

ANALYSIS OF COLIFORM BACTERIA IN WSPs AT ALSCON USING MACCONKEY BROTH AND LOCALLY MADE SOLUTION

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ABSTRACT

Enumeration of coliform bacteria in wastewater was carried out by comparing between imported Macconkey broth solution and the locally prepared solution type. Wastewater samples were obtained from four Waste Stabilization ponds (WSPs) at the Aluminium smelting company located at Ikot Abasi Local Government Area of Akwa Ibom State. The results of the Analysis showed that the imported media yielded higher numbers of coliform bacteria per 100ml, as compared to the locally prepared media. Two methods were used for this analysis namely: the membrane Filtration Technique (MFT) and the Multiple Tube Technique (MTT). The MFT was more precise, simple and faster in enumerating coliform bacteria per 100ml as compared with the MTT method. The two methods (MTT and MFT) were used to determine the amount of coliform present in two different samples each of locally made solution and imported Macconkey broth solution. The Average results obtained for sample 1 from the MTT method for ponds 01 to ponds 04 respectively for locally made solution are 255.75, 268, 271.25, and 262, while that from imported solution are 293.75, 312, 317, and 2995. Also the average result from MFT for locally made solution are 246, 260.5, 257.5 and 247.5; while that for imported solution is 265.25, 282, 278, and 267.75 all in multiples of 1000. For sample 2, the results obtained from MTT method from ponds 1 to 4 for locally mixed solution are 178.25, 192.5, 184.5 and 177.5, while that of imported macConkey broth solution are 158, 167, 5, 171.25 and 162. Also that of MFT for locally mixed solution are 206.25, 227, 206.25 and 211.75, while that of imported macConkey solution are 186, 201.75, 187.5 and 187.5 all in multiples of 1000 per 100ml the other average results from pond 1 to 4 are obtained from the different compartments of each pond, this includes the pH of sample (6.853, 6.655, 6.378 and 6.918), The TDS (81.125, 98.25, 116.575, and 129.010), the DO (2.893, 2.585, 2.58, and 2.798), the BOD (1.748, 1.435, 1.430, and 1.648), The COD (98, 115.25, 124.70 and 131.160), conductivity (162.7, 197, 233.4 and 258.05), and Temperature in celcius (28.25, 29.145, 29.155, 28.685).

KEYWORDS: Total Coliform, waste stabilization pond, bacteria, wastewater and Macconkey broth.

INTRODUCTION

This analysis involves the determination of physical, chemical and biological characteristics of the wastewater samples at the Aluminum smelting company located at Ikot Abasi Local Government Area of Akwa Ibom State. The primary analysis is for indicator organisms rather than the pathogens that might cause concern.

Indicator organisms are bacteria such as non-specific *coliforms*, *Esherichia Coli* and *Pseudomonas aeruginosa* that are very commonly found in the human or animal gut and which, if detected, may suggest the presence of sewage.

Indicator organisms are used because even when a person is infected with more pathogenic bacteria, they will still be excreting many millions times more indicator organisms

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Bacteria in wastewater are generally classified in different ways, but the coliform bacteria in wastewater are often described as being aerobic (needing oxygen), anaerobic (not needing oxygen) and facultative (can survive in the presence or absence of oxygen). Other systems of classification include their shapes, which could be spherical, rod shaped, bent, or curved shapes.

However, bacteria are unicellular plants varying in size from 0.5 to 3 microns, and without chlorophyll. They take soluble food and convert it into new cells. Reproduction is by binary fission (Agnawamba, 2001). Bacteria are sensitive to pH and temperature.

Testing for the presence of coliforms is the standard way to indicate the possible additional presence of more harmful pathogens in food, beverages and water. While some of these "indicate bacteria" are frequently present in our everyday lives to a certain extent, they themselves usually only cause issue when they reach elevated numbers, such as with *Escherichia Coli* bacteria. It is present in most warmblooded animals including people, and exists harmlessly in most cases. When numbers elevate, or certain strains are introduced however, this is when illness is more likely to occur.

1.2. Significant Of Coliforms in Wastewater

Monitoring for total coliforms at the treatment plant and in the distribution and storage system is carried out to provide information on the adequacy of drinking water treatment and on the microbial condition of the distribution system. The presence of total coliforms in water or waste water leaving any treatment plant signifies inadequate treatment has taken place and therefore additional actions such as notifying the responsible authorities, investigating the cause of the contamination, and implementing corrective actions; which could include issuing a boil water advisory.

In the distribution and storage system, when water tested immediately post-treatment is free of total coliforms, indicates water quality degradation, possibly via bacterial regrowth or post treatment contamination. In municipal-scale systems, the detection of more than 10% of samples in a given sampling period, or of consecutive samples from the same site, that are

positive for total coliforms indicates changes in the quality of the water and a need for follow-up action to be initiated. In residential scale systems where there is little or no distribution system, presence of any total coliforms should trigger follow-up actions to investigate the cause of the positive results.

Since the wastewater from the WSPs are sources of fecal contamination to both surface and underground water. It becomes very pertinent to check the degree of treatment at the ponds before it discharges into either the surface or underground waters to contaminate it.

