

**TITLE PAGE**

**COMPARATIVE ANALYSIS OF PIPEBORNE WATER AND  
OTHER SOURCES OF WATER WITHIN ENUGU  
METROPOLIS FOR HUMAN CONSUMPTION.**

**(INDEPENDENCE LAYOUT LOCALITY)**

**BY**

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INMICROBIOLOGY AND BIOTECHNOLOG**

## CERTIFICATION

I certify that this project was carried out by Anichukwu Ifeanyi S.(MB/2008/407) in the department of microbiology and biotechnology, Faculty of Natural science, Caritas University Amorji –Nike, Enugu. The department recognized that Anichukwu Ifeanyi S.(MB/2008/407) bear full responsibility for this work.

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## **DEDICATION**

Dedicated to Almighty God, the giver of wisdom, to my lovely parents, my supervisor and to my fellow students.

## **ACKNOWLEDGEMENT**

It is not possible to mention here all those who supported me in one way or the other during my research exercise.

I wish to register my unalloyed gratitude to Dr. Orji being my supervisor for his proper supervision to see the reality of this project,

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And to everybody else whose names are not mentioned above.

## **ABSTRACT**

Comparative examination of three main sources of water supply in Independence layout Enugu was carried out with a view to determine their levels of contamination of bacteria. The sources of water examined are tap water, well water and stream water. The pour plate method was used to examine the water samples. Bacteria isolated from the water samples include coliforms especially *Escherichia coli*. Stream water and well water were found to contain bacterial isolates unlike the tap water that has none.

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# CHAPTER ONE

## INTRODUCTION

Following the theory of creation, it is clear that water is as old as man. From time immemorial, man has resorted to the use of this unique commodity for domestic and other purposes.

Most of our water supplies are from surface water which include: rivers, streams, lakes, oceans and seas and there water bodies are likely to be polluted with domestic and Industrial as well as agriculture waste, As populations increase, the problem become more serious and as such, water can endanger the health and life of human beings because when polluted by fecal materials it becomes potential carrier of pathogenic organism (Carpenter, 1977).

Water, is of course, absolutely essential to life, not only human life but all life, animal and vegetable. Most of the biochemical reaction that occur in metabolism and growth of living cells involved water, and all take places in water. (Camp et al,1974).

Man uses water not only for drinking purposes but also for bathing, washing, laundering, heating, air conditioning, agriculture, stock raising and gardens, Industrial processes and cooling water power and steam

power, fire protection, fishing, swimming and wild life propagation and navigation.

Natural water contain not only then natural flora but also micro – organisms from soil and possible from animals or sewage. Surface waters in streams or pools and stored waters in lakes and large ponds vary considerably in microbial content. (frazier, 1978) water is broadly divided into three types viz., surface water which include: streams, rivers, lakes seas, and oceans (Kelman et al, 1957).

The ground water, well, bore hole, many people have defined the ground water in different ways: ground water is non saturated water that occurs where all pores in the soil or rock counting materials are saturated (pelezer et al, 1992).

The atmospheric water, which include rainfalls. All water bodies consist of a variety of bacterial and other microorganisms like the Algaes, fungi, which inhabit these natural water bodies. Some of these micro – organisms are indigenous to thus natural water while others are transient, entering the water from external environment (Pelezar and Reg, 1997).

The generality of bacteria are mostly commonly found ordinarily in fresh water some of which include: pseudomonas, Archacbacter, and vibrio these are gram negative, the gram-positive bacterial which are found in



water include: micrococcus Archacbacter and actinomycetes (Gebharal, 1975). Tap water, as one of the water sources is mostly used domestically, it is observed that tap change sometime the water tap will be clear this calls for load, in order to be sure of its portability (Bonde, 1977).

The increase in drinking water from different sources especially in Enugu state has made necessary to investigate the microbial content of water. Water is a potential carrier of pathogenic organisms that can endanger human life. Most of drinking water sources are often contaminated with different pollutants like faeces, animal and plant wastes, making such water unfit for drinking if not treated. The pollution of water with pathogenic organisms and other pollutants can only be detected by carrying out microbiological assessment of such water. Most human disease such as typhoid paratyphoid cholera, amoebiasis, Trichinosis, gastroenteritis, salmonella shigellosis, diphtheria, giardia, dracunculus etc are known to be water borne disease. (Ewington et al, 1971).

