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General Information

Background Brief: The Nigerian Journal of Technological Research (NJTR) is the official journal of the Federal University of Technology, Minna, Niger State, Nigeria. It was first published in June 1989.It has since made giant strides in its effort to provide an avenue for the dissemination of relevant modern up-to-date research information in the core areas of discipline available in The University at inception; namely, Pure and Applied Sciences, Engineering Technology, Environmental Technology and Agricultural Technology.

Philosophy: As a strictly scientific and technological journal, it tends to provide information on problem solving technology to its immediate environment and the international community.

Development: The journal being responsive to the dynamic nature of research and development in the Federal University of Technology, Minna and its environs, has widen its scope of information dissemination to include but not limited to Information Communication Technology (ICT), Management Technology, Educational Technology and Entrepreneurship. It has developed electronic communication procedures to ensure that, it has the capacity to reach a larger community at a faster rate. It is the anticipation of the journal that scientific data which will provide very current information to problem solving in the identified areas of The University program will be found in it.

Management: The Nigerian Journal of Technological Research has a unique management structure which enables it to carry out its functions promptly. This include; The Management Board, Editorial Board, Editorial advisory Board, Regional editors, Associate editors and a Business Manager. These groups bring to beer their vast knowledge which ensures the quality and reputable academic output from the journal.

Finally, The Management Board and The Editorial Board of The Nigerian Journal of Technological Research believe firmly in quality of information that will benefit mankind, hence their commitment to ensuring productivity and quality of information dissemination.

EDITORIAL COMMENTS

This edition of the Nigerian Journal of Technological Research is the last edition for volume 15 2020. It has been packaged so that outstanding manuscript which address production technology in all fields are captured. Manuscripts from the field of environmental technology and waste disposal have been specially captured since they also deal with contemporary issues relating to immediate economic crisis facingNigeria. Most of the authors who have their manuscript in thiss edition have demostarted substantial resilience in packaging their manuscript to address immediate national challenges.

We wish to use this forum to encourage contributors to please comply and remain with the noble ethcs associated with academic publishing. It is only in this can we appreciate the benefit of our contributions. As good as progression of authors is paramount to The Board, authors are encouraged to put quality research output first which will guarantee the advancement of the author when necessary.

As always, African Journal Online (AJOL) has made the visibility of the journal quite global and relevant. Consequently, The Editorial Board will wish to congratulate AJOL and encourage them to ensure that all the quality assurance effort being put in place for quality research output information is brought out in good time.

The Editorial Board is ever grateful to the university management for the immense support and encouragement provided to them. Also, the intervention from TETFUND under The Federal Ministry of Education of The Federal Republic of Nigeria is appreciated. The recently organised workshop on Knowledge Management and Manuscript Development hosted by the Federal University of Technology Minna, is a clear testament of this support. It is our hope that the knowledge derived from the workshop will revitalise our system.

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Biodegradation Potential of Abattoir Wastewater Microbiota in Nigeria

Bala, J. D., Kuta, F. A., Adabara, N. U., Abioye, O. P., Auta H. S. and S. Gumel. Department of Microbiology, School of Life Sciences, Federal University of Technology, P.M.B 65, Minna, Niger State, Nigeria.

Abstract

Water used for washing carcasses of slaughtered animals and slaughter house is referred to as abattoir wastewater. This study was designed to investigate the microorganisms associated with abattoir wastewater and to establish the biodegradation potential of abattoir wastewater microbiota. Isolation of the microbes was carried out using pour plate technique. The total viable count for the microbes' ranges from 2.5×10^4 - 4.6×10^5 cfu/mL. Results revealed that all the physicochemical parameters exceeded the permissible limits (total dissolved solid (TDS) 1748mg/L, total suspended solid (TSS) 176mg/L, biochemical oxygen demand (BOD_5) 91 mg/L and chemical oxygen demand (COD) 227 mg/L). Microorganisms isolated include Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis, Bacillus anthracis, Aspergillus niger, A. flavus, Mucor sp, Trichophyton quickeanum and Penicillium sp. Some of the microbes were observed to have biodegradation potential by their ability to grow on mineral salt media (MSM) incorporated with starch, cellulose, crude oil, kerosene and diesel as the sole source of carbon and energy. This study suggests that abattoir wastewater harbors microorganisms that could be hazardous to public health when discharged into the environment untreated hence the need for strict monitoring. These microbes isolated could be employed as agent of bioremediation of wastewaters.