1.3. Objective of the Study

- To determine the presence and degree of pathogen in the WSPs at ALSCON since most pathogens that can contaminate water supplies come from the feces of humans or animals.
- Reduce the cost of testing for the pathogens since coliform test is considerably very cheap compared to other methods of testing for pathogens.
- Reducing the time as well as making the test for pathogens simpler by the use of imported macckonkey broth, this also enhances the accuracy of results produced for the coliform test as compared with the locally made solution used for tests of coliform.

1.4. Total Coliform (TC)

Total coliforms are those bacteria that can be found everywhere in nature. They could be found in the soil, air and water; hence, they are not specific to fecal materials only like the fecal coliforms. Knowledge of total Coliform is very important in wastewater treatment as the bacteria degrade the organic waste to biomass (sludge) and water.

Their presence in water indicates that the water has been contaminated by waste material from agricultural waste, run-off, industrial waste, sewage and even dissolved particles from the air. Their presence in water does not mean that they cause disease directly but signifies that the water has been contaminated and could pose possible health threat to individuals.

1.5. Faecal Coliform (FC)

Faecal coliforms are those bacteria that live in the intestinal tract of man and other warm

blooded animals. Their presence in water indicates recent fecal contamination of that water by man or other warmed blooded animals. The most common member of feacal Coliform is the *Escherichia coli* (E.coli), which is used as indicator to detect pathogens in the water, since the direct detection of the pathogens is always very difficult. Although these bacteria do not cause disease directly but high quantity of it suggests the presence of disease causing micro organisms.

1.6. Study Area

The wastewater used for this work was obtained from the waste stabilization pond of the Aluminum Smelter Company of Nigeria (ALSCON), Ikot Abasi. The pond at ALSCON consists of three Facultative ponds, measuring 150m x 50m x 1.5m in series and a maturation pond measuring 120m x 60m x 1.2m. Ikot Abasi Local Government Area is located in Akwa Ibom State of Nigeria and is an industrial town with a population of over 700,000 people. The main occupation of the area is farming. Figure 1 show the map of the Akwa Ibom State showing the study area.