Water born disease are those disease which have water as their vehicle of transmission these disease are capable of destroying a whole community if not checked. Therefore, the quickest ways to prevent outbreak of these disease and to determine the portability of such water sources is to

determine the microbial load or content if the microbial content is not within acceptable limit, such water sources should be condemned immediately (Fair et al, 1970).

### **1.1. AIMS AND OBJECTIVE**

- I. To find out if well, stream, Tap water contain pathogens.
- II. To help the public to know the danger of drinking these water without adequate treatment.
- III. To compare the microbial load of the water source and advice on safer source of water .

### **1.2. STATEMENT OF PROBLEM**

These source of water are contaminated through one way or the other

- (i) The short falls in the distribution of treated pipe borne water leads people to resort to alternative source of water which may be unfit for human consumption
- (ii) Tap water can be polluted through leakage's/ improper plumbing.
- (iii) Well water is contaminated as a result of running off into it, especially shallow well.

- (iv) Streams can be contaminated through waste from industries, leaves, dust, and rain run often.

### **1.3. SIGNIFICANTS OF STUDY**

- 1) The study will advice on water meet the standard quality required for any particular purpose
- 2) Also advice the eswc on quality of their product. For future nature modification of treatment methods

### **1.4. LIMITATION**

Fewer sample were worked on because of lack of fund, the survey is however limited to the bacteria flora of waters, and not all organisms even on bacterial flora specification, the number of sample culture were limited by lack of funds and culture media is expensive.

## CHAPTER TWO

### LITERATIVE REVIEW

Bacteriological criteria for determining water quality have been directed primarily toward concerns for microbial hazard to human health associated with exposure to potable water supplies among others, where as some bacterial are indigenous to natural water, other gain access from land, air or humans and other animal wastes (Ade, 1987)

Several micro organisms have been detected in water and found to be contaminated which thus led to the real problem of microbial contamination in water.

Basically, the identified microbes were observed to be contaminated from different sources, useful and well reliable information on how certain indicators and bacteria connected with drinking water pollution could be detected and enumerated has since been introduced (Gneldrech,1972).

According to (ogedengbe,1981) infectious disease such as gastroenteritis, fever, poliomyelitis typhoid fever, cholera, diarrhoea and some other intestinal tract disease could be acquired transmitted to man through drinking water.

(Skerrrow,1977) reported the outbreak of epidemic disease as a result of drinking water in an extensive review of water quality.

Ogedengbe and Adeniji (1978) stated that for any water to conform with the international standards such water must be safe biologically, chemically and acslhtically and the possibility that disease could be spread through polluted water was first suspected during the epidemics of the 19<sup>th</sup> century (Ruys,1959) the discovery of germs of cholera and typhoid proved the relationship and pointed to the need for water treatment.

According to Pelezer et al (1977) common bacterial species are common inhabitants of the intestinal tract of human and the presence of any of these enterobactericen species in drinking water, indicates that the water has received contamination of an intestinal origin.

Fried defined pollution as a modification of the physical, chemical and biological properties of water, restricting or preventing its use in the various application where it normally plays a part (Fried, 1975)

Water pollution is usually back to four main origins: industrial, domestic, agricultural and environmental pollution.

2.1. (i) **INDUSTRIAL POLLUTION:** are used water which contained chemical compounds and trace element such as metals. Rawactive pollution from atomic plats can also be brought in this ways

rain infiltrating through waste disposals, accidents like breaking of pipe line (Diosi,1961)

(ii) **DOMESTIC POLLUTION:** is carried to the aquifer by rain intelterating through sanitary lard tills accidents, like breaking septic tanks.

(iii) **AGRICULTURE POLLUTION:** is due to irrigation water or rain carrying away fertilizers, mineral salt herbicides and pesticides.

(iv) **ENVIRONMENTAL POLLUTION:** is manly due to sea water infusion in water aquifer bacteriological pollution mainly originates in domestic water such as fecal erosion and is the main source of pathogens in water (Fried, 1975).

