



PREVALENCE OF MICROBIOLOGICAL CONTAMINATION OF FOOD AND WATER SAMPLES FROM SELECTED REGIONS OF SHILLONG.

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ABSTRACT

The study aims to assess the microbiological status of selected food and water samples collected from a selected region of Shillong. The research was carried out at the State Food Testing Laboratory, Commissionerate of Food Safety under the Department of Microbiology Pasteur Hills, Shillong, Meghalaya. For our research, four selected samples were taken for the study. These samples include tap water, homemade jam, infant milk powder, and pork samples respectively. The selected samples were collected from various sources and selected regions of Shillong. Samples of 'tap water' were collected from selected localities of Shillong namely; Mawprem, Lumdiengjri, and Jaiaw areas. From the study, it was shown that two localities viz, Lumdiengjri and Jaiaw show the presence of E. coli and coliform whereas; one locality of Shillong i.e., 'Mawprem locality' depicts negative results respectively. Similarly; samples of 'homemade jams' were also collected on random sampling and analyzed in the laboratory where the result was found to be all negative. Another sample of 'Infant milk powder' was analyzed as per the Food Safety and Standard Act 2006 and the results were found to be negative. However, Pork samples were similarly collected on random sampling from three different localities of Shillong viz, Mawprem, Mawlai, and Iewduh area and the result obtained from analysis of these pork samples indicate that all the samples collected from these localities show positive results for the present of E. coli, Salmonella spp, Staphylococcus spp, Yeast and Molds and Pseudomonas spp. The study also shows that all the collected pork followed standard procedure during sampling where a clean environment was taken for this study to prevent cross contamination. The evaluation of these samples tested was authentic. During analysis, negative and positive controls were taken to indicate quality control of the product tested. Therefore, from the study, it was observed that; from the four selected samples, two samples namely, water and pork samples were found to show the presence of pathogen whereas, the homemade jam and infant milk powder showed the absence of pathogen respectively.

Keywords: *Infant milk powder, Escherichia coli spp., Salmonella spp, Staphylococcus spp, Pseudomonas spp, pathogenic bacteria, meat safety, room temperature, refrigerated temperature, added preservatives.*

1. INTRODUCTION

Water is essential to life. An adequate, safe, and accessible supply must be available to all. Improving access to safe drinking water can result in significant health benefits (WHO, 2008). Every effort should be made to achieve drinking water quality as safe as possible. The World Health Organization (WHO) estimates that 80% of poor health in developing countries is water sanitation-related problems (WHO, 2002). The fastest growth in human and animal populations has changed the global ecology and environmental quality, and the safety of water has become a matter of great concern (WWF). A clean and treated water supply to each house may be the norm in Europe and North America, but in developing countries, access to both clean water and sanitation is not the rule, and waterborne infections are common. Two and a half billion people have no access to improved sanitation, and more than 1.5 million children die each year from diarrheal diseases (Fenwick, 2006)

Food safety simply means assurance that food according to its intended use is acceptable for human consumption and a Food Safety Management System means the adoption of Good Manufacturing Practices, Good Hygienic Practices, Hazard Analysis and Critical Control Points, and such other practices as may be specified by regulation, for the food business (P. K. Jaiswal, 2009).

The best source of babies feeding is their mother's milk (breastfeeding). But in a few cases, the mother naturally fails to fulfill the breastfeeding requirement of a baby due to disease factors or hormonal imbalances. So, they follow the infant formula (available in the market) suggested by their nutritionist or doctor. No doubt, Infant milk powders are generally considered products of good microbiological quality with no risk of spoilage, but several factors may contribute to changes in its physical and chemical properties which reduce shelf-life and thus its commercial value (Cousins *et al*, 1987). Infants and babies are more susceptible to infection by such pathogens because of their less well-developed immune system and lack of competing intestinal flora (Townsend *et al*, 2007). The low moisture content of dried infant foods and even ready to eat baby's acts as an inhibitory factor concerning any bacterial spores or vegetative that have survived drying or processing. These microorganisms cannot grow and play any direct role in their spoilage. Their occurrence in the products is of great significance and serves as an index of hygienic standards maintained during production, processing, and handling (Yadav, J. S. *et al*, 1993)