Key words: Abattoir; Biodegredation; Isolation; Microbiota; Wastewater
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Introduction

An abattoir is a place registered and approved by the government for sterile butchering and examination of animals, preparing and preservation of meats for human consumption (Alonge, 1991). Abattoir, otherwise called slaughterhouse is a place where animals are butchered for human consumption. Water from abattoir used for washing slaughtered animals and the slaughter house is called abattoir wastewater (Coker *et al.,* 2001). Various process that take place in the abattoir results in direct and indirect pollution of the environment (Adelegan, 2002).

Wastewater that results from butcher houses usually contains fat, blood, stomach waste, bone, hair. The wastewater is known to have high biochemical oxygen demand (BOD) and total solids (TS) of 8000 mg/L and 800 mg/L respectively (Nafanda, 2005). The contaminations of soil and water bodies by abattoir wastewater have been reported (Nwachukwu*et al.,* 2001*;* Akpan, 2004; Efe, 2005). Abattoir tasks, including butchering, burning and to produce wastewater profoundly charged in solvent and insoluble inorganic matter. This compares to high loadings biochemical oxygen demand (BOD) because of blood substance and high loadings of total suspended solids (TSS) because of particulates collected from the butchering processes (Coulibaly*et al*., 2003).

Studies have revealed that zoonoses from abattoir wastewater are yet to be fully controlled in more than 80% public abattoirs in Nigeria. (Cadmus *et al*., 1999). Cholera, diarrhea, typhoid fever, respiratory diseases, pneumonia are the diseases reported to be associated with abattoir activities.(Bello and Oyedemi, 2009).Feaces of animals from slaughter houses contains *Escherichia coli* and are shown to contaminate undercooked beef from abattoir which are consumed.(Encarta, 2005).Carriers of disease or animals can spread diseases to people within the vicinity (Nwachukwu*et al*., 2011) studied on microbial assessment of surface water and sediment samples from different points (A,B,C) in Otamiri river receiving abattoir wastes. Preliminary identification indicated that the proteolytic bacteria isolates included *Pseudomonas* sp., *Bacillus* sp., *Enterobacter* sp., *Escherichia* sp., *Klebsiella* sp., *Streptococcus* sp., *Staphylococcus* sp. and *Proteus* sp. While lipolytic bacteria were *Pseudomonas* sp., *Moraxella* sp., *Acinetobacter* sp., *Arthrobacter* sp. and *Micrococcus* sp. Some are causative agents of gas gangrene, food poisoning, infantile diarrhea, chronic infections and gastrointestinal irritation (Holt *et al*., 1994).

The biodegradation potential of abattoir wastewater microbiota is disregarded as such there seem to be dearth of information on the microbiota been documented proving that a well developed understanding of these is

needed. Therefore, this study represents one of the few studies in Nigeria. The diverse microbiota communities are known to participate effectively in the biodegradation of abattoir wastewater. Therefore, the study on the microbiological characteristics of abattoir wastewater lays a basis to promote better understanding of the types and nature of microorganisms domicile in abattoir wastewater. This will provide evidence of the microbiota characteristics of abattoir wastewater. Their involvement in biodegradation of abattoir wastewater may possibly help in achieving higher reduction of organic load present in abattoir wastewater. This study was designed to explore the microorganisms associated with abattoir wastewater and to establish the biodegradation potential of abattoir wastewater microbiota.

Materials and Method

Study Area

The abattoir is situated at Bahago road, Tayi village, Bosso, Minna, Niger state, Nigeria (Figure 1). It is one of the biggest slaughterhouses in Niger state.