(Hajner, 1975) started the routine bacteriological examination of metropolitan water supply when he employed Kochs gelatin method. In 1819, Hammer also pointed out that one must look for organisms characteristic of sewage to provide evidence of dangerous pollution, for the purpose of determing the portability of a water supply. It is necessary to establish that the water is not contaminated with pathogenic, if present could be greatly out numbered by normal inhabitant (Skeat, 1961) it is more satisfactory to examine the water for presence of the pathogens

could be present. (Cabeth, 1997) more emphasis have been place on faecal discharge. (Gneldrrech, 1985)

## **2.5. UNDER GROUND WATER**

Underground water usage follows in rank to the surface water sources, ground water sources embrace all water sources embrace all water source obtained below the earth surface these include spring well borehole, underground dam (B rem, 1909)

## **2.6. WELL WATER**

Well are used for a variety of purposes including exploration for mineral resources, drainage, disposal and water supply, it can be shallow deep well. Well water is stagnant it may contain a lot of clay and other mineral salt it may also contain the remains of dea organisms which might have fallen into it. It may as well be hard as a result have fallen into it. It may as well be hard as a result of the presence of lime stone on the bed, thus well water requires treatment to be suitable for both domestic and industrial uses, according to (tranal et al 1966) it may contain acid and an abundance of trace element including poisonous arsenic it occur in saturated treat called aquifer which is present nearly every where. Well is

very where. Well is very difficult to protect from contamination because they may be polluted by surface water flow through an inadequately sealed well cover by seepage polluted ground water etc (Lay and Mitarb, 1967) well maintenance is very important through sanitary protection maintenance of the well seal and connection, protection from surface drainage are extremely important, since detraction of well safety component may allow it to become polluted.(William, 1999)

Wells over thirty (30) meters deep are considered as deep wells, those less than thirty (30) meters in depth are considered Shallow wells (Clifton, 1965) underground water accumulated by infiltration of rain water, melt water (form snow and ice) and other source of water of stream, ponds, lakes, and reservoirs (William, 1999) the movement of water into the ground and down ward zone of saturation is called infiltration (Layi and Mitarb) and the amount of cufiltration depends on the quality of water involved. (Babor and Lehman, 1950).

Ground water sources are safer than surface water, is less susceptible to pollution, Although ground water is less exposed to pollution by domestic and industrial pollutants it is easily more contaminated by salts which dissolves a lot of mineral substances as it passes through (Loud, 1989) such ground water are classified as brackish water having not



more than 1 % dissolved salts (Diosi, 1961) for this reason, some ground water sources are not immediately useful (Pereia, 1993) started that the total fresh water sources available to man is less than 0.5% of the worlds total water contents. This is due to the high concentration of salts in ground water which results in hardness.

Ground water is an important of supply for much of our water, people have used ground water for nearly all of recorded history and millions of wells have been bunk all over in the containing bench for it. Ground water system have

Three characteristic that make supply, they are of adequate surface water supply they are:

- (1) They are extensive in distribution and location
- (2) They are large reservoirs and are free evaporation losses.
- (3) They improve water quality by infiltration during percolation maintenance of uniform temperature by retention of undesirable element of soil particle alteration by allowing time for short life radioactive substance to decay during slow percolation.

In support of this, (Mitchell, 1972) revealed that ground water in many respects is preferable to surface but in some area, it may not be sufficient and in addition in some parts of the temperate countries.

## **2.7. PIPE BORNE WATER**

It can be defined as channels of distribution of water through urban area or as water supplies to urban area through pipe, it is underground waters which collect on the top of impervious earth layer or strata (Schoop,1950) This is sourced by drilling holes to a depth of between 100 - 150ft or more into the earth crust depending on the geological nature of the area. Pipe borne water has been extended to rural areas from central urban undertaking (Elendayo, 1978).

However, because of inadequacies supply technological problems and ignorance of the people, many of the rural communities served in these ways have not been able to derive maximum benefit (Knocke, 1967) it is little wonder that our rural people still depend very much on rivers, stream, ponds and shallow wells for their water supply (the analyst December, 1988) from the observation made therefore of the urban and rural water supplies, it is necessary to determine or carry out series of experiment on water sources available to know microbial or bacteria contents if within the acceptable unit 50 as to guide against water pollution which could result in water borne disease as earlier discussed. Pipe water, as one of the water sources is mostly used domestics show

colour change and be clear. Sometimes this cells for need to actually verify it's microbial load.