A jam consists of one or more fruits that are preserved with the use of natural preservatives such as sugar, and honey followed by being cooked to a desired consistency, treated with preservatives or heat to extend its shelf life. Jams are used as the filling of different bakery products or could be consumed with pastas, but mostly it is common to eat them with bread or by itself. Jams have become one of the most popular food products because of their low cost, their availability all year long, and their organoleptic properties (Gakowska, D. *et al*, 2010). Jams were traditionally produced as an effort to preserve fruit and to make it available for consumption during the off-season. In the process of manufacturing jams, the sugar and the fruits are both mixed in the proportions of 1:1 which is the same quantity of both the fruit and sugar. The mixture of fruit and sugar is then cooked to produce a substance that is delicious and possesses the capability to be stored for a longer period. With the use of extreme thermal treatment, the mix becomes concentrated

in such a way as to acquire the necessary final total soluble solid content (Iguar, M. *et al*, 2013). Depending upon the end product flavouring and colouring agents may be added. To achieve the desired consistency pectin and acid may be added to deal with the insufficiency from the fruit itself. The gel in jams can be formed within a narrow range of pH values. The optimum pH conditions for proper gel formation are found to be near 3.2. The ability to form a gel by the fruits is found to be with a TSS of 65% but it is possible to have gel formation at 60% solids, with the help of increasing the pectin and acid levels (Desrosier, N.W. *et al*, 1978). The main areas of quality control that are important for producing highly uniform, high-quality products are as follows: fruit preparation, accurate weighing and mixing of ingredients, hygienic preparation of fruits and fruit juices, correct acidity, moisture content, and final total soluble solids content (Ali, S. A *et al*, 2003).

Pork is one of the most traditional and popular meats consumed in the world despite the negative thoughts about the impact of the consumption of pork on human health. Domestication of pigs started somewhere around 5000 years ago. Pigs have great potential to fulfill the demand for meat for the increasing population of the world because of their high feed conversion ratio, high prolific rate, short gestation period, and great adaptability concerning food and climate (Pond WG *et al*, 1991). The word 'pork' has been derived from the French 'porc' and Latin 'porcus' meaning "pig". Pork has been proven to be an important source of food worldwide contributing about 40% to the total meat production worldwide (Sherikar AT *et al*, 2013). When carcasses leave an abattoir, they are invariably contaminated with bacteria during the distribution of meat to the consumer, The microbiological sanitation of food is crucial for public health concerns. Particularly, meat acts as an optimal medium for microbial growth, and its spoilage imposes an economic loss on the producers as well as health hazards on the consumers due to the possible presence of pathogenic microorganisms Pork is the most perishable of all-important foods since it contains sufficient nutrients needed to support the growth of microorganisms (Magnus P. 1981). The carcasses of Bovine are prone to be contaminated during the slaughter process when they come in contact with the bovine skin and hair, limbs, blood, stomach, gut contents, bile, and other excretions, facilities, equipment, and hands and worker's clothes (Sofos J. N, 2008). These factors can determine cross-contamination, resulting in meat with a high bacterial load and possible contamination from fecal origin, where *Escherichia coli* stands out on the national and international scene as a microorganism of importance in animal health, hygiene, and public health(Franco, R. M, 2002). *Salmonella sp.* is among the main agents involved in human-borne foodborne toxins. Pork is one of the linkers of this bacterium, which reaches the food due to procedural errors in the slaughterhouses, excessive handling during meat processing, contact of processed meat with raw meat, and errors in storage temperature. Pork contamination also occurs in a variety of ways, including bowel rupture during evisceration, indirect contamination with tainted water, and handling and packaging of finished pork products (TURCI, R. C *et al*, 2013).

2. MATERIAL AND METHODS

i. Tap water:

a) Random Sampling:

For this study, an analysis of drinking water was performed by receiving samples from three different regions of Shillong, East Khasi Hills District, Meghalaya.

b) Procedure for Sampling:

Samples of water for analysis were collected in sterilized bottles. These sterilized bottles were supplied by the State Food Testing Laboratory, Pasteur Hills, to avoid any cross-contamination. The three water samples received were collected from three different localities, namely, Lower Mawprem (A), Lumdiengjri (B), and

Jaiaw (C). To ensure the authenticity of the results, care was taken to store and transport the collected samples meant for analysis. According to the Food Safety and Standard Regulations Act of India 2006, the water samples collected for analysis were properly sealed in sterilized containers/bottles to avoid contamination. Also, the samples were collected and sent for analysis within 24 hours.

1. Enumeration of Total Viable Count: The Standard Plate Count (SPC) test can be used to measure the bacteriological quality of drinking water in public, semi-public, and private water systems. SPC is performed using the following inoculation methods:

- (i) Pour plate method
- (ii) Spread plate method
- (iii) Streaking method

After sample inoculation, the plates were sealed and incubated for 24 hours at 35-37°C. Examine the number of colonies growth is reported that the presence of bacteria in the water sample.

2. Enumeration of Yeasts and Moulds Count: Three sets of petri plates each were arranged. Chloramphenicol Yeast Glucose Agar (CYGA) was aseptically prepared based on the manufacturer's instructions. 30ml of aseptically prepared media were poured into each Petri plate. After the media had solidified, streaking of the samples was done. Following this, the plates were sealed and incubated at 22-25°C for 24 – 48 hours. Colonies showing yellowish thread-like structures are indicative of the presence of yeast and mold.

