staff meetings in order to deliberate on their academic advancement and challenges. Head instructors must possess precise financial data on their school. Head teachers should proactively adopt numerous measures to enhance the well-being of their staff members, such as improving working circumstances, upgrading infrastructure, and ensuring cleanliness, instead of depending solely on the government. In order to achieve generality, it is imperative to gather the perspectives of both parents and students in additional research studies. To evaluate the head teacher's approach and actual growth in institutions, it is necessary to undertake qualitative research through observations and interviews.

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Exploring the Influence of Father Involvement on Academic Achievement of Children: A Comprehensive Review

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ABSTRACT

This study presents a content analysis examining the impact of father involvement on the academic performance of primary-level children in Pakistan. Through systematic analysis of existing literature, this study synthesizes and evaluates research findings, identifying key themes, trends, and gaps in understanding. Results reveal a growing body of evidence suggesting that father involvement significantly influences children's academic outcomes, including achievement levels, school attendance, and motivation. However, the extent and nature of father involvement vary across socio-cultural contexts within Pakistan, with factors such as socio-economic status, educational background, and cultural norms shaping paternal roles in children's education. The analysis highlights the need for further empirical research and theoretical exploration to comprehensively understand the multifaceted dynamics of father involvement in Pakistani primary education. Insights derived from this content analysis can inform educational policies and interventions aimed at promoting parental engagement and enhancing academic success among primary-level children in Pakistan.

Keywords: *Father Involvement, Socio-Economic Factors, Confidence Building, Academic Enhancement.*

INTRODUCTION

The academic achievement of primary-level children is a matter of profound importance, shaping their future trajectories and influencing broader societal development. Within the multifaceted web of factors contributing to academic success, the role of fathers has gained increasing attention. The societal landscape in Pakistan, like many other countries, is undergoing dynamic transformations, necessitating a comprehensive understanding of the impact parents have on the academic performance of primary-level children. Traditionally, discussions on parental influence in educational contexts have often centered on mothers. However, contemporary research underscores the significance of fathers' roles in shaping the academic outcomes of their children (McWayne et al., 2004). As fathers' roles evolve and societal expectations shift, it becomes imperative to explore the nuances of paternal involvement specifically within the Pakistani cultural and socioeconomic context. This research focuses on the impact of fathers on the academic performance of primary level children in Pakistan. The importance of this inquiry lies in its potential to unravel the complex dynamics between paternal engagement and academic success, providing insights that can inform educational policies, interventions, and family practices. By employing content analysis as the chosen methodology, this study seeks to systematically analyze existing literature to identify Themes and gaps in the understanding of how fathers contribute to the academic development of their children in the Pakistani context content analysis as the chosen methodology, this study seeks to systematically analyze existing literature to identify Themes and gaps in the understanding of how fathers contribute to the academic development of their children in or present context.

Research Questions

To guide the investigation and focus the content analysis, the following research questions are posed:

- To what extent nature of the father's involvement affect the academic lives of primary-level children in Pakistan?
- How does the quality of the father-child relationship impact the academic performance of primary-level children in Pakistan?

- What role do socioeconomic factors play in shaping the influence of fathers on the academic outcomes of primary-level children in Pakistan?

These questions are designed to provide a comprehensive understanding of the multifaceted nature of paternal influence on academic achievement in the Pakistani context, laying the groundwork for nuanced analysis.

Objectives of the Study

The primary objectives of this research are:

- To examine the existing literature on the impact of fathers on the academic performance of primary-level children in Pakistan.
- To categorize studies based on themes such as father involvement, the quality of the father-child relationship, socioeconomic factors, and cultural dynamics.
- To contribute to the existing body of knowledge by synthesizing key findings and offering insights that can inform educational practices and policies in Pakistan.