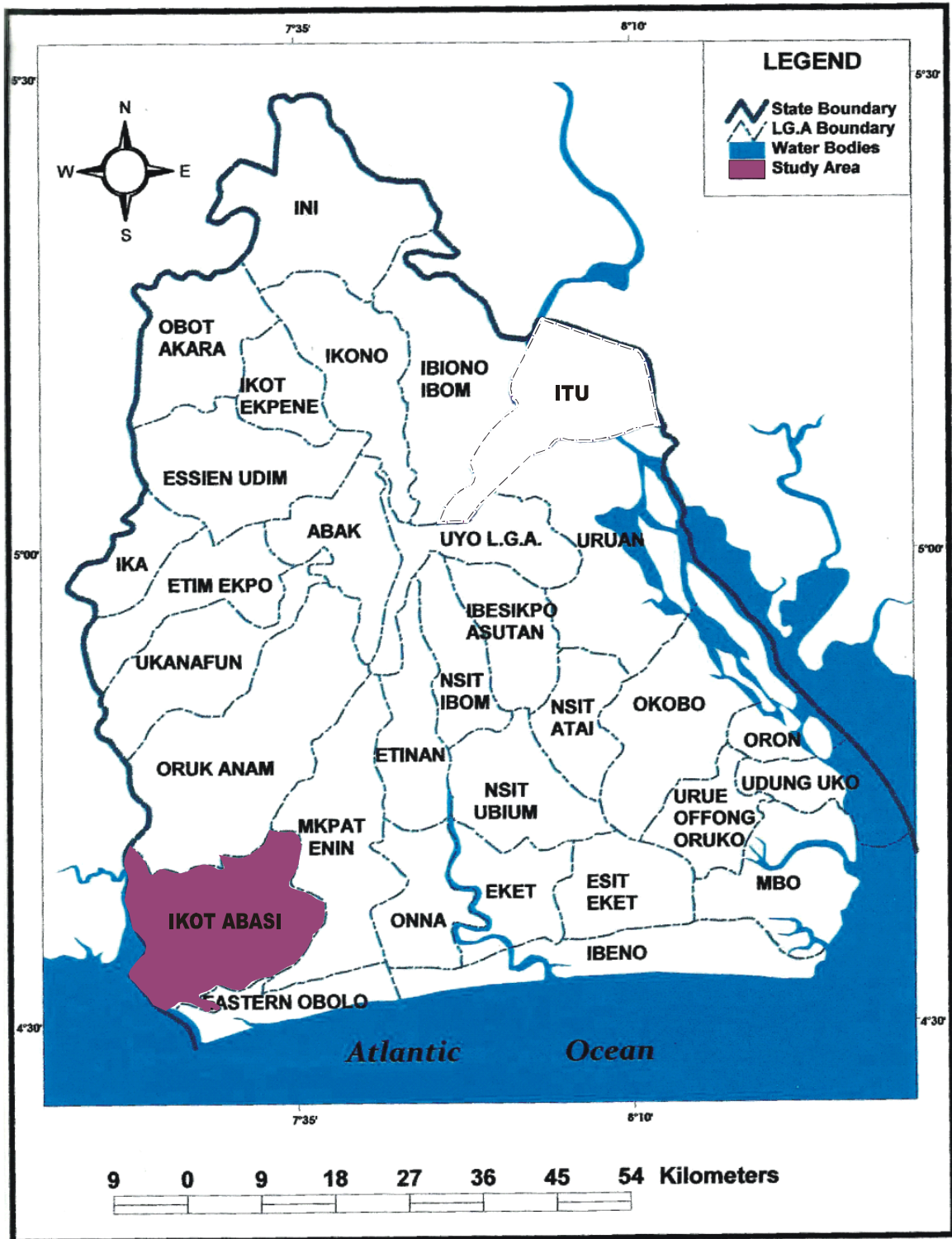


Figure: 1: Map of Akwa Ibom State showing Ikot Abasi L.G.A - the study area

1.7. Characteristics of wastewater

Water is a simple chemical compound with a chemical formula of H₂O. Most analysis of wastewater sample is aimed at determining the impurity level and the type of treatment required for effective purification before it is used.

The physical characteristics include; temperature, taste, odour, colour, turbidity, dissolved solid etc. The chemical characteristics which are defined in terms of organic and inorganic matter present in the water include; pH, hardness, alkalinity, acidity, chlorides, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand (COD). The biological characteristics include; fecal Coliform (FC), total Coliform (TC) etc.

Attempts have been made in recent time to correlate the physical and biological characteristics of certain members of Coliform bacteria with human fecal contamination in an attempt to sharpen the sanitary significance of such organism.

1.8. Classification of Coliform Bacteria

Bacteria are generally classified in different methods, but the Coliform bacteria in wastewater are often described as being aerobic (needing oxygen), anaerobic (not needing oxygen) and facultative) can survive in the presence or absence of oxygen). Other system of classification include their shapes, which could be spherical, rod shape bent or curved shapes etc.

2.0. MATERIALS AND METHOD

2.1. Source and Collection of Samples

The wastewater samples were collected from the waste Stabilization pond of the Aluminum Smelter Company of Nigeria (ALSCON), Ikot Abasi. The company has four WSP namely; 01, 02, 03 and 04. Each of this pond consist of three facultative ponds in series and a maturation pond.

Four set of samples were taken from each of the pond (i.e. from 01, 02 etc.) and the Total and fecal coliforms were enumerated using the standard MPN method and membrane filtration method (APHA, 1992).

The sample was conveyed to the laboratory with extreme care and the bacteriological test was carried out within 24 hours of the collection of the samples to ensure that the bacteria to be tested for do not die off. Samples were stored in refrigerator at 4°C to avoid biological activities.

2.2. Sterilization

All the glassware used in the work were wrapped in aluminum foil and sterilized in a hot box oven (Gallenkamp) at 160°C for one hour. The plastic equipment used in this analysis were sterilized in 90% ethanol for two hours and dried in an incubator at 45°C. The surface of the work bench where the practical was carried out was disinfected with 95% ethanol before the commencement of the experiment.

2.3. Preparation of Culture media/reagent

The culture media used was the MacConkey Broth, with the following composition: peptone (20g), lactose (10g), Bile salt (5.0g), sodium chloride (5.0g), neutral red (0.075g). The optimum pH use was 7.4 ± 0.2°C. 40 grams of the media was dissolved in one (1) litre of distilled water and was thoroughly mix and then distributed into screw capped bottle fitted with Durham tube. Sterilization is done using autoclave at 121°C for 15 minute under a pressure of 15 lb per square inch.

2.4. Methods of Analyzing Coliform Bacteria

Two techniques are commonly used to detect the presence of Coliform bacteria in water. The first of these is called the 'multiple fermentation tube' or "most probable number" technique. In this method measured portions of a water sample are placed in test-tubes containing a culture medium. The tubes are then incubated for a standard time at a standard temperature. In the second technique, a measured volume of sample is passed through a fine filter that retains bacteria. The filter is then placed on culture medium and incubated. This is called the "membrane filter" technique. Features of the two techniques are compared in Table 1.0.A

Table 1.0.A: Comparison of methods for analysis of coliform bacteria

Multiple fermentation tube technique	Membrane filter technique
Slower; require 48 hours for a positive	More rapid; quantitative results in or presumptive positive about 18 hours
More labour-intensive	Less labour-intensive
Require less culture medium	Require more culture medium
Require more glassware	Require less glassware
Result obtained indirectly by statistical approximation (low precision)	Results obtained directly by colony count (high precision)
Not readily adaptable for use in the field	Readily adapted for use in field
Applicable to all types of water	Not applicable to turbid waters
Consumables readily available in most countries	Cost of consumables is high in many countries
May give better recovery of stressed or damaged organisms in some circumstances	

Source: APHA, 1992

2.5. Most Probable Number (MPN)

This method has been extensively used for the analysis of drinking water for many years with satisfactory results. It is the only procedure that can be used if water samples are very turbid or if semi-solids such as sediments or sludge are to be analyzed. It is a statistical estimation of the concentration of coliform organism present in 100ml of the sample. Agañwamba (2001), stated that the coliform organisms comprise of all the aerobic, anaerobic, facultative, gram negative, non-spore forming rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C.