3. Enumeration of *E. coli*: The samples were streaked on the selective media, Eosin Methylene Blue agar (EMB) plates, and were incubated at 35-37° C for 24 hours. Colonies showing metallic sheen are considered as presumptive *E. coli*.

4. Enumeration of Total Coliform and *E. coli* using Membrane Filtration (MF) method: The membrane filter method was employed for quantitative analysis. 250 ml of the samples were poured into a membrane funnel assembly and the air was allowed to pass completely through 0.45-micrometer filter paper and then aseptically placed on the chromogenic coliform agar (CCA) media and incubated for 24 hours at 37°C. The membrane filter showing dark blue colonies is considered *E. coli* while pinkish and mucous-like colonies are considered as the total coliform bacteria. It aligns with the International Standard Organization – IS 15185: 2002 and ISO 9308-1: 2014.

ii. Infant Milk Powder:

1. Collection of infant powder samples: Three samples of infant milk powders i.e., Lactogen (A), Nan (B), and Amul Spray (C) of 1-6 months were purchased and brought to the State Food Testing Department, Pasteur Hills, Shillong, Meghalaya for further microbiological evaluations and testing.



Fig 1: Selected Infant milk powders for study (Lactogen, Amul spray, and Nan)

2. Preparation of test samples: Milk powder (1g) was diluted in warm diluent water (9ml) to make primary dilution (10⁻¹). Then a series of dilutions (10⁻², 10⁻³, etc.) was prepared by transferring the primary dilution (1 ml) into a test tube containing sterile diluents (9 ml) to obtain 10⁻² dilution and repeating the operations with sterile diluents (9 ml) using the 10⁻² and further dilutions to obtain 10⁻³, 10⁻⁴ and so on.

3. Enumeration of total viable count: Total viable counts were enumerated according to the method of the International Dairy Federation (IDF, 1991). Pre-prepared test samples (1 ml) of 10⁻³, 10⁻⁴, 10⁻⁵, etc. dilutions were transferred into sterile Petri dishes in duplicate through a sterile graduate pipette and/or dispensing pipette (1000 µl) with sterile plastic tips and warm sterile plate count agar medium was mixed with inoculum. The mixture was allowed to solidify and incubated (37°C) for 24h. The dishes containing more than 30 and/or fewer than 300 colonies were selected and counted using the colony counter (IDF, 1990).

4. Enumeration of yeasts and molds counts: Yeasts and molds counts were enumerated according to the method of IDF (1990). Pre-prepared test sample (1 ml) of 10⁻¹, 10⁻², 10⁻³, etc. dilution was transferred into sterile Petri dishes through a dispensing pipette (1000 µl) with sterile plastic tips and warm sterile Chloramphenicol Yeast Glucose Agar (15 ml) was mixed with inoculum. The mixture was allowed to solidify and incubated (25°C) for 5 days. The dishes containing more than 10 and/or fewer than 150 colonies were selected and counted using the colony counter (IDF, 1990)

5. Enumeration of Coliforms and *E. coli*: The coliforms are not a valid taxonomic distinction, but are defined functionally i.e., by the fermentation of lactose. Coliforms are Gram-negative, oxidase-negative, aerobic, or facultative anaerobic non-spore-forming rods, able to grow in the presence of bile salts that ferment lactose to produce acid and gas within 48 h at 37°C in warm sterile Eosine Methylene Blue Agar (Pitkänen *T et al*, 2007).

iii. **Homemade Jams:**

The study was conducted to study the quality of homemade strawberry jams for one month. The strawberry jams were placed in different conditions, room temperature (RT), Refrigerated Temperature (RfT), and added Preservative (ADP). The jams from each condition were microbiologically analyzed after one month.

Method of Sample collection and preparation:

The raw materials required for jam cooking were purchased from the local market of Shillong, City. The fruits were thoroughly washed with clean water, the stems were removed, and the fruits were diced into desirable sizes. The diced fruits were further made into a pulp. The jam was properly formulated by following a well-developed procedure where the fruit pulp and the sugar were properly weighed in the ratio of 1:1 i.e., 2 kgs of fruit with 2 kgs of sugar; the mixture was properly blended using a hand blender. The mixture was then cooked in a medium flame and cooked for 20 minutes till a rolling boil was observed; the mixture was further cooked till the concentration reached 65-68 degrees, Brix. The flame was switched off and the jam was filled into clean sterilized bottles. The jam was conditioned to the three categories mentioned above. The Jams were kept for study for 1 month under 3 conditions and they are room temperature, refrigerated, and added preservative.



Figure 2: Steps for Preparation of homemade jam

1) Enumeration of Total Viable Count: The Standard Plate Count (SPC) test can be used to measure the bacteriological quality of the homemade jam streaking method used for inoculating the sample into the designated media. After sample inoculation, the plates were sealed and incubated for 24 hours at 35-37°C. Examine the number of colonies growth is report the presence of bacteria in the water sample.