## **2.8. SURFACE WATER**

Majority of the water used both municipally and industrially are derived from surface water sources. It include all the bodies of water available on the earth surface viz: streams, rivers Dams, canals, ponds etc. according to (Seiberlin and Hapear, 1955).

## **2.9. POTABLE WATER**

Potable water is any water that is fit for human consumption, and also water which in free from chemical substances like lead, Arsenic acid, Ag, Ag etc and also micro organism like Esherichia coli, Salmonella Spp, Shigella Spp etc Dondero (1961)

Potable water is required mostly for drinking and processing of food raw materials pharmaceutical etc. therefore non potabe water is implicated with many types of health hazard and also it is pertinent to subject water to necessary specified treatment before human consumption (Sykes and Skinner, 1971).

Ground water is usually of high quality when compared to surface water according to (Mitchell, 1972) as shown in the table below

**TABLE I: COMPARATIVE QUALITY OF GROUND WATER & SURFACE**

<b>Quality parameter</b>	<b>Ground water</b>	<b>Surface water</b>
1. Coliform bacteria	Low	Moderate high
2. Total bacteria count	Low	High
3. colour	Low	High/variable
4. Taste	Pleasant	Variable
5. Turbidity	Low	Moderate/ high
6. Temperature	Low	Variable / high
7. Dissolved solids	High	Low/moderate
8. Radio actives	Low	Variable
9. Dissolved oxygen	Low	Variable

The presence of bacteria in ground water is particularly to those bacteria of faecal origin e.g E coli streptococcus fecalis (Beger, 1952) the world health organization (WHO) has set up human certain microbiological parameters for water quality which aim to exclude all microbes of human and animals faecal origin because most pathogenic microbes found in water are introduced, into the water through faecal contamination (Duguid and Mitarb, 1985).

These parameter are as follows

- (1) No sample should contain 10 E coli in 100 ml of sample.
- (2) Through out any year, 95% of the sample as examined should not contain organism in any 100 ml sample.
- (3) It should contain less than 10 Coliform organisms per 100ml (Wistreich and Lechtman, 1984).
- (4) Coliform organisms should not be detectable in any 100 ml of two consecutive samples.

For water meant for individual or small communities such as well, springs lakes etc should have Coliform counts, less than 10/ 100ml. Persistent failure to achieve this, especially if E coli is repeatedly found in these samples, the sources of water should be condemned (Boria and Mitarh, 1966).

## **2.9. INDICATOR ORGANSIMS**

The Coliform group of which E coli is a member serves as indicator organisms of feacal pollution. Another group of bacteria that normal feacal pollution as CL perfringens and streptococcus feacalis also serves as indicator organisms (prescolte et al 1964)

The use of bacteria particularly those of feacal origin as indicator of the sanitary guilty of water can be justified for the following reason:

1. Coliform organisms particularly E coli are constantly present in the human intestine in large numbers, it is estimated that billion of these organisms are excreted by an average person per day. So their presence in water shows that such water has been polluted by feces. (Babor and Lehrman)
2. These organisms live longer in water than intestinal pathogens do.
3. These organisms outnumber and are easier to detect than pathogenic ones
4. They are present in sewage's polluted water
5. Their presence in water shows that pathogenic organisms are present
6. They are absent from unpolluted water
7. They are easier detected by simple laboratory techniques
8. They have consistent characteristics
9. They are harmless to men and animals
10. Their numbers correlate with the amount of pathogens. (Sarrison and Shaw, 1977)

## **2.10. WATER ANALYSIS**

The methods for the bacteriological analysis of water samples are many, which include the multiple tube technique (MTT) and the membrane filtration techniques (MFT) are commonly used to determine the presence of

coliforms and E coli (pelezar et al 1987) water to be used at home must therefore be treated to exclude the pathogenic organism so that such water will be fit for human consumption.

In this wise, water collected form well, stream etc must be steam, boiled and filtered before useage and major analysis of drinking water is to ensure that water does not transmit organism causing human disable to human health (Jiwa et al 1992).

## **2.11.MICRO BIOLOGICAL ANALYSIS**

This determine total bacteria count, total Coliform count / 100ml and E coli count / 100ml it also use to determine sanitary quality and suitability water for general use. (Umbreit, 1966).

