



## **Are Street Foods Safe: Detection of *Escherichia coli* in Street Foods Sauces**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors FMDS, KMCL and MCGV designed the study, performed the statistical analysis and wrote the protocol. Authors FMDS, MRBB, JJCB, JJBV and VBEV managed the analyses of the study, wrote the first draft of the manuscript and managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Good manufacturing practices (GMP) is the key in quality food services. This is to ensure that the food our body take in is safe from harmful bacteria that may cause disorder in its normal function. In this research, detection of *Escherichia coli* (*E. coli*) was done in the sauces of the street foods vendor at the University of Eastern Philippines. The result of this study will be of use to the local units that need to regulate the franchise of these street foods; to ensure that safety in the delivery of food products. Samples were collected from the stalls of the street vendors and were subjected to microbial analysis. Results showed that *E. coli* is present in the street sauces but in minimal count. Though the count is far from the threshold, vendors must consider increasing their knowledge and practices with GMP to ensure safe and quality food delivery.

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## 1. INTRODUCTION

*Escherichia coli* are members of a large group of bacterial germs that inhabit the intestinal tracks of humans and other warm-blooded animals. Newborns have a sterile alimentary track, which within two days become colonized with *E. coli* [1].

Because of its prominence as a normal intestinal bacterium in most humans, *E. coli* is currently one of the indicators to monitor fecal contamination in water, food and dairy products. According to this rationale, if *E. coli* is present in a water sample, fecal pathogens such as salmonella, viruses, or even pathogenic protozoa may also be present. Coliforms such as *E. coli* are used because they are present in larger numbers, can survive in the environment, and are easier and faster to detect than pathogens. If a certain number of coliforms are detected in a sample, the water is judged unsafe to drink [2].

According to Roberts, et al. [3], *Escherichia coli* strains are almost universal residents of the intestinal tracts of humans and a number of other animals. Although most strains are harmless, certain ones produce specific virulence factors that allow them to cause intestinal disease other strains, with different virulence factors, cause urinary tract infections, septicemia, and meningitis.

As cited from Ching [4], the World Health Organization (WHO) [5] explained that EHEC produces toxins known as toxins known as verotoxins or Shiga-like toxins similar to the toxins produced by *Shigella dysenteriae*. This is the reason why enterohemorrhagic *Escherichia coli* (EHEC) is also being referred as Shigatoxin-producing *E. coli* or verocytotoxin-producing *E. coli*. EHEC symptoms may include abdominal cramps and diarrhea which sometimes lead to bloody diarrhea (haemorrhagic colitis). Fever and vomiting may also occur. Commonly, EHEC affect high risk group such as children and elderly.

At present, street vended food is becoming a serious public health concern due to the intervention of different pathogenic microorganisms. The lack of hygiene in the preparation of street vended foods (SVFs) poses risk factors for borne disease outbreaks globally.

Lack of knowledge among street food vendors about the causes of food-borne disease is a

major risk factor [4]. Poor hygiene, inadequate access to potable water supply and garbage disposal, and unsanitary environmental conditions such as proximity to sewers and garbage dumps further exacerbate the public health risks associated with street foods.

Food borne bacterial agents are the leading cause of severe and fatal food borne illnesses. Of the many thousands different bacterial species, more than 90% of food-poisoning illnesses are caused by species of *Staphylococcus*, *Salmonella*, *Clostridium*, *Campylobacter*, *Listeria*, *Vibrio*, *Bacillus*, and *Enteropathogenic Escherichia coli* [6].

In the study of Ching [4] were he used street vended fried chicken and barbeque sold in the vicinity of the university revealed that there are *Escherichia coli* colonies present in the gravy sauce than the ketchup in terms of fried chicken and in the barbeque, sour sauce had the highest *E. coli* count and followed by the spicy sauce and the lowest is sweet sauce. The preparation may affect the growth of *Escherichia coli* in terms of barbeque sauce.

Thus this study aimed to determine the presence of *Escherichia coli* in street food sauces collected around the university main campus of UEP.

## 2. METHODOLOGY

Using a sterile cup, the researchers collected per stall three sample of sweet sauce and spicy sauce and were immediately tested at that same day of collection. The samples had three (3) trials for both physical properties and microbial analysis.

To evaluate the pH of the samples, a pH meter was used to quantify the result. If the pH level is equal to 7.0, it is neutral; if the pH level is above 7.0 it is basic; and if the pH level is below 7.0 it is acidic. Salinity was measured using a refractometer. The samples were diluted using the ratio 1:1. Temperature was measured using a laser thermometer. All of these property tests were replicated three (3) times.

Before the start of the inoculation, the samples were diluted according to the standards of 6404/6414 *E. coli*/ coliform count plate, 3M Petrifilm [7]. Butterfield's phosphate buffer, 0.1% peptone water, peptone salt diluent, quarter-strength Ringer's solution, saline solution (0.85-

0.90%), distilled water, and the sample. Blend the sample. For optimal growth and recovery of microorganisms, adjust the pH of the of the sample suspension to 6.6-7.2. For acidic samples, adjust the pH with 1N NaOH, for alkaline sample, adjust the pH with 1N HCl.

A 6404 *E. coli*/ coliform count plate, 3M Petrifilm plate was placed on a leveled surface. The top film was lifted in order to start the inoculation of the sauce samples. One (1) mL of inoculum was distributed aseptically into the 3M Petrifilm *E. coli* count plates using a new sterile pipette. A spreader was placed on top of the film and a pressure was gently applied to distribute the inoculum over the circular area. An incubator creates the proper growth temperature and other conditions. This promotes multiplication of the microbe over a period of hours, days and even weeks. In this study, following the AOAC Official Method 991.14 the samples were incubated for 24±2hours. Incubation produces a culture, the visible growth of the microbe in or on a medium. The temperature used to grow *E. coli* was 35±1°C.