2) Enumeration of Yeasts and Moulds Count: For this analysis Chloramphenicol Yeast Glucose Agar (CYGA) was used as the media. For this test, 3 numbers of Petri plates were sterilized, and 30 ml of the media was poured into the plates, after the media had solidified, the cultured samples were streaked into the media. After this, the plates were aseptically sealed and incubated at 22-25°C for 48 hours.

3) Enumeration of *E. coli*: For the analysis of *E. coli*, Eosin Methylene Blue agar (EMB) was used as the media for inoculating. The samples were streaked on the selective media and were incubated at 35-37° C for 24 hours.

4) Enumeration of *Salmonella*: For analysis of *Salmonella*, Xylose Lysine Deoxycholate (XLD) was used. The samples were streaked on the selective media and were incubated at 35-37° C for 24 hours.

5) Enumeration of *Staphylococcus*: For analysis of *Staphylococcus*, Mannitol Salt Agar (MSA) was used. The samples were streaked on the selective media and were incubated at 35-37° C for 24 hours.

iv. Pork:

1. **Sampling collection:** Three random samples from three different localities were purchased in the morning and tested in the afternoon. The ambient temperature at the time of sampling was 26-27 degrees C.

2. **Media preparation:** All the media used were prepared using the manufacturer's instructions. For example for plate count agar

Number of plates = 3

The volume of ultra-pure water required for each plate = 30 ml

For 3 plates, the volume of ultra-pure water required = 30x3

= 90 ml

For 1000 ml of ultra-pure water, the amount of Sabouraud Dextrose Agar (SDA) required

= 23.5 gm

For 1 ml of ultra-pure water, amount of SDA required = 23.5 x 1gm/1000

For 240 ml of ultra-pure water, the amount of SDA required = 23.5x90/1000gm =2.115 gm

We take 2.115 gm of plate count agar in a conical flask and add 90 ml of ultra-pure water to it. The mixture is then vortexed well till all the solute dissolved into the solvent forming a homogenized solution and sterilized in the autoclave for 15-20 minutes at 121 degrees Celsius. After autoclaving we pour the media into sterilized petri plates for approximately 30ml and allow it to stand for 10-20 minutes till the media solidified. Pouring of media takes place in lamina airflow which is an aseptic medium.

3. **Preparation of the inoculum:** Each sample was pounded using mortar and pestle and 1 gram of each pork sample was measured in sterilized culture tubes. Dilutions of the homogenate were done with 9ml milli-Q water to determine microbial counts.
4. **Streaking of the sample:** The sample was streaked using the platinum loop. The platinum loop was sterilized onto the flame, and dipped into the sample; the loop was sterilized again onto the flame and streaked in the plate containing the solidified agar. After streaking the plate was incubated at 35-37 degree Celsius in an inverted form for 24 hours for the growth of colonies.

RESULTS AND DISCUSSION

Water: According to WHO the presence of *E. coli* in drinking water provides conclusive evidence of recent fecal pollution (WHO, 2011). The most recommended technique used to determine the fecal contamination of water is by *E. coli* streaking and pouring plates and membrane filtration method. Out of the three samples examined, two were obtained from *E. coli* and all three are negative in yeast and molds.

Table 1: Test results of three different Tap water sources of Meghalaya region.

Sample type	Microbiological parameters				Remarks
	CCA Coliform	EMB <i>E. coli</i>	CYGA Yeast and molds	PCA Standard Plate Count	
Tap water (Lower Mawprem)	Absent	Absent	Absent	Absent	Satisfactory
Tap water (Lumdienjri)	Present	Present	Absent	Present (≤ 10 cfu/ml)	Unsatisfactory
Tap water (Jaiaw)	Present	Present	Absent	Present (≤ 50 cfu/ml)	Unsatisfactory

Bacteriological status of Tap Water samples collected from selected regions of Shillong (Random sampling) from June to August 2023.

The various 'Tap Water' samples collected on random sampling from selected regions of Meghalaya are tested with the parameters as per FSSAI Act 2006, for analyzing water samples. These parameters include the Coliform Test, Standard Plate Count (SPC), Detection of Yeast and mold, and Detection of *E. coli* respectively.

It was observed from my study that one of the samples was found to be free from yeast and molds, coliform, and other bacterial contaminants. The *E. coli* is found to be present in two of the water samples. Hence, the overall status of Tap Water was received and tested. So, the status of drinking water in these three regions i.e., in June to August 2023 is found to be fit and still considered satisfactory for human consumption.