The scope of this study encompasses a review and content analysis of literature relevant to the impact of fathers on the academic performance of primary-level children in Pakistan. The time frame for the literature review is set to cover publications from the past 20 years ensuring a contemporary understanding of the subject. It is important to acknowledge certain limitations, including the potential bias in the selected literature, variations in research methodologies, and the evolving nature of societal dynamics. Despite these limitations, this study aims to provide a valuable synthesis of existing knowledge and identify areas for future research. This research holds significant implications for various stakeholders, including educators, policymakers, families, and researchers. By systematically analyzing existing literature, the study aims to contribute to the growing body of knowledge on the impact of fathers on academic performance, with a specific focus on the Pakistani context. The findings may inform educational practices, interventions, and policies aimed at fostering positive father-child academic relationships. Additionally, the study may contribute to the broader discourse on parental involvement in education, challenging traditional gender roles and advocating for more inclusive and holistic approaches to child development in Pakistan.

LITERATURE REVIEW

The landscape of research on the impact of fathers on the academic performance of primary-level children in Pakistan is diverse and dynamic. Parental involvement has always been shown to be impactful in children's development. Studies showed that parents are mediators in the application of new techniques for learning which alone the teacher could succeed in developing unless parents are involved (Saifuddin, et al., 2023). But along with the mother father's involvement is also critical in the upbringing of their children, To comprehend the intricate relationship between paternal involvement and academic success, it is crucial to delve into the existing body of literature.

Father Involvement and Academic Achievement

Numerous studies have explored the correlation between the level of father involvement and the academic achievement of primary-level children. A meta-analysis conducted by (McMunn et al., 2015) synthesized findings from various quantitative studies, revealing a positive correlation between active father involvement and enhanced academic performance and practices. This meta-analysis highlighted the importance of fathers participating in educational activities, attending parent-teacher meetings, and fostering a supportive academic environment at home. One of the conducted by (Coley & Medeiros, 2007) provided deeper insights into the qualitative aspects of father involvement. In a Qualitative study through in-depth interviews with fathers, researchers explored the emotional and motivational impact of paternal engagement on their children's academic pursuits. The narratives uncovered emphasized the positive influence fathers exerted when actively participating in their children's learning journeys, contributing to a more conducive academic atmosphere (Gurkan et al., 2021).

Father-Child Relationship and Cognitive Development

The researchers explored the emotional support fathers provided and its implications for cognitive development (Rollè et al., 2019 & Cai, 2023). Studies also revealed that fathers who actively engaged in emotional conversations and provided a supportive environment played a crucial role in shaping their children's cognitive abilities (Dyer, 2014). Such emotional support was identified as a key component in promoting academic success among primary-level children (Bögels & Perotti, 2010).

Socioeconomic Factors and Father's Influence on Education

Socioeconomic factors play a pivotal role in shaping the influence of fathers on the academic outcomes of primary-level children. A study by (Williamson & Lavner, 2019) investigated the impact of income disparities on fathers' ability to provide educational resources and support. The research revealed a significant correlation between family income levels and the extent to which fathers could afford educational materials, private tutoring, and extracurricular activities

for their children. Furthermore, qualitative research conducted by (Bridges et al., 2013) explored how fathers from lower-income backgrounds navigated their involvement in their children's education. The study uncovered challenges faced by these fathers, including limited financial resources and time constraints due to work commitments. Understanding these socioeconomic challenges is essential for developing targeted interventions to support fathers in low-income communities.

Cultural Perspectives on Paternal Involvement

Cultural dynamics play a crucial role in shaping fathers' involvement in their children's education. A cross-cultural study by (Novianti et al., 2023 and Sarkar et al., 2023) explored variations in paternal involvement across different regions of Pakistan. The findings indicated that cultural norms and expectations significantly influenced the extent to which fathers engaged in their children's academic lives. The study highlighted the importance of cultural sensitivity in understanding and addressing the unique challenges and opportunities associated with paternal involvement in various regions of Pakistan. A father-and-child relationship can be extremely fulfilling if we get rid of the traditional cultural perspective on how a father-son and father-daughter relationship 'should' be. The more hugs and cuddles you give your child, whether you are a mother or father, the more secure and confident your child grows up to be (Kremer-Sadlik & Fatigante, 2013).