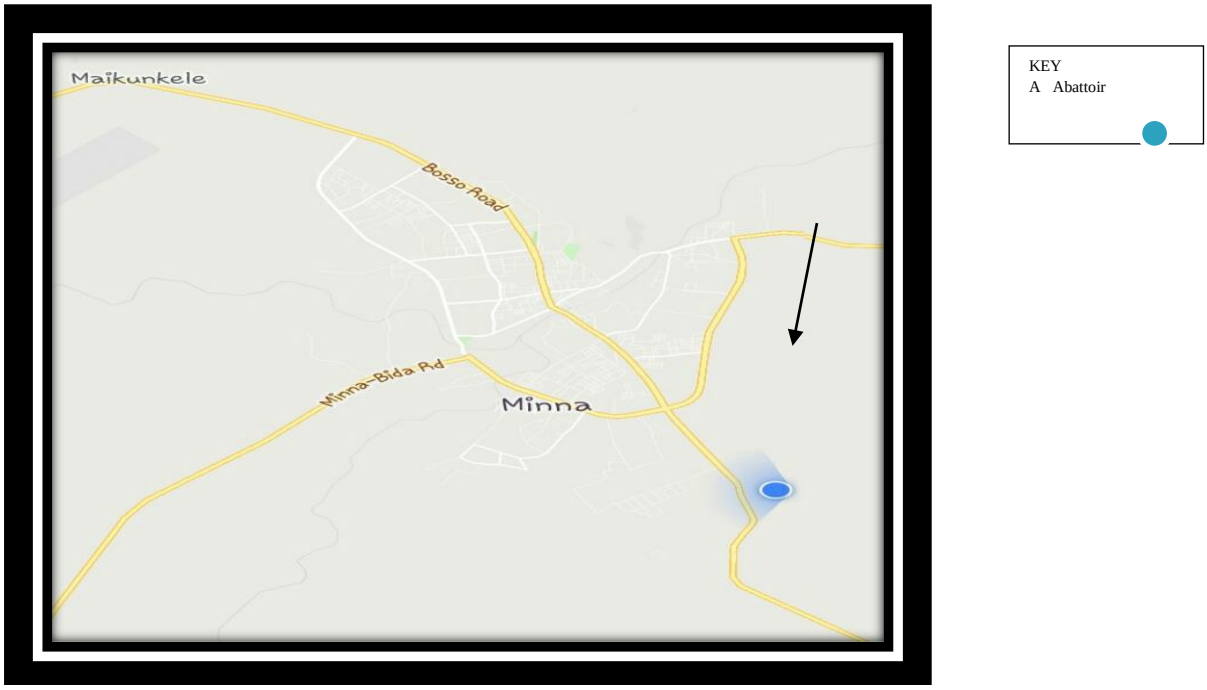

Figure 1: Niger state map indicating the location of Bosso abattoir, Minna, Niger state, Nigeria

Sample collection

The sample was collected from Minna abattoir at Bosso, Tayi village, Minna, Niger state, Nigeria into a sterile bottle using the grab sampling method of Nafanda (2005). The sample bottle was tilted 45°N to the fast moving wastewater and dipped 10cm into the wastewater. The sample was collected in duplicates. Samples from two points (discharge and downstream) were collected from Bosso abattoir in Tayi village, Minna, Niger state, Nigeria. The standard method for examination of water and wastewater procedure according to American Public Health Association (APHA) (2005) was used. The samples were transported to the Microbiology Department laboratory of Federal University of Technology, Minna Niger state, Nigeria for analysis.

Determination of physicochemical properties of abattoir wastewater

All physicochemical parameters of the abattoir wastewater sample were determined in accordance with the standard methods published by American Public Health Association (APHA, 2005). The basic parameters that were analysed for abattoir wastewater sample are as follows: chemical oxygen demand (COD), biochemical oxygen demand (BOD_5), total suspended solid (TSS), total dissolved solid (TDS) and total solid (TS). Biochemical oxygen demand (BOD) was determined according to standard method 5210 **B** (APHA, 2005). Chemical oxygen demand (COD) was determined according to standard method 5220 **D** (APHA, 2005). Total suspended solid (TSS) was determined

according to standard method 2540 **D** (APHA, 2005). Thermometer and pH meter were used to measure temperature and pH respectively.