## **CHAPTER THREE**

### **MATERIALS AND METHOD**

The media and the reagents used in this work and the methods of their preparations are presented in the appendix.

#### **3.1. SAMPLE COLLECTION**

Water sample were collected from fifteen different sources comprising; five tap water samples from different compounds, five well water samples from different compounds and five stream water samples.

Sterile universal sampling bottles were used to collect the samples, The samples were thereafter brought to the laboratory for analysis in a cellophane bag containing ice block. The samples were examined within two hours of collection.

#### **3.2. ANALYSIS OF SAMPLE.**

The water samples was first analyzed physically with their characteristics which is odor, taste and color level.

Then after which the samples labeled 1-15 were analyzed using a pour plate method.

Each water sample (100ml) passed through a pour plate method, this method was carried out by fixing a cylinder gas with the Bunsen burner on a neat table for 15mins so as to sterilized the atmosphere, water



samples each was collected with a syringe of 1ml into a Petri dish close to the Bunsen burner so as to avoid the atmospheric contamination with the addition of already prepared liquefied Eosin methyl blue Agar (EMBA) for the identification of coli forms.

E. coli test.

The E. coli test involved the pour plate method which a media name Violet Red Bile Agar (VRBA) is used with the collection or 100ml of each water sample in a Petri dish.

### **3.3. STERILIZATION OF MATERIALS**

All the material used: Pipettes, flasks, cylinder beaks, hockey rod, autoclave, weighing balance plates, tubes, oven etc were washed thoroughly and allowed to dry and there after sterilized in oven at 180c for 1<sup>i</sup>/2 hours all the media were also sterilized in an autoclave at 121<sup>0</sup>c for 15 minutes.

## CHAPTER FOUR

### RESULTS

#### Table1;

Total coliform count of the water samples that grew on the Eosin Methyl Blue Agar. It shows the total number of coliform after 3days incubation at 37<sup>0c</sup> and it was found that only pipe borne water has none colony but other sources has more colonies.

<b>Sample no.</b>	<b>Sample sources</b>	<b>Colony count</b>
<b>Tap water</b>		
<b>Sample 1</b>	<b>Tap</b>	<b>None</b>
<b>Sample 2</b>	<b>Tap</b>	<b>None</b>
<b>Sample 3</b>	<b>Tap</b>	<b>None</b>
<b>Sample 4</b>	<b>Tap</b>	<b>None</b>
<b>Sample 5</b>	<b>Tap</b>	<b>None</b>
<b>Stream water</b>		
<b>Sample 1</b>	<b>Stream</b>	<b>46</b>
<b>Sample 2</b>	<b>Stream</b>	<b>46</b>
<b>Sample 3</b>	<b>Stream</b>	<b>5</b>
<b>Sample 4</b>	<b>Stream</b>	<b>2</b>

<b>Sample 5</b>	<b>Stream</b>	<b>6</b>
<b>Well water</b>		
<b>Sample 1</b>	<b>Well</b>	<b>2</b>
<b>Sample 2</b>	<b>Well</b>	<b>4</b>
<b>Sample 3</b>	<b>Well</b>	<b>5</b>
<b>Sample 4</b>	<b>Well</b>	<b>8</b>
<b>Sample 5</b>	<b>Well</b>	<b>19</b>

Table 2: Shows the result of the physical analysis being carried out on the water samples

<b>Sample no.</b>	<b>Source</b>	<b>Odor</b>	<b>Taste</b>	<b>Color</b>
<b>Sample 1</b>	<b>Tap</b>	-	-	-
<b>Sample 2</b>	<b>Tap</b>	-	-	-
<b>Sample 3</b>	<b>Tap</b>	-	-	-
<b>Sample 4</b>	<b>Tap</b>	-	-	-
<b>Sample 5</b>	<b>Tap</b>	-	-	-
<b>Sample 1</b>	<b>Stream</b>	-	-	+
<b>Sample 2</b>	<b>Stream</b>	-	-	+
<b>Sample 3</b>	<b>Stream</b>	-	-	+
<b>Sample 4</b>	<b>Stream</b>	-	-	+
<b>Sample 5</b>	<b>Stream</b>	-	-	+
<b>Sample 1</b>	<b>Well</b>	+	+	+
<b>Sample 2</b>	<b>Well</b>	+	+	+
<b>Sample 3</b>	<b>Well</b>	+	+	+
<b>Sample 4</b>	<b>Well</b>	+	+	+
<b>Sample 5</b>	<b>Well</b>	+	+	+