APHA, (2005) used the MPN method to enumerate for total coliform and E.coli, in their study of the concentration of enteric bacteria in reservoir feeder. They used Glutamate media modified with minerals for the presumptive enumeration of total coliform. Peptone water and lactose broth were used for the confirmation of E.coli presence. The result showed significant increases in enteric bacterial concentration in 9 out of the 11 reservoir feeder streams examined. They suggested that a flushing mechanism might be aiding the transports of enteric bacteria into upland reservoirs. The MPN method according to APHA standard is divided into three stages;

1. Presumptive test using MacConkey broth and the result estimated using MacCraday's probability table.
2. Confirmed test otherwise called the Ejikam's test used to ascertain whether the coliform detected in the presumptive

test are plated on Eosin methylene blue medium.

- 3). Complete test, used for the characterization of coliform by metallic sheen which can be differentiated from others by their colonies.

Bartram, (2000) while working on inhibition of coliform by bacteriocinlike substance in drinking water distribution system came up with the possible causes of their inability to detect coliform by MPN method. These causes were:

- 1) Interaction of non-coliform bacteria with coliform bacteria resulting in nutritional competition.
- 2) Mechanical injury which cumulatively suppressed coliform growth in standard MPN test.
- 3) Non-lactose fermenting bacteria pollute water and a strain of antibiotic producing bacilli inhibiting growth of coliform bacteria.

Both Olson and Fischer while working on enhanced accuracy of coliform testing in sea water by modification of the MPN method and the antagonistic effect of aerobic bacteria on coli, suggested that the failure of coliform bacteria to produce gas from lactose fermentation in the presumptive portion of the test may be a function of bacteriocin absorption and release, which can result in a series of underestimation of bacteriological quality of water supply. They do eventually recover this ability in the confirmed

test. However, the major limitation of the MPN method is underestimation of both the incidence and number of coliform in a sample of water.

Agumwamba (2001) stated that the MPN test may be determined by using;

- 1) The MPN model
- 2) Thomas approximate method or
- 3) Statistical tables.

The MPN model is given by:

$$Y = 1/a[(1 - \exp(-N_1\lambda))^p(\exp(-N_1\lambda))^q][(1 - \exp(-N_2\lambda))^r(\exp(-N_2\lambda))^s][(1 - \exp(-N_3\lambda))^t(\exp(-N_3\lambda))^u].$$

Where N_1, N_2, N_3 = various size of portion examine

p, r, t = no of portion of respective size giving positive tube for Coliform

q, s, u = no of portion of respective size giving negative test for coliform

λ = concentration of Coliform in ml

Y = Probability of occurrence of a particular result.

a = constant

The MPN is determine by selecting the values of A that will maximize Y . In the Thomas method MPN is estimated by;

$$\text{MPN} = \frac{100 \times \text{number of positive tube}}{[(\text{volume of all negative portions}) / (\text{volumes of all portion})]^{0.5}}$$

For statistical table the MPN is determine by reading the values from already prepared tables based on the number of positive tubes in the multiple dilutions.

2.6. Membrane Filtration Method

The membrane filter method gives a direct count of total Coliform and faecal Coliform present in a given sample of water. The membrane filtration technique is based on the fact that special filter discs with small pore size (0.2-0.8 μ m) will retain bacteria cells which can be made to growth out to visible colonies by incubating the filter discs on a nutrient medium e.g. the Endo medium, which can cause the growth of recognizable coliform colonies that can be counted after incubating at 35°C within 24 hours. The MF is easy to perform and highly reproducible, as compare with the MPN

technique. The MF method yields a faster result with greater precision. Membrane filtration was first used in Britain in 1953 for the enumeration of total coliform in water (Taylor, 1957). Muller in Germany used membrane filters for the analysis of portable water for Coliform. Bartram, *et. al.*, (2000). He also reported that by the early 50's membrane filtration was a practical alternative to the MPN approach, although it's inability to demonstrate gas production with membrane was considered a major draw back. The membrane filter- most probable number (MF-MPN) procedure were used by Altherholt, *et. al.*, (2003). In laboratories studies of estuarines water to recover coliform and faecal coliform comparable to those obtained by the standard multiple tube (MPN) procedure.

Bartram, (2000). Studied chlorine resistant pattern of bacteria from drinking water distribution system using the MF technique which they asserted, allowed for rapid and qualitative assessment of the chlorine resistance pattern of bacteria population obtained directly from an aquatic environment. The ME procedure also facilitates the detection, qualitative enumeration and axenic isolation of highly chlorine resistant sensitive cell types which may be present in a particular water supply.