Infant milk powder

Although the microorganisms in infant formula milk owing to their low moisture content cannot grow and thus do not play any direct role in their spoilage, their occurrence in these products is of great significance [3]. The present study has been conducted to assess the general hygienic quality of Infant milk powders Lactogen (A), Nan (B), and Amul Spray (C), and the evaluated results are depicted in Table 1. In the present study, the total viable count of samples A, B, and C all showed no significant growth. It is also of interest to point out that enumeration for *E. coli*, *Salmonella*, and Yeasts and Moulds showed lower to no significant growth.

Table 2:

S.NO	Parameters/ analysis	Media used	Brands			Limits of safety
			Lactogen (a)	Nan (b)	Amul spray (c)	
1.	Total plate count	Plate Count Agar (PCA)	Absent	Absent	Absent	Absent/ 0.1g
2.	<i>E. coli</i>	Eosin methylene blue (EMB) Agar	Absent	Absent	Absent	Absent/ 0.1g
3.	<i>Salmonella</i>	Xylose Lysine Deoxycholate (XLD) Agar	Absent	Absent	Absent	Absent/ 0.1g
4.	<i>Yeasts and Molds</i>	Chloramphenicol Yeast Glucose Agar (CYGA)	Absent	Absent	Absent	Absent/ 0.1g

Parameters and analysis of the three different infant milk powder samples

From the above table, it can be reported that there are no significant growths observed from samples Lactogen (A), Nan (B), and Amul Spray (C) in which they are grown or cultured in their respective culture media. According to the limits put forth by the Food Safety and Standards Act, 2006 for infant formula showed that there should be less than or no significant growth per g. Thus, the samples can be considered safe, in a hygienic condition, and without risk level for the infant's health.

Home-made jam

If the Total Soluble Solids (TSS) of the jam is below 68-degree brix, it can easily be spoiled due to the presence of untrapped moisture which can nurture the growth of microbes. The different tests performed for detecting any presence of total plate count, *E. coli*, *Salmonella*, *Staphylococcus*, and *yeast and molds* showed negative.

Microbiological analysis of the jams is given in the table depicted below, from the table it is evident that in one month there was no visible growth of any of the total plate count, *E. coli*, *Salmonella*, *Staphylococcus* and *yeast and Molds*, the test that was performed came out as negative. From this current study, we can say that jam, when cooked at the right

temperature, is desirable TSS the jams can have a longer shelf life and are considered safe for consumption, and they can be stored at room temperature of 21-25 degrees Celsius for one month.

Table 3: Parameters showing negative results of the products analyzed.

SI No.	Sample Name and Condition	Amount collected	Media Used	Parameters	Result
1.	Strawberry Jam Room temperature	250 gms	1. PCA	Total plate count	Absent
			2. EMB	<i>E. coli</i>	
			3. XLD	<i>Salmonella</i>	
			4. MSA	<i>Staphylococcus</i>	
			5. YGCA	<i>Yeast and Mold</i>	
2.	Strawberry Jam Refrigerated Temperature	250 gms	1. PCA	Total plate count	Absent
			2. EMB	<i>E. coli</i>	
			3. XLD	<i>Salmonella</i>	
			4. MSA	<i>Staphylococcus</i>	
			5. YGCA	<i>Yeast and Mold</i>	
3.	Strawberry Jam Added preservative	250 gms	1. PCA	Total plate count	Absent
			2. EMB	<i>E. coli</i>	
			3. XLD	<i>Salmonella</i>	
			4. MSA	<i>Staphylococcus</i>	
			5. YGCA	<i>Yeast and Mold</i>	

PORK

All collected pork samples were tested for the presence of pathogens and other physical contamination. Pork tested positive for *Escherichia coli* spp., *Salmonella* spp., *Staphylococcus* spp., and *Pseudomonas* spp., and they also contained *yeast and molds*. (Table 1) shows that the average total standard plate count of micro-organism for 3 samples range from <300cfu/ml to too numerous to count on comparing the bacterial contamination between the three pork meat samples. The results obtained from Mawlai contain the highest number of microorganisms. Pork meat contains all the nutrients necessary for microbial growth and metabolism, making it susceptible to microbial contamination. Given the microbial quality of pork, proper hygiene must be ascertained to ensure safety. The presence of these organisms in raw pork meats depicts a deplorable state of poor hygienic and sanitary practices employed in the slaughtering, abattoir, and storage at the retailer's stall or shop, the animal's skin, and fur impregnated with dirt and feces, that can carry millions of aerobic and anaerobic bacteria; air and dust; the water used to wash the carcass, equipment, utensils (knives, saws, and hooks) and the various containers in which the labor used [Carvalho, 2010]. Other causes are humidity, high relative humidity (RH) influences the water content of food and high water content to promote microbial growth, or it is because of the packaging material from the abattoirs to the retailer stall and the customer. These factors can determine cross-contamination, resulting in meat with a high bacterial load and possible contamination from fecal origin. The presence of *S. aureus*, and *E. coli* in raw pork meat samples is an indication of fecal contamination of the pork meats. However,

it is believed that cooking processes and hygiene could greatly reduce the microbial load to harmless levels. The current microbiological guideline levels for pork in retail establishments should be stricter, with a modification to satisfy both meat safety and sensory palatability.