**Key; + positive**

**- negative**

**Table3: Shows the identification of E. coli from the water samples using Violet Red Bile Agar. (VRBA)**

<b>Sample no.</b>	<b>Sample source</b>	<b>E coli</b>
<b>Sample 1</b>	<b>Well</b>	<b>+</b>
<b>Sample 2</b>	<b>Well</b>	<b>+</b>
<b>Sample 3</b>	<b>Well</b>	<b>+</b>
<b>Sample 4</b>	<b>Well</b>	<b>+</b>
<b>Sample 5</b>	<b>Well</b>	<b>+</b>
<b>Stream</b>		
<b>Sample 1</b>	<b>Stream</b>	<b>+</b>
<b>Sample 2</b>	<b>Stream</b>	<b>-</b>
<b>Sample 3</b>	<b>Stream</b>	<b>-</b>
<b>Sample 4</b>	<b>Stream</b>	<b>+</b>
<b>Sample 5</b>	<b>Stream</b>	<b>+</b>
<b>Tap water</b>		
<b>Sample 1</b>	<b>Tap water</b>	<b>-</b>
<b>Sample 2</b>	<b>Tap water</b>	<b>-</b>
<b>Sample 3</b>	<b>Tap water</b>	<b>-</b>
<b>Sample 4</b>	<b>Tap water</b>	<b>-</b>
<b>Sample 5</b>	<b>Tap water</b>	<b>-</b>

## CHAPTER FIVE

### DISCUSSION

The analysis examination carried out on the water sources that serves for private and public water supply were intended to assist in the determination of the quality of drinking water in Independence layout of Enugu state. (World Health Organization[WHO], 1985). have stipulated standards for water meant for human consumption and the result of the present investigation did not meet the standards except the tap water.

The total bacterial count of the water sources showed general variation from different samples (table2) the result shows that the well water sources has poorer quality in terms of contamination with coliform. (table1) The tap water sources showed no content of any coliform unlike other water sources, this result expected as the water source is most likely to have been treated by the process of chlorination to public out lets

The isolation of coliform from the water sources is indication of fecal contamination of the water sources like the well and the stream water. Their presence also indicates poor sanitary condition of the water sources.

## **RECOMMENDATION**

Judging from the result obtained I would like to recommend the following.

Personal hygiene should be adopted by every one using natural water, that is, water obtained from any of the natural sources should be boiled or treated before consumption.

Water purification method that provides safe drinking water should be made available by government in order to avoid out break cause by pathogenic organism found in water. The government should make more sacrifices to provide adequate treatment facilities that purify sewage prior to discharge or disposal, so as to save our drinking water form continuos pollution.

## **CONCLUSION**

Stream water and well water in (Independence layout locality) Enugu metropolis has been found to be unsafe for consumption and for industrial uses because of the large number of bacteria that grew on agar plate incubated for 24 hours.



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## **APPENDIX**

### **MATERIALS USED**

Bunsen burner- for sterilization.

Syringe- for collection of water samples.

Petri dishes – Are used for the culturing of the micro organisms petri-dish. canmsters – used for packing petri dishes to be sterilized.

Pipettes – used for transferring and measuring measuring cylinders – used for measuring liquid (water sample).

Flasks – (with screw or without screw) used for melting and storing the media.

Colton wool – for mopping up liquid, cleaning slide etc.

Autoclave – used for sterilizing materials like petridishes etc.

Hot air oven (thermostatic) used for incubation .

Refrigerator (Kelvinator) for storing specimen and media.

Microscope: used for viewing / identification of microorganisms.

Incubator- used for incubating at different temperature.

## **PREPARATION OF MEDIA**

### Eosin Methyl Blue agar (EMBa)

6.7g of the agar was dissolved in 250ml of distilled water in a conical flask, covered with aluminum foil sealed with masking tape and then autoclaved at 121<sup>0</sup>c for 15 minutes.

### **VIOLET RED BILE AGAR**

6.7g of the powder agar was dissolved in 250ml of distilled water. The flask was placed in the autoclave for sterilization at 121<sup>0</sup>c for 15 minutes.