Bacteriological analysis

The method of Abba *et al*. (2009) was used where a tenfold serial dilution of the abattoir wastewater samples were carried out. Aliquot of 1mL of the sample were pipetted each from the 10^{-4} dilution tubes into well labeled petri dishes. Then 20mL of molten nutrient agar was added into each plate and swirled gently to allow for proper mixing and incubated at 37°C for 24hrs. The colonies formed were counted and expressed as colony forming unit per milliliter (cfu/mL). The samples were analyzed in duplicates. The average was calculated and recorded. The colonies found to be different in size, shape and color were sub-cultured repeatedly on sterile nutrient agar to obtain pure isolate. The pure isolates were preserved on agar slant bottle for further investigated.

Mycological Analysis

Fungi were isolated from abattoir wastewater samples collected by using pour plate method. Serial dilution was carried out by taken one milliliter(1mL) of the abattoir wastewater sample and transferred into 9 mL of sterile distilled water to make tenfold (1:10) dilution and further dilutions was made up to 10^{-4} dilutions. Molten Sabouraud Dextrose Agar (SDA) containing 0.01% chloramphenicol was poured into the petri dish containing 1ml of the desired aliquot and swirled gently to allow for proper mixing. The plates were incubated at ambient temperature for 3 days and observed for the development of colonies after which colonies were counted (Fawole and Oso, 2007). Isolated colonies were transferred to freshly prepared SDA plates in order to obtain pure cultures.

Characterization and Identification of Microbial Isolates
Bacterial Isolates

The characterization and identification of the bacterial isolates were carried out based on cell morphology, Gram's reaction and biochemical tests (coagulase, oxidase, catalase, growth on mannitol salt agar (MSA) and starch hydrolysis) according to methods described by Oyeleke and Manga (2008). The isolates were identified by comparing with those of known taxa using the schemes of Cowan and Steel (1973).

Fungal isolates

The fungal isolates were characterized based on the colour of aerial and substrate hyphae, type of hyphae, shape and kind of asexual spores, presence of foot cell, sporangiophore, conidiophores, and the characteristics of the spore head. A small portion of the mycelia growth was carefully picked with the aid of a sterile inoculating needle and placed in a drop of lactophenol cotton blue on a microscopic slide and covered with a cover slip. The slide was examined under the microscope, first with (x10) and then with (x40) objective lens to detect the spores and some special structures of the fungi. The isolates were identified by comparing their characteristics with those of known taxa using the schemes of Domsch and Gams (1970).

Biodegradation
Starch degradation
Bacterial isolates

The pure isolates of the test bacteria were tested for their amylolytic activity, which is used for starch degradation into simple sugars. Their amylolytic activity is determined using the starch agar. The isolates were inoculated into nutrient agar supplemented with 1g soluble starch. After incubation at 37°C for 1 day, the Petri dishes were flooded with Lugol's iodine to reveal clear zones around the cultures. The zones represent the amylolytic activity of the isolates.

Fungal isolates

Zajic and Supplisson (1972) Mineral Salts Medium (MSM) was used to check the biodegradation potential of the fungi isolates. The composition includes: $NaNO_3$ 2g, KPO_4 1g, $MgSO_4$ 0.05g, KCl 0.5g, $FeSO_4$ 0.01%, soluble starch 1%, Agar agar 20g. The isolates were inoculated and incubated at room temperature for 21days. Presence of growth indicates the potential of the organisms to degrade starch (Ijah*et al.,* 1988).

Hydrocarbons degradation

Crude oil, kerosene and diesel degradation
Bacterial isolates

Zajic and Supplisson (1972) Mineral Salts Medium (MSM) was used to check the biodegradation potential of the fungi isolates.

The composition includes: 1.8g, k_2PO_4, 1.2g KH_2PO_4, 4.0g, NH_4CL, 0.2g, $MgSO_4.7H_2O$, 0.1g NaCl, 0.01g $FeS0_4$,.$7H_2O.7H_2O$ in 11mL of distilled water (PH 7.4). Oil agar MSM plus 1.0% crude oil, kerosene or diesel respectively for each of the hydrocarbons and 20g of agar (Oxoid). The organisms were inoculated in the media and incubated at room temperature for 21days.