Altherholt *et. al.*, (2003). used MF technique to study the effect of turbidity on chlorination efficiency and bacterial persistence in drinking water. Total coliform were enumerated by the modified ME technique which include an added resuscitation step, they used the lauryl tryptose broth saturated pads and M Endo Agar and their result were in conformity with those published by the American Public Health Association (APHA) on standard method for the examination of water and waste water. However, this technique is unsuitable for water containing very high level of suspended material, sludge's and sediments all of which could blocked the filter before an adequate volume of water will pass through. Result of membrane filtration is calculated from the following formula;

$$\text{Number of colonies per 100ml} = \frac{\text{no of colonies} \times 100}{\text{Volume of filtered}}$$

The colonies count at this stage are presumed to be Coliform bacteria (presumptive result)

Presentation of result

The result of relevant tests carried out during this study which gave values for DO, BOD, TDS, pH, faecal Coliform, Total Coliform,

temperature etc. are presented in Table 1, 2, 3, 4, 5, 6 and also in Figures respectively as shown below;

TABLE 1: Result of Physiochemical Parameters for Pond 01 (Chambers A to D)

PARAMETERS/ UNITS	POND 01				
	A	B	C	D	MEAN
pH	6.57	6.8	6.94	7.1	6.853
TDS MG/L	76.5	80	83	85	81.125
DO MG/L	2.8	3	2.77	3	2.893
BOD MG/L	1.67	1.85	1.62	1.85	1.748
COD MG/L	92	98	100	102	98
Conductivity Us/cm	154.8	160	166	170	162.7
TEMP. °C	28.6	28	28.3	28.1	28.25

TABLE 2: Results of Physiochemical Parameters for Pond 02 (Chambers A to D)

PARAMETERS/UNITS	POND 02				
	A	B	C	D	MEAN
pH	7	6.4	6.45	6.35	6.55
TDS MG/L	90	98	100	105	98.25
DO MG/L	2.6	2.56	2.6	2.58	2.585
BOD MG/L	1.45	1.41	1.45	1.43	1.435
COD MG/L	110	115	117	119	115.25
Conductivity Us/cm	180	196	201	211	197
TEMP. °C	29	29.33	29.1	29.15	29.145

TABLE 3: Result of total coliform for imported and locally prepared MacConkey Broth

Pond type		Total coliform per 100ml			
		Local		Imported	
		MTT (in 10 ³)	MFT (in 10 ³)	MTT (in 10 ³)	MFT (in 10 ³)
1	A	260	240	300	260
	B	250	245	285	265
	C	263	250	305	270
	D	250	249	285	266
2	A	265	255	309	275
	B	270	260	315	280
	C	265	263	310	285
	D	272	264	315	288
3	A	270	259	315	279
	B	275	248	320	268
	C	270	260	315	280
	D	270	263	318	285
4	A	258	255	290	275
	B	260	245	300	265
	C	255	240	288	260
	D	275	250	320	271

Note; MTT = Multiple Tube Technique
MFT = Membrane Filtration Technique

TABLE 3A: Result of Average Coliform bacteria Obtained from Locally Imported Solution.

POND	LOCALLY		IMPORTED	
	MTT (in 10 ³)	MFT (in 10 ³)	MTT (in 10 ³)	MF (in 10 ³)
Pond 1	255.75	246	293.75	265.25
Pond 2	268	260.5	312.25	282
Pond 3	271.25	257.5	317	278
Pond 4	262	247.5	299.5	267.75

TABLE 4: Results of Physiochemical Parameters for Pond 03 (Chambers A to D)

PARAMETERS/UNITS	POND 03				
	A	B	C	D	MEAN
pH	6.38	6.35	6.4	6.38	6.378
TDS MG/L	107	110	120.6	128.7	116.575
DO MG/L	2.59	2.58	2.56	2.59	2.580
BOD MG/L	1.44	1.43	1.41	1.44	1.430
COD MG/L	120	122	127	129.8	124.700
Conductivity Us/cm	215	220	241.2	257.4	233.400
TEMP. °C	29.05	29.2	29.25	29.12	29.155

TABLE 5: Results of Physiochemical Parameters for Pond 04 (Chambers A to D)

PARAMETERS/UNITS	POND 04				
	A	B	C	D	MEAN
pH	7.1	6.82	6.9	6.85	6.918
TDS MG/L	125	127.84	130	133.2	129.010
DO MG/L	2.9	2.83	2.76	2.7	2.798
BOD MG/L	1.75	1.68	1.61	1.55	1.648
COD MG/L	128	128.94	132.3	135.4	131.160
Conductivity Us/cm	250	255.8	260	266.4	258.050
TEMP. C	28.5	28.67	28.77	28.8	28.685

Where; A, B, C, AND D are the Pond Chambers or Compartments

TABLE 6: Result of faecal coliform for imported and locally prepared MacCONKEY Broth.