In counting the colonies in the 3M Petrifilm plate was placed in an improvised colony counter (lamp shade and magnifying lens) which will enlarge the colonies and enable us to see clear and start counting which followed a method that was used in counting the red blood and white blood cell in a snake like pattern. Estimate was to be made on the plate if it contains greater than 150 colonies by counting the number of colonies using the bacterial colony counter in one or more representative square and determining the average number per square multiply the average number by 20 to determine the estimated count per plate.

To know the awareness of the vendors to GMP, a questionnaire was prepared. In the last question, the vendors were asked if they know what is Good Manufacturing Practice (GMP).

### 3. RESULTS AND DISCUSSION

The following results shows the physical properties of the collected street food sauces. Table 1 summarizes the pH level, salinity level, and temperature of the sauces. These parameters are considered crucial to the growth

of *E. coli*. This bacterium needs low pH to grow rapidly [8]. Increase in salt concentration triggers the increase of colony count of *E. coli* [9]. This bacterium also grows at temperatures greater than 30°C [10].

The sauce samples are prone to increase growth of *E. coli*. Low pH level, higher salinity, and room temperature increases the chances of increasing the colony count of the bacteria. Hence, it is advised to the vendors to check if the sauces are properly heated to kill the bacteria and to maintain the pH and salt level to inhibit the bacterial uprising.

In Table 2, this explains the colony count of the *E. coli* to the street food sauces. According to the USA Institute of Medicine [11], the acceptable *E. coli* count for ready-to-eat food intake is less than 100 CFU/g. The results showed that some street food stall have the bacteria are not exceeding the allowable colony formation in the human body. But, the sweet sauce of street food stall number 4 is above the allowable limit. Hence, the street vendor must review the good practices in food delivery so that the number of bacteria will not exceed again. The results were the mean of each food stall with three (3) replicates.

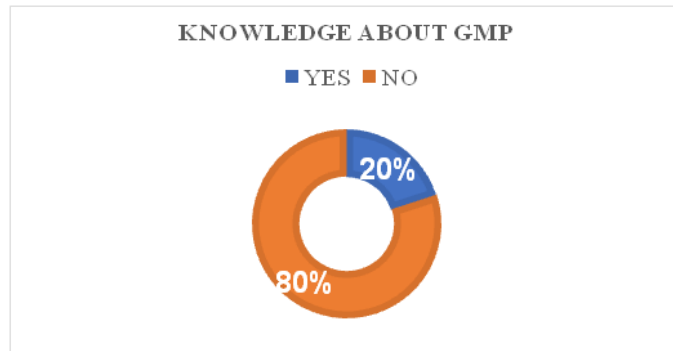
GMP's principle is that quality is built into a product, and not just tested into a finished product. It is the assurance that the product not only meets the final specification, but that it has been made by the same procedures under the same conditions each and every time it is made. A presentation to the street vendors' knowledge to GMP is presented in Fig. 1. It is seen in the result that their knowledge to good manufacturing practices is low hence a need to review and enhance their GMP attitude is a must. Ensuring a clean and healthy environment is a key factor in less or better zero contamination. If there is a low knowledge on GMP within the circles of vendors this should be address as an issue to the public health. The vendors must be knowledgeable to GMP as they offer basic foods that the students ate in lieu of a clean cooked food because of their hectic schedule. The local government unit through its sanitary unit must ensure to the public that every food stall should meet the minimum bare standards for delivery of food products, that is to ensure the safety of what the community eats.

**Table 1. Physical properties of street food sauces**

Parameter	Vendor Street Food Stall				
	1	2	3	4	5
<b>I. Spicy Sauce</b>					
pH level	acidic	acidic	acidic	acidic	acidic
salinity	10.00%	18.67%	14.33%	10.64%	10.00%
temperature	29.40°C	28.33°C	28.52°C	30.96%	28.76%
<b>II. Sweet Sauce</b>					
pH level	acidic	acidic	acidic	acidic	acidic
salinity	9.33%	16.33%	21.33%	10.67%	10.33%
temperature	29.83°C	29.40°C	28.50°C	30.97°C	28.77°C

**Table 2. E. coli colony count of street food sauces**

Parameter	Vendor Street Food Stall				
	1	2	3	4	5
Sweet Sauce	10 CFU/g	21 CFU/g	22 CFU/g	117 CFU/g	16 CFU/g
Spicy Sauce	35 CFU/g	44 CFU/g	8 CFU/g	55 CFU/g	11 CFU/g



**Fig. 1. Distribution of GMP knowledge to every street vendors**

**4. CONCLUSION**

In terms of physical properties, all samples resulted to be acidic, high in salt level, and resulted to have temperature below the optimum temperature growth.

Based on gathered data, the researchers concluded that all of the sauce samples are contaminated with *Escherichia coli* but it does not exceed the acceptable *E. coli* CFU making the samples safe for a moderate intake. There were more *Escherichia coli* colonies visible in sweet sauce samples than spicy ones. It may have been because people dip more in sweet sauces causing it to be easily exposed to contamination. Even the samples are above the "satisfactory" limit, the public and the vendors must be knowledgeable on how to prevent this case in happening again. A training on basic GMP is necessary to address the issue of food contamination.

The result of this study indicates awareness for students and consumers in eating not only on street foods but in all kind of dishes. Vendors must be oriented in keeping a good sanitary business and to make sure that the foods they serve for the people is clean.

**CONSENT**

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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