Fungal isolates

Zajic and Supplisson (1972) Mineral salts medium (MSM) was used to check the biodegradation potential of the fungi isolates. The composition include: $NaNO_3$ 2g, $KPO_4$1g, $MgSO_4$ 0.05g, KCl 0.5g, $FeSO_4$ 0.01%, (0.1%crude oil, kerosene, diesel) and Agar agar 20g . The isolates were inoculated and incubated at room temperature for 21days. Presence of growth indicates the potential of the organisms to degrade.

Cellulose degradation
Bacterial Isolates

Confirmation of cellulose-degrading ability of isolate was performed by streaking on MSM containing 1% Carboxymethylcellulose agar (CMC), 1.8g, k_2PO_4, 1.2g KH_2PO_4, 4.0g, NH_4CL, 0.2g, $MgSO_4.7H_2O$, 0.1g NaCl, 0.01g $FeS0_4$. $7H_2O$. $7H_2O$ in 11mL of distilled water (PH 7.4). The organisms were inoculation in the media and incubated at room temperature for 21days.

Fungal Isolates

Zajic and Supplisson (1972) Mineral salts medium (MSM) were used check the biodegradation potential of the fungi isolates. The composition includes: $NaNO_3$ 2g, KPO_4 1g, $MgSO_4$ 0.05g, KCl 0.5g, $FeSO_4$ 0.01%, 1% Carboxymethylcellulose agar (CMC) and Agar agar 20g. The isolates were inoculated and incubated at room temperature for 21days. Presence of growth indicates the potential of the organisms to degrade.

Statistical Analysis

The data generated were represented in mean ± standard deviation using statistical package for the social sciences (SPSS) with one-way ANOVA. The values with the same alphabetical superscript show that there were no significantly different ($p>0.05$) and the values with different alphabetical superscript show that they are significantly different ($p<0.05$).

Results and Discussions

Physicochemical and biological characteristics of abattoir wastewater

Results revealed that all the physicochemical parameters exceeded the permissible limits for discharge of wastewater from the meat industries into water bodies (Federal Environmental Protection Agency (FEPA), 1991). Total dissolved solid (TDS) 123 -1748 mg/L, total suspended solid (TSS) 161 - 176 mg/L, biochemical oxygen demand (BOD_5) 28 - 91 mg/L and chemical oxygen demand (COD) 70 - 227 mg/L Table 1 and 2. The physicochemical assessment showed that there was significant difference ($p < 0.05$) in the levels of all the parameters. However, there was no significant difference ($p > 0.05$) in the levels of biochemical oxygen demand (BOD_5) and total suspended solid (TSS) tested Table 2.

Table 1: Characteristics of physiochemical parameters of abattoir wastewater.

Sample	Temp (°C)	pH	COD (mg/L)	BOD (mg/)	TDS (mg/L)	TSS (mg/L)
1	29	8.94	70.0	28.0	123	176
2	27	8.58	227	91.0	17.48	161
MEAN	28	8.76	148.5	59.59	35.5	168.5

COD: Chemical oxygen demand; BOD: Biochemical oxygen demand; TDS: Total dissolved solid; TSS: Total suspended solid; TEMP: Temperature

Table 2: Physiochemical parameters of abattoir wastewater

Physicochemical Parameters	Mean value(mg/L)
COD	148.5 ± 5.00^{d}
TDS	935.50 ± 14.50^{e}
TSS	168.50 ± 7.50^{c}
BOD	59.50 ± 0.50^{c}
TEMP	28.00 ± 1.00^{b}
pH	8.76 ± 0.20^{a}

Values are mean ± Standard error of mean duplicate determination. Values on the same column with different superscript are significantly different from each other ($p <0.05$) while those with the same superscript are not significantly different from each other ($p >0.05$).

The high values of the physiochemical parameters obtained from raw abattoir wastewater in the present study suggest the polluting potential of abattoir wastewater and the adverse environmental impacts. Investigations has revealed alarming rise in environmental pollution due to the discharge of untreated wastewaters into the environment (Abass *et al.*, 2012; Bala *et al.* 2012; Maygaonkar *et al.*, 2012; Bala *et al.* 2014a, 2014b, 2014c; Mohammed *et al.*, 2014; Soleimaninanadegani and Manshad, 2014;

Bala *et al.* 2015a, 2015b; Bala 2016, Bala *et al.* 2018; Bala *et al* 2018a and b). In addition, a factor to consider is the various processes and activities that take place in the abattoir/slaughterhouse which vary widely throughout the year due to abattoir operations and may possibly or conceivably result to high values of the physiochemical parameters obtained.