POND TYPE		FAECAL COLIFORM PER 100ML			
		LOCAL		IMPORTED	
		MTT	MFT (in 10 ³)	MTT (in 10 ³)	MFT (in 10 ³)
1	A	175	200	160	180
	B	180	210	155	185
	C	178	215	163	190
	D	180	200	156	189
2	A	190	220	165	195
	B	195	225	170	200
	C	190	230	165	205
	D	195	233	170	207
3	A	198	202	170	199
4	B	200	208	175	188
	C	195	205	170	180
	D	200	210	170	183
	A	165	220	158	195
	B	175	210	160	185
	C	180	200	155	180
	D	190	217	175	190

TABLE 6A: Results of Average Coliform bacteria Obtained from Locally Imported Solutions.

POND	LOCALLY		IMPORTED	
	MTT (in 10^3)	MFT (in 10^3)	MTT (in 10^3)	MFT (in 10^3)
Pond 1	178.25	206.25	158	186
Pond 2	192.5	227	167.5	201.75
Pond 3	184.5	206.25	171.25	187.5
Pond 4	177.5	211.75	162	187.5

3.1 DISCUSSION OF RESULT

From the table 1, 2, 4 and 5, it can be deduced that the averages for the following tests are: pH 6.675, TDS 106.24mg/l DO 2.714mg/l, BOD 1.565mg/l, COD 117.278mg/l, conductivity 212.788mg/cm and temperature 28.809^oc. Meanwhile the maximum values of each of the parameters occurred as shown in the table as follow:

pH. 7.1 (occurred in pond 1, chamber D), DO 3.0mg.l (occurred in pond 1, chambers B and D), BOD 1.85mg/l (occurred in pond 1, chambers B and D), COD 135.4mg/l (occurred in pond 4, chamber D), conductivity 266.4 mg/l (occurred in pond 4, chamber D), and Temperature 29.33^oc (occurred in pond 2), chamber B).

The minimum values of the different parameters are also seen as shown: pH 6.35 (pond 1, chamber D) and pond 3 chamber B) TDS 76.5mg/l (pond 1, chamber A), DO 2.56mg/l (pond 2 chamber B and pond 3 chamber C), BOD 1.41mg/l (pond 2, chamber B and pond 3 chamber C) COD 92mg/l (pond 1, chamber A), conductivity 154.8us/l (pond 1, chamber A), Temperature 28.0^oc (Pond 1, chamber B).

From table 3A (for sample 1) and 6A (for samples 2) it can be deduced that the average coliform in each tank is as follows sample 1: pond 1(274.75 x 10^3) and 255.875 x 10^3 for MFT), Pond 2 (290.125 x 10^3 for MFT) and pond 4 (280.75x 10^3) for MTT and 257.625 for MFT). Table 6A (Sample 2): Pond 1 (168.125 x 10^3) for MTT and 196.125 x 10^3 for MFT), Pond 2 (180.0 x 10^3 for MTT and 214.375 x 10^3 Pond 3 (195.375 x 10^3) for MTT and 196.875 x 10^3 for MFT) Pond 4 (169.75 x 10^3 for MTT and 199.625 x 10^3 for MFT). Also for Table 3A (Sample 1), the maximum coliform 320 x 10^3 maximum coliform 320 x 10^3 for MTT is in Pond 3, camber B and pond 4 chamber D, MFT 288 x 10^3 is in pond 2 chamber D and the minimum 250 x 10^3 is shown in pond 1 chamber D for MTT and 240 x 10 x 10^3

ponds 1, chamber A and pond 4 chamber C for MFT as shown in table 3A.

For sample 2, the maximum coliform 200 x 10^3 is shown in pond 3 chamber B and D for MTT and 233 x 10^3 ponds 1 chamber A, Pond A, Pond 3 chamber C and Pond 4 Chamber C for MTT and 180 x 10^3 Ponds 1 chamber A, Pond 3 chamber C and Pond Chamber C showing in Table 6A.

From the results of the tests, there were decreases in the values of BOD, DO, TDJ and pH. This may be attributed to the preliminary treatment of the wastewater, which led to the reduction in the concentration/strength of the wastewater. The low pH was as a result of the neutralization of the neutralization done during the preliminary treatment of the wastewater. The low BOD and Do may be as a result of preliminary removal of toxic favourable temperature substances, sedimentation, classification, detention time and the favourable temperature of the pond.

Figures 2and 3 shows the different variations in locally made and imported Mackonkey broth. From the result of the Analysis, membrane filtration technique (MFT) was found to be more precise, simple and quicker in the enumeration of coliform bacteria as compared with the multiple tube technique (MTT). This was attributed to the fact that the MFT gave actual count of colonies that was formed, while the result of MTT was approximate value obtained from statistical table, based on the number of tube showed positive showed positive result in each dilution.

CONCLUSION

From the experimental result and analysis obtained and evaluated, it could be observed that the imported MacConkey broth did yield higher number for total coliform and lower for faecal coliform per 100ml. This was attributed to the compounding of the imported broth. The

imported broth seems to be more compounded (mix) than the locally prepared broth. Other factors were the inconsistency in weighing the component that constitute the locally prepared broth, pH and temperature.

From the analysis, the membrane filtration technique (MFT), was found to be more precise, simpler and quicker in enumerating Coliform bacteria than the multiple tube technique (MTT). This is so because the

membrane filtration method gives the actual counts of the colonies being formed per 100ml, while the multiple tube technique gives result based on comparing the number of tubes that are positive with approximated values from a standard statistical table (MPN Table).