Thorough cooking as well as good hygiene is to prevent contamination of food. It is therefore necessary; to follow the recommendations and findings from this study.

1. Meat handlers and sellers should be educated on the adverse effects of a lack of proper personal and environmental hygiene and sanitation.
2. Veterinary doctors should inspect the animals to be slaughtered before the meat is sold to the public.
3. Good manufacturing practices should be adhered to strictly by butchers and those selling the meat, the water used in washing the meat should be sterile, also the equipment must be washed properly before use.
4. Further regulatory and educational efforts are needed to improve safety.

Table 4: Pork sample and their respective standard plate count

SL NO	SOURCE	SPC/gm of pork
1	MAWPREM	<300cfu/ml
2	MAWLAI	Too numerous to count
3	IEWDUH	<300cfu/ml

PARAMETERS /ANALYSIS	MEDIA USED	RESULT			OBSERVATION	INTERPRETATION		
		MAWPREM	MAWLAI	IEWDUH		MAWPREM	MAWLAI	IEWDUH
<i>E. coli</i>	Eosin Methylene Blue (EMB)	Present	Present	Present	Colonies with dark centres, metallic green sheen			
<i>Salmonella</i>	Xylose Lysine Deoxycholate (XLD)	Present	Present	Present	The bright pink, red appearance			After incubation raw pork tested positive for
<i>Yeasts and Molds</i>	Chloramphenicol Yeast Glucose Agar (CYGA)	Present	Present	Present	Yellow plate coloration, white or light-yellow colonies			<i>Salmonella</i> , <i>E. coli</i> , <i>staphylococcus</i> Yeast and Mold, which is unsafe for human consumption if thorough cooking is not done.
<i>Staphylococcus</i>	Mannitol Salt Agar (MSA)	Present	Present	Present	Yellow colonies with yellow zones, smooth surfaces			
<i>Pseudomonas</i>	Citrate Agar (CA)	Present	Present	Present	Ultraviolet light, yellow-green to blue colour			

Table 5: Result and Interpretation of tested pork samples

Conclusion

The study was carried out to determine the microbiological status of four selected samples. All four samples that were collected from Shillong City showed variable results. However, most samples abide by the safety standards as specified in the Food Safety and Standards Act, 2006, Regulations 2011. During the study, two samples i.e., Tap water and Pork samples were tested positive for the presence of pathogenic microorganisms like *E.coli*, *Salmonella*, *Staphylococcus aureus*, etc., and presence of other physical & chemical contaminants. Undoubtedly, this could possibly be the results of the improper cooking processes and therefore; unhygienic nature of the product could reduce the overall potential for microbial food hazards. Besides; the quality of the sample is also dependent upon the room temperature, storage condition, and proper hygiene.

Food eventually contaminated by microorganisms, pathogens, or their metabolites can have a serious effect on human health and well-being. Therefore, freezing, chilling, reduction of water activity, modified atmosphere packaging, acidification, nutrient restriction, and non-thermal physical treatments or the addition of synthetic antimicrobials are the several food preservation methods that can be utilized to control food spoilage by microorganisms and would be made fit and safe for human consumption.



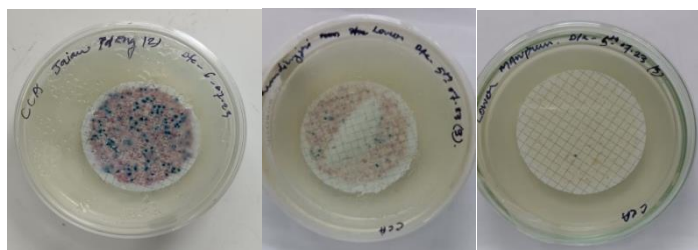


Fig 3: Chromogenic Coliform Agar (CCA) plates showing the presence of Total coliform and *E. coli*.



Fig 4: Eosine Methylene Blue (EMB) agar plates showing the presence of *E. coli*.

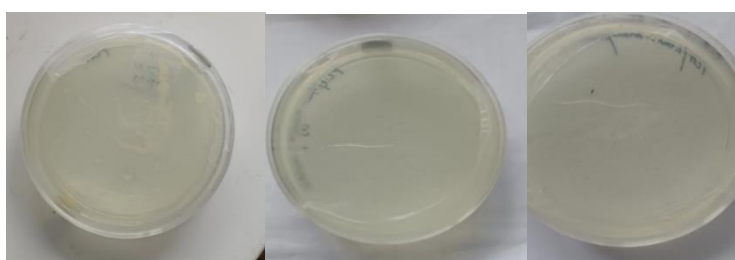


Fig 5: Plate Count Agar (PCA) showing the presence of colonies.