The results obtained for abattoir wastewater temperature range from 27-29°C. This contradicts the results of 32°C-34°C reported by Osibanjo and Adie (2007). Variation in abattoir wastewater temperature may perhaps be due to the reflection of the abattoir/slaughterhouse environmental ambient temperature at that time when samples were collected. The pH range of 8.58-8.94 was also in contrast with the findings of Adeyomi *et al*. (2007) who reported the pH of abattoir wastewater to be acidic, ranging from 4.3 to 5. This might be attributed to the different abattoir wastewater constituents or components found in a particular abattoir/slaughterhouse environment. High COD values of abattoir wastewater are indication of high organic matter in the wastewater (Nafanda, 2005). Biochemical oxygen demand (BOD) level recorded in this study was similar to those reported by Moran *et al.* (1980).

Microorganisms

Microorganisms isolated from abattoir wastewater in the present study include *Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus subtilis, Bacillus anthracis, Aspergillus niger, A. flavus, Mucor* sp, *Trichophyton quickeanum and Penicillium* sp Table 3 and 4.

Table 3: Identification of abattoir wastewater microbiota (bacteria)

Isolates code	GR	Catalase	Oxidase	MSA	Coagulase	Starch hydrolysis	Identified bacteria
A_1	-rod	-	+	-	-	-	*Pseudomonas aeruginosa*
B_1	+rod	-	-	-	-	+	*Bacillus subtilis*
C_1	-rod	-	+	-	-	_	*Pseudomonas aeruginosa*
D_1	+rod	-	-	-	-	+	*Bacillus subtilis*
E_1	+rod	-	-	-	-	+	*Bacillus subtilis*
F_1	+rod	-	-	-	-	+	*Bacillus subtilis*
A_2	+rod	-	-	-	-	+	*Bacillus subtilis*
B_2	+rod	-	-	-	-	+	*Bacillus anthracis*
C_2	+cocci	+	-	+	+	+	*Staphylococcus aureus*
D_2	+rod	-	-	-	-	+	*Bacillus subtilis*
E_2	+cocci	+	-	+	+	+	*Staphylococcus aureus*

GR: Gram's reaction; MSA: Growth on mannitol salt agar (MSA)+: Positive -: Negative

Table 4: Identification of abattoir wastewater microbiota (fungi)

Isolate	Macroculture	Reverse colour	Microscopy	Inference
A	Velvety to flaky surface due to marked sporulation	Black	Conidiophores borne laterally on the hyphae.	*Aspergillus niger*
B	Velvety with a fine Fringy border.	Light brown	Microconidia is roundish to pear-shaped.	*Trichphyton quickeanum*
C	Powdery or velvety surface.	Green	Conidiophore is rise vertically from the hyphae.	*Penecillum* sp
D	Velvety to flaky surface due to marked sporulation	White-yellow	Conidiophores borne laterally on the hyphae.	*Aspergillus flavus*
E	Long fibred, rough woolly network of hyphae.	White	Conidiophores is departing laterally from the mycelium, ramified, spherical at the end.	*Mucor* sp

Microbial count from abattoir wastewater revealed the count ranging from 2.5×10^4 - 4.6×10^5 cfu/mL. Bala *et al.* (2012) has also reported similar counts from pharmaceutical wastewater. These corroborate the presence of diverse microorganisms in wastewaters (Bala *et al.* 2018).

The reasons for variations in the type of microbial populations found in abattoir wastewater compared with other wastewaters could probably include nutrient, pH, minerals, temperature and oxygen level of different wastewaters. High population of microbes isolated from abattoir wastewater may possibly be linked with contaminations from poor sanitation in the abattoir/slaughterhouse and irregular disinfection of the environment. In addition, it may also be due to the existing environmental conditions in the abattoir. The presence and growth of bacteria and fungi in abattoir wastewater may possibly be associated with the fact that abattoir wastewater is rich in blood from the slaughtered animals and cellulosic materials from the gastrointestinal tract of slaughtered ruminant animals.