It was also observed that the BOD, DO, TDS, pH had low values. This was as a result of preliminary treatment of the wastewater before being discharged into water bodies.

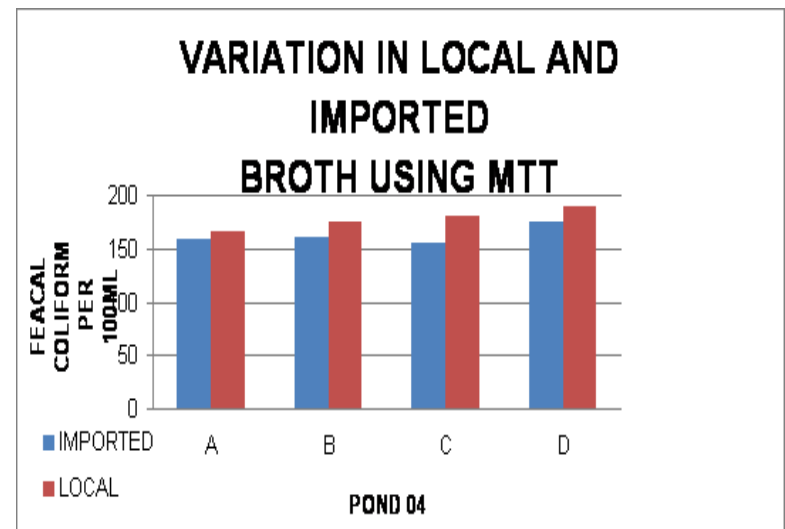
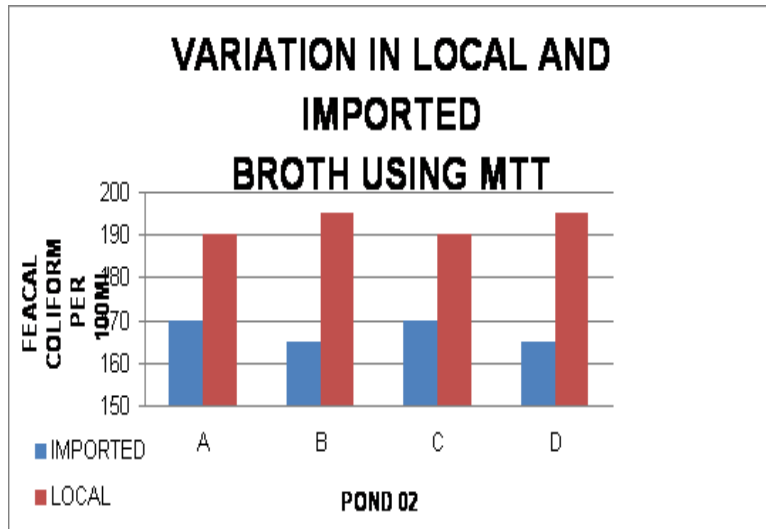
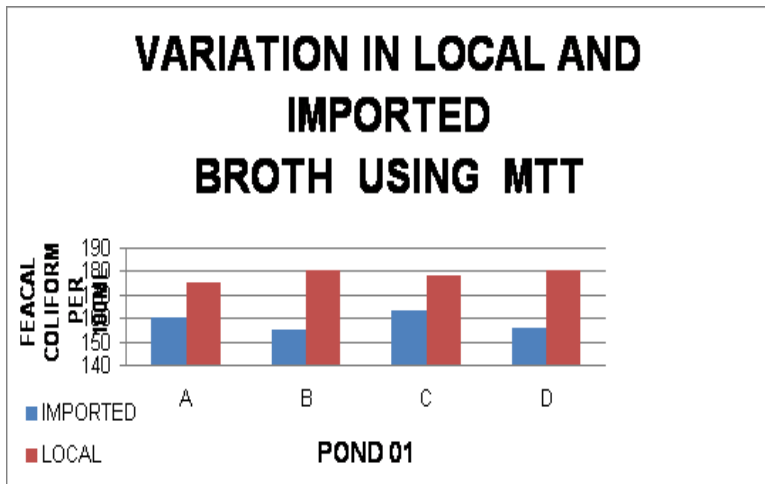