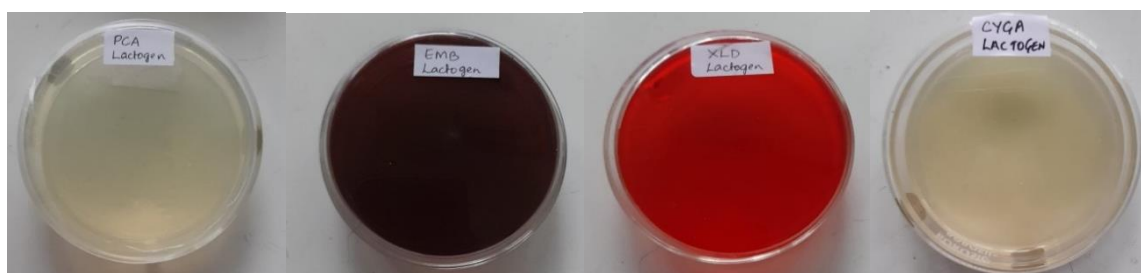


Fig 6: For Lactogen milk powder- Plate Count Agar (PCA), Eosine Methylene Blue (EMB) agar, Xylose Lysine Deoxycholate (XLD), and Chloramphenicol Yeast Glucose Agar (CYGA) showed no growth of colonies.

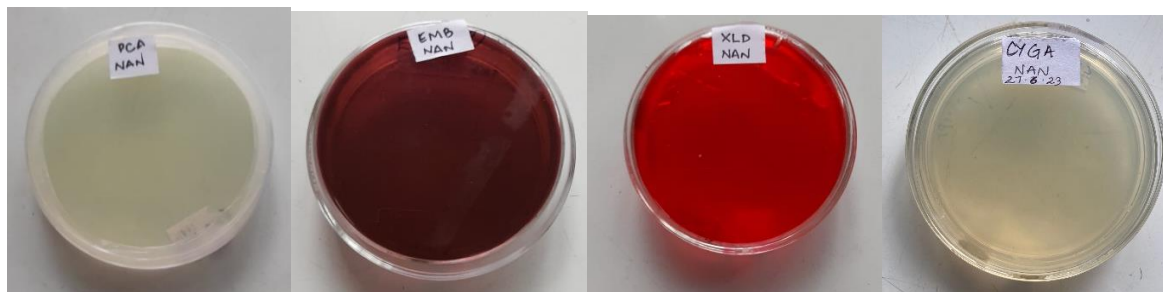


Fig 7: For Nan milk powder- Plate Count Agar (PCA), Eosine Methylene Blue (EMB) agar, Xylose Lysine Deoxycholate (XLD), and Chloramphenicol Yeast Glucose Agar (CYGA) showed no growth of colonies.

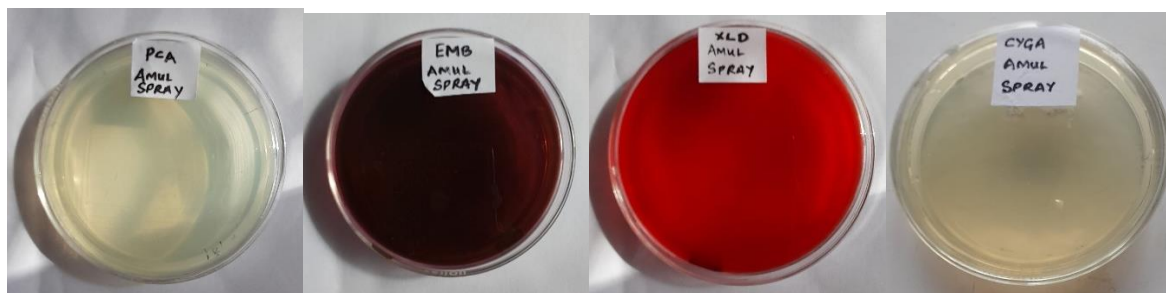


Fig 8: For Amul spray milk powder - Plate Count Agar (PCA), Eosine Methylene Blue (EMB) agar, Xylose Lysine Deoxycholate(XLD), and Chloramphenicol Yeast Glucose Agar (CYGA) showed no growth of colonies.



Fig 9: Xylose Lysine Deoxycholate(XLD) agar plates showed the absence of colonies of *Salmonella spp.* for homemade strawberry jam.