Biodegradation

Results obtained from biodegradation potential of bacteria isolated from abattoir wastewater revealed that 3 bacteria isolates (75%) (*Bacillus subtilis, Staphylococcus aureus* and *Bacillus anthracis)* were able to degrade starch, 3 bacteria isolates (75%) (*Pseudomonas aeruginosa, Bacillus subtilis* and *Bacillus anthracis*) degraded cellulose, 2 bacteria isolates (50%) (*Pseudomonas aeruginosa* and *Bacillus anthracis*) degraded kerosene and 3 bacteria isolates (75%) (*Pseudomonas aeruginosa, Bacillus subtilis* and *Bacillus anthracis*) degraded both diesel and crude oil Table 5.

Table 5: Determination of biodegradation potential of bacteria isolated from abattoir wastewater

Organism	Starch	Cellulose	Crude oil	Kerosene	Diesel
Pseudomonas aeruginosa	-	+	+	+	+
Bacillus subtilis	+	+	+	-	+
Staphylococcus aureus	+	-	-	-	-
Bacillus anthracis	+	+	+	+	+

+: Presence of growth -: Absence of growth

Biodegradation potential of fungi isolated from abattoir wastewater also revealed that 3 fungi isolate (60%) (*Aspergillus niger, Penecillum* sp and *Aspergillus flavus),* were able to degrade starch, 2 fungi isolates (40%) (*Penecillum* sp and *Aspergillus flavus*) degraded cellulose, 4 fungi isolates (80%) (*Aspergillus niger, Penecillum* sp, *Aspergillus flavus* and *Mucor* sp) degraded both crude oil and kerosene and 5 fungi isolates (100%) (*Aspergillus niger, Trichophyton quinckeanum, Penecillum* sp, *Aspergillus flavus* and *Mucor* sp) degraded diesel Table 6.

Table 6: Determination of biodegradation potential of fungi isolated from abattoir wastewater

Organism	Starch	Cellulose	Crude oil	Kerosine	Diesel
Aspergillus niger	+	-	+	+	+
Trichophyton *quinckeanum*	-	-	-	-	+
Penicillin sp	+	+	+	+	+
Aspergillus flavus	+	+	+	+	+
Mucor sp	-	-	+	+	+

+: Presence of growth -: Absence of growth

The ability of the microbes isolated from abattoir wastewater to grow on mineral salt media (MSM) supplemented with starch, cellulose, crude oil, kerosene and diesel as the sole source of carbon and energy, depict their potential to degrade carbon source present in abattoir wastewater.

In the present study, *Pseudomonas aeruginosa, Bacillus* sp, *Penecillum* sp and *Aspergillus* sp has demonstrated their ability and potential to degrade cellulose and hydrocarbon substrates (crude oil, kerosene and diesel). Their ability to degrade hydrocarbon substrates as sole carbon source has been previously reported by Ahamed *et al.* (2010); Al-Nasrawi (2012). However, *Bacillus* sp, and *Aspergillus* sp are connected with lipase and cellulase production. They are good producers of cellulase and lipase. These enzymes are responsible for the breakdown of cellulose and oil. In addition, Bala *et al.* (2012) had also reported the isolation of *Bacillus subtilis* from industrial wastewater.

Biodegradation is associated with the ability of bacteria and fungi to grow and degrade carbon sources in industrial wastewaters (Haimann 1995). The organic matter in abattoir wastewater possibly will have played an essential role in the abundance of microbes isolated in the present study.

The results obtained from the present study revealed that the microbes isolated are identical to those found in areas polluted with wastewaters (Abass *et al.* 2012; Soleimaninanadegani and Manshad 2014; Bala *et al.* 2015a) and crude oil or petroleum hydrocarbons (Okereke *et al.* 2007).

Conclusion

Results obtained from the current study revealed the existence of microbes in abattoir wastewater. The microbes were able to demonstrate their ability and potential to degrade starch, cellulose and hydrocarbon substrates (crude oil, kerosene and diesel). This suggests their effectiveness for efficient bioremediation of polluted environment with wastewaters.

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