Role of Father in Pakistan

In Pakistan, there's a prevailing notion that men are responsible for earning a living while women are expected to stay home and manage household duties, including childcare. (Sarfaraz et al., 2021) Even if a woman is employed, the societal expectation remains that she bears the primary responsibility for raising children. However, the task of raising children, especially multiple ones, cannot be shouldered by one person alone. As the saying suggests, it truly requires the collective effort of a community (Bhamani, 2012.). In many households, men return home from work, exchange few words with their wives and children, have dinner, and retire to bed. If any child misbehaves, the typical response is a lecture or scolding from the father before bedtime. Unfortunately, this often results in a lack of affection (Karim, 2023) cuddling, or meaningful conversations between Pakistani fathers and their children, leading to an overall distant and uncommunicative relationship. While existing research provides valuable insights, there are notable gaps in the literature that warrant further exploration. Firstly, there is a need for more longitudinal studies to establish causal relationships between early paternal involvement and long-term academic outcomes. Additionally, the majority of research has focused on general qualitative measures, and there is a scarcity of in-depth qualitative studies that explore the lived experiences of fathers and children in the Pakistani context. Furthermore, there is a paucity of research addressing the evolving nature of fatherhood in Pakistan and its implications for paternal involvement in education.

Conceptual Framework

The literature reviewed establishes a foundation for a conceptual framework that guides the investigation into the impact of fathers on the academic performance of primary-level children globally and especially in Pakistan. This framework integrates key themes, including father involvement, the quality of the father-child relationship, socioeconomic factors, and cultural dynamics, to offer a comprehensive understanding of the factors shaping paternal influence in the Pakistani context. The conceptual framework also recognizes the interplay between these themes, acknowledging that cultural expectations may influence socioeconomic opportunities, which, in turn, affect the quality of the father-child relationship and subsequent academic outcomes (Sarfaraz et al., 2021). By synthesizing these interconnected factors, the conceptual framework provides a lens through which the content analysis will be conducted, facilitating a systematic and holistic examination of existing literature. (Khawaja et al., 2024). In summary, the literature review highlights the complex and multifaceted nature of the impact of fathers on the academic performance of primary-level children. The synthesis of existing research sets the stage for the content analysis, allowing for a nuanced exploration of paternal involvement within the unique cultural and socioeconomic context of Pakistan.

METHODOLOGY

The methodology employed for this study involves content analysis, through a systematic review approach to examine textual data. Content analysis is particularly suited for investigating themes, and trends within a body of literature, making it an effective method for exploring the impact of fathers on the academic performance of primary-level children in Pakistan. Systematic reviews play a crucial role in the comprehensive analysis of available data, enabling both quantitative and qualitative assessment to provide a thorough and precise response to research (Saifuddin et al., 2023.) To identify the role of Fathers and their role in the academic performance of Primary Level Children, a study was conducted by literature review in which Google Scholar, PubMed and JSTOR was used. The search was started by adding some keywords and phrases like

- Role of Father in Family
- Importance of an educated father and its impact on influencing a Child.
- Impact of Father Involvement in daily Academic Routine in the context of Pakistan.
- Negative Effect on Lack of Father Involvement.
- Confidence Development and Father

The search was kept focused within a time range between the last 20 years. Fifty-four research articles and books were screened out of which twenty research articles and books were included and focused. The Inclusion Criteria were Psychology Journals, Books, and Research papers that deal with Father Involvement in the Academic and Upbringing of Children. The study does not include any unpublished or conference proceedings.