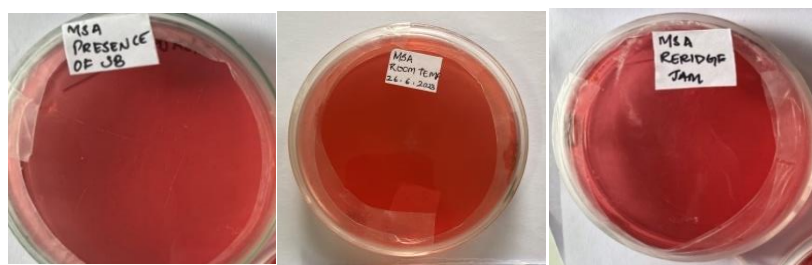


Fig 10: Mannitol Salt Agar (MSA) plates showed the absence of colonies of *Staphylococcus spp.* for homemade strawberry jam.



Fig 11: Eosine Methylene Blue (EMB) agar plates showed the absence of colonies of *E. coli. spp.* for homemade strawberry jam.



Fig 12: Plate Count Agar (PCA) plates showed no growth of colonies for homemade strawberry jam.

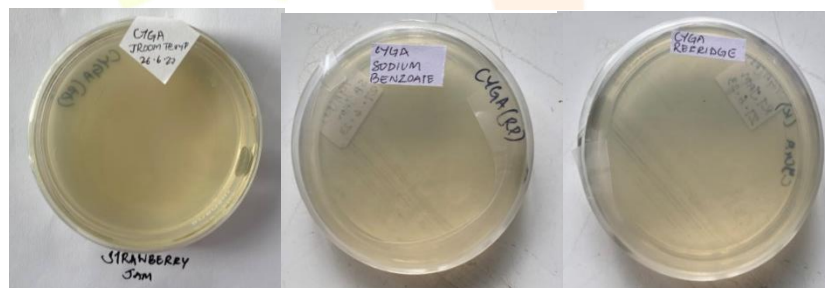


Fig 13: Chloramphenicol Yeast Glucose Agar (CYGA) plates showed the absence of yeasts and mold colonies for homemade strawberry jam.

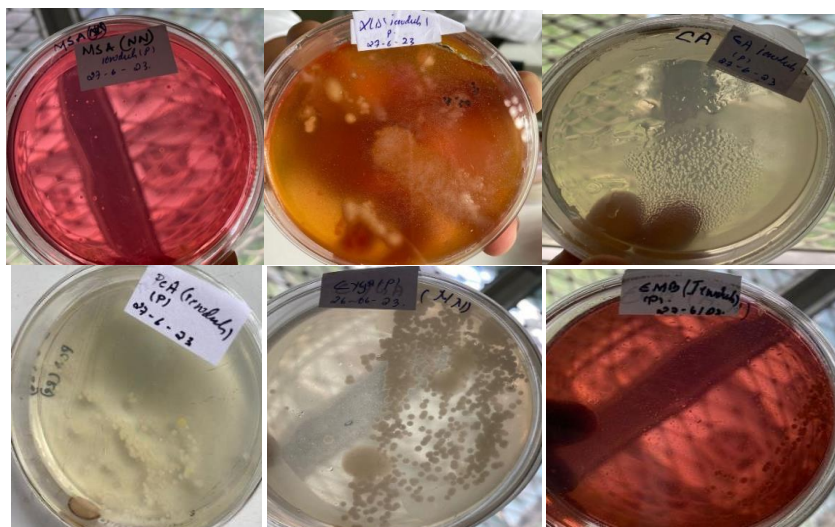


Fig 14: For pork samples -Mannitol Salt Agar (MSA), Xylose Lysine Deoxycholate (XLD) agar, Citrate Agar (CA), Plate Count Agar (PCA), Chloramphenicol Yeast Glucose Agar (CYGA) and Eosine Methylene Blue (EMB) respectively showed the presence of colonies.

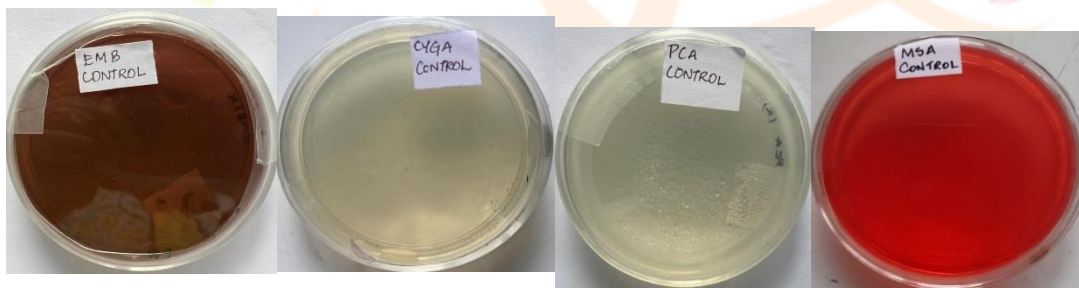


Fig 15: Eosine Methylene Blue (EMB), Chloramphenicol Yeast Glucose Agar (CYGA), Plate Count Agar (PCA), and Mannitol Salt Agar (MSA) control plates.

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