FIGURE 2: VARIATION OF FEACAL COLIFORM IN LOCAL AND IMPORTED BROTH USING MTT

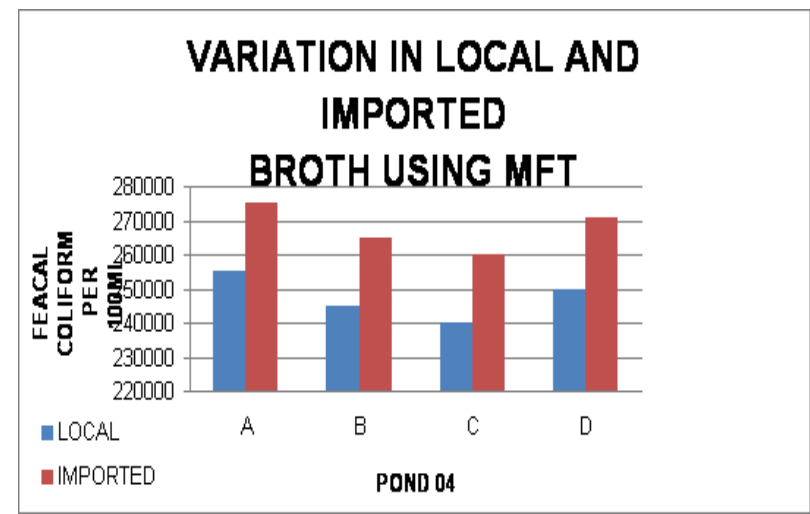
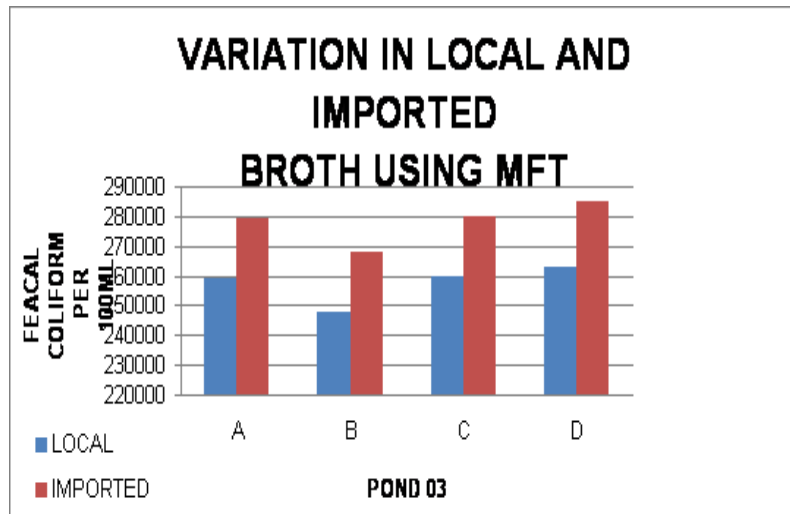
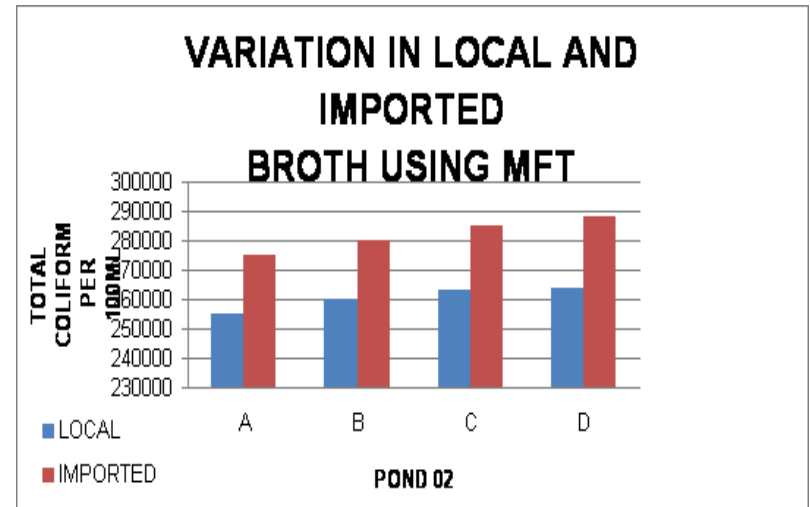
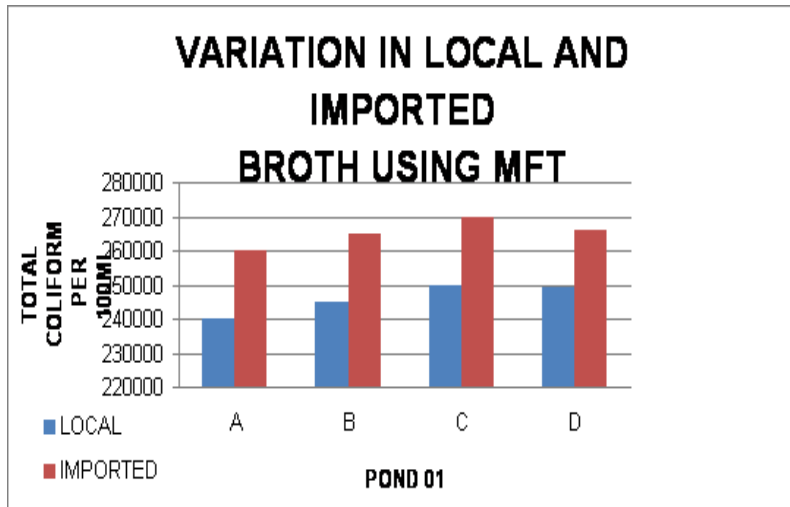


FIGURE 3: VARIATION OF TOTAL COLIFORM IN IMPORTED AND LOCAL BROTH USING MFT

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