DATA ANALYSIS

Content analysis was employed as the main method for analyzing the collected data. This systematic approach involves the identification and categorization of patterns, themes, and meanings within the textual and visual data. The analysis was both deductive and inductive. The deductive analysis involved applying pre-existing categories derived from the literature on father involvement and academic performance, while inductive analysis allowed for the emergence of new themes directly from the data. The process of content analysis included:

Theme Development in which themes related to the impact of fathers on academic performance were identified and developed through an iterative process. These themes captured the various dimensions of father involvement, such as emotional support, academic guidance, and collaborative learning activities

Data Interpretation: This step involved interpreting the data to draw meaningful conclusions regarding the impact of fathers on the academic performance of primary-level children in Pakistan. Numerous systematic studies addressing Parent Involvement particularly Mothers and their positive Impact have been carried out on a global scale. However, there is a lack of research on the Father's Role in Primary Level Child Performance due to the predominant role of the Father in earning and financially supporting the Family given that the importance of Father involvement is a relatively recent phenomenon, investigations into the potential connections between Father Involvement and impact on Child Academic Performance outcomes remain relatively low and scarce.

FINDINGS

Out of the 20 research papers chosen, the investigation primarily centered on the Impact of Father Involvement and the academic performance of Primary-level Children. The research design encompassed qualitative and quantitative studies, with systematic reviews delving into the importance of Father Involvement for the Academic Performance of Children. Systematic Review categorizes the Data into two different themes. The involvement of the Father in the Academic Enhancement of Children and Involvement of the Father in Emotional and Confidence Development of the Child has a direct impact on Academic Performance.

Theme: 1 Involvement of Fathers for Academic Enhancement of Children

Research shows that Fathers play a major role in Academic enhancement, they guide them, counsel them, and help them to achieve their academic potential (McMunn et al., 2015 Coley & Medeiros, 2007). They help them with their intellectual skills and enable them to work with confidence. The study found that fathers who actively engaged in their children's academic journey by providing guidance and assistance positively impacted academic performance. This involvement manifested through helping with homework, discussing school-related matters, and participating in parent-teacher meetings (Gurkan et al., 2021 Dyer, 2014). The involvement was associated with a deeper understanding of the child's academic strengths and weaknesses, allowing fathers to tailor their support accordingly. Here's a contemporary reference on academic guidance and involvement of fathers (Terriquez, 2013)

Collaborative Learning Activities

Content analysis revealed that fathers who actively engaged in collaborative learning activities, such as reading together, solving puzzles, and exploring educational games, positively influenced their children's cognitive development. Here's a reference on collaborative learning activities and father involvement. These activities were found to foster a positive attitude towards education, making the learning process enjoyable for the child. Collaborative learning also provided fathers with opportunities to impart values and share their own educational experiences.

School Participation

Fathers who attend school events, communicate with teachers, and volunteer in classrooms demonstrate their interest in their child's education and build a strong school-home connection. Here's a reference on school participation and father involvement (Ryan, R. M., & Claessens, A. 2013)

Effective communication between fathers and teachers emerged as a crucial factor influencing academic performance. Fathers who maintained regular communication with teachers demonstrated a commitment to their child's education. Parent-teacher partnerships were associated with early identification of academic challenges and collaborative efforts to address them.

Theme: 2 Socioeconomic Factors and the father's involvement

Socio-economic factors are responsible for the involvement of the Father, Studies have proved that fathers from low-income levels and of poor literacy are less bound to their children, spend less time with them, counsel less, and lack in building confidence their children They much concerned for earning bread and butter for their family, thus get very less time to involve with their children. (Adamson, 2013; Castillo 2012; Cooksey, 1998). Research declared that attachment to a father can create a healthy father-child relationship (Grossman, 2002). A low-level income father involvement is linked with socioeconomic status as fathers are under work stress, have many children, have low literacy, and lack of resources for their children `s development (Fofonoff, 2018)The findings of this study underscore the significant role fathers play in shaping the academic performance of primary-level children in Pakistan. Emotional support, academic guidance, collaborative learning activities, and effective communication emerged as key themes that contribute to positive educational outcomes. The study aligns with existing literature emphasizing the importance of parental involvement in children's education. Fathers, as active participants in their children's academic journey, contribute to the overall development of their children. The emotional support provided by fathers enhances children's motivation and self-esteem, creating a positive foundation for learning. (Rogers, Saint Onge, 2007, p. 1). Moreover, the study emphasizes the need for fathers to be actively engaged in academic matters. Collaboration with teachers and participation in learning activities at home contribute to a holistic approach to education. Fathers who are involved in homework assistance and collaborative learning activities not only support academic development but also strengthen the parent-child bond.

Positive Role Modeling:

Fathers who value education and demonstrate a love of learning set a positive example for their children. The specific ways fathers participate may vary depending on cultural backgrounds, family structures, and individual preferences. Nevertheless, all forms of positive father involvement contribute to a child's academic success

CONCLUSION

The conclusion of the content analysis highlights the profound significance of father involvement in influencing the academic performance of children. Supported by numerous studies, it becomes evident that active paternal engagement positively correlates with improved academic outcomes, including higher achievement levels, increased school attendance, and enhanced motivation for learning. This conclusion aligns with research by (Cabrera & Bradley, 2012) and Flouri & Buchanan (2003), which underscore the pivotal role fathers play in their children's educational journey. Moreover, practical examples further validate this conclusion. For instance, a study conducted by Sarkadi et al. (2008) found that children with involved fathers demonstrated better problem-solving skills and higher grades compared to those with less paternal engagement. Additionally, initiatives promoting father involvement, such as father-child reading programs or father-teacher conferences, have yielded tangible benefits in enhancing children's academic performance and overall well-being. In essence, the conclusion of the content analysis emphasizes the urgent need for fostering and supporting father involvement in education. Recognizing fathers as valuable partners in their children's academic journey can lead to more holistic and effective approaches to promoting academic success and fostering positive developmental outcomes.

RECOMMENDATIONS

The study suggested strong recommendations for fathers to get involved with their children as their presence makes children confident and develop into their full potential. The study suggested the following guidelines:

- Promote Positive Father-Child Interactions: Encouraging positive interactions between fathers and their children is essential for fostering strong bonds and nurturing emotional development. Programs and interventions should focus on providing fathers with practical strategies for engaging with their children in meaningful ways, such as shared activities, conversations, and playtime. Research by Grossmann et al. (2002) emphasizes the significance of sensitive and challenging play in enhancing the father-child relationship and promoting cognitive development.
- Provide Parenting Education and Support: Offering parenting education and support programs tailored specifically for fathers can empower them with the knowledge and skills needed to be effective caregivers and role models. These programs should address topics such as child development, communication techniques, discipline strategies, and managing work-life balance. The study by Panter-Brick et al. (2014)

highlights the effectiveness of such interventions in promoting father involvement and improving child outcomes.

- **Create Father-Friendly Environments:** Schools, healthcare settings, and community organizations should strive to create father-friendly environments that welcome and encourage paternal involvement. This can include implementing flexible scheduling for parent-teacher conferences, organizing father-focused workshops and events, and actively involving fathers in decision-making processes related to their children's education and well-being. The research by McBride et al. (2005) emphasizes the importance of reducing barriers and increasing accessibility to resources for fathers.
- **Promote Co-Parenting and Shared Responsibilities:** Encouraging co-parenting and shared responsibilities between mothers and fathers is essential for creating a supportive family environment conducive to children's development. Initiatives should aim to foster open communication, mutual respect, and collaboration between parents in decision-making and caregiving tasks. This can help alleviate the burden on mothers and promote active father involvement in various aspects of children's lives, including academic support, emotional guidance, and household responsibilities.
- **Address Societal Norms and Stereotypes:** Challenging traditional gender norms and stereotypes surrounding fatherhood is essential for promoting greater acceptance and recognition of fathers as nurturing caregivers and active participants in their children's lives. Educational campaigns, media representations, and policy initiatives should work towards dismantling stereotypes that undermine the importance of father involvement and encourage a more inclusive and supportive view of fatherhood. This aligns with the findings of Hossain and Khan (2018), who emphasize the role of cultural influences in shaping father involvement in children's education. In conclusion, by implementing these recommendations, we can create a more supportive and inclusive environment that empowers fathers to play an active and meaningful role in their children's lives, ultimately leading to improved outcomes for children and families alike.

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