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Microbes in Street-Vended Fishballs and Dipping Sauce: Implications to Young Learners' Health and Nutrition

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INTRODUCTION

In the Philippines, people from all walks of life more especially the students patronize familiar street foods being sold such as fishballs and the like. These street-vended foods are ready-to-eat foods and beverages prepared and/or sold by vendors in public places. These foods are very cheap that people from different societal strata can buy and consume. These street-vended foods are sometimes sold on skewered bamboo sticks like barbecue or placed on small paper plates pricked with toothpicks as to be eaten. These are commonly dipped in a variety of sauces either, sweet, spicy, and sour.

Sauce is a worldwide tradition not only for street foods but also from international cultures, like dipping Japanese sushi and dumplings in soy sauce to the very American tradition of dipping cookies into milk. But the idea of dipping and dunking food in liquid for added flavor and moisture can provide problems. Nowadays, local authorities, international organizations and consumer associations are increasingly aware of the socio-economic importance of street foods but also their associated risks.

The major concern in street-vended foods is their safety for consumption. This is due to the observed handling, preparation and selling of street foods. Studies revealed that direct double dipping can directly transfer saliva – there are different mouth bacteria that can be transferred in the sauce through direct dipping, species such as *Streptococcus*, *Prevotella*, and *Veilonella*. Street-vended food samples were found to be unsatisfactory due to high levels of aerobic plate count, coliform, and *Escherichia coli* bacteria.

Several research had been conducted to identify microorganisms that may cause diseases and food poisoning in street foods and sauce of the street-vended foods and also the health risk and issues in eating street foods. Street foods are often seen as possessing nutritional components associated with an unhealthy diet and potentially holding a higher risk of contamination by physical, chemical, and biological agents, i.e., become a serious concern in terms of food safety. Street foods can cause the emergence of foodborne diseases, due to the ease of contamination by pathogenic and non-pathogenic microorganisms, and the development of chronic non-communicable diseases, since the street foods usually have high quantities of carbohydrates and fats (*Journal of Clinical Nutrition and Dietetics*, 2015). Developing this kind of research is very essential for the national development and progress. As stated in the 1987 Constitution, Article X, Section 10.

“Science and Technology are essential for national development and progress.

The State shall give priority to research and development of invention, innovation, and their utilization. And to science and technology education training and services.

It shall report indigenous appropriate and self-reliant scientific and technological capabilities and their application to the country's productive systems and national life”.

This study needs to undertake microbial analysis to validate the microbial content of specific street food such as fishballs and dipping sauce.

This study was conducted to determine the microbial count of street-vended fishballs together with its accompanying sauce, identify the disease-causing organism that will contaminate it, the tolerable or acceptable levels of microbial contaminant in streetfoods, determine the perceived effects of too much intake of these fishballs to the schoolchildren and the health education campaigns that may be implemented to disseminate useful information.

MATERIALS AND METHODS

This part presents the overall framework and methodology of the research. This includes the research design and procedure of investigation.

Research Design

Mixed Design was used in this study. Quantitative method was used to determine the microbial count of street-vended fishballs and its dipping sauce using an aerobic plate count (APC) and also *Escherichia coli* plate count in determining the number of *Escherichia coli* bacteria in every sample was analyzed by Central Bicol State University of Agriculture (CBSUA) Food Testing Laboratory in Pili, Camarines Sur. Qualitative method was employed to a group of health professionals using Focus Group Discussion (FGD) to determine the perceived effects of too much intake of street-vended fishballs and dipping sauce as well as the suggested Health Education Campaign to disseminate proper information about the risk of eating street-vended foods.

Procedure of Investigation

Collection of Samples. Fishballs and dipping sauce samples were collected from the four vendors at Plaza Rizal in Naga City. Vendors were blinded and were not aware that their fishballs and dipping sauce were used for this study. Fishball samples were obtained newly cooked and placed in a sealed plastic and the sauce was also then placed in a sealed plastic. After collecting the food samples from the street vendors, the food samples were placed in a sterile container separately and labeled accordingly. The food samples in a sterile container were placed in an ice box that contained frozen ice bags to avoid contamination. The collected food samples were then brought to the said laboratory area for about 0 – 4 hours after the collection.

Microbiological Analysis. The collected samples were then brought to the laboratory for microbial analyses including enumeration and colony counting of potential presence of *Escherichia coli*. Under aseptic conditions, 25 grams each of the samples both fishballs and dipping sauce were weighed using a top loading balance and homogenized in a stomacher with 225 ml of peptone water. Under aseptic conditions, 1 ml of the homogenate sample was taken using a pipeter and placed in a 9 ml peptone water that makes 10^{-1} dilution blank. Further dilutions were prepared by transferring 1.0 ml of the homogenized sample to a sterile 9 ml peptone water until 10^{-4} dilution was achieved. Test tubes were shaken vigorously in the vortex mixer to obtain evenly distributed sample.

Aerobic plate count. An aliquot of 1.0 ml from 10^{-2} and 10^{-4} dilution was inoculated in a 3M™ Petrifilm CC and labeled accordingly to every fishball and sauce sample. Films were then incubated at 35.5 °C for 24 - 48 hours in an incubator. Colony-forming units (CFU) per gram were then computed using the colony counter.

Escherichia coli plate count. An aliquot of 1.0 ml from 10^{-2} and 10^{-4} dilution was inoculated onto 3M™ Petrifilm CC /EC Count Plate. Films were then incubated at 35.5°C for 24-48 hours to obtain coliform count. Petrifilm shows present coliforms and particular species *Escherichia coli*. *Escherichia coli* showed blue color in the plate. Colony-forming units (CFU) per gram were then computed using the colony counter.

Focus Group Discussion

A Focus Group Discussion (FGD) was used and conducted to obtain health professionals' insights about eating contaminated street-vended foods. The FGD participants were purposively selected for about 9 members. Before the conduct of FGD, the questionnaire on demographic information was given to the participants that require not more than two or three minutes to complete. During the conduct of FGD, Focus Group Questions on Street-Vended Foods were utilized to obtain detailed information and deep insights about eating street-vended foods. Focus group questions were open-ended, unambiguously worded, concise, and non-threatening or embarrassing for both gender and consist of eight (8) questions. They were classified in three (3) types: 1) Engagement Questions, which introduce participants to and make them comfortable with the topic of discussion. 2) Exploration Questions, to get to the meat of the discussion and 3) Exit Questions, to check and to see if anything was missed in the discussion. The FGD was conducted for about 1 to 2 hours.

RESULTS AND DISCUSSIONS

This part presents the results and discussions of the study. The study was focused on the analysis of microbial growth in street-vended fishballs and dipping sauce; possible microbial contaminant present; tolerable or acceptable level of microbial contaminant; perceived effects of too much intake of street foods and health education campaign to disseminate useful information about street-vended fishballs and dipping sauce.

Microbial Growth of Street-Vended Fishballs and Dipping Sauce

Table 1. Analysis for Fishballs Microbial Growth.

Sample and Lab Code	Sample Description	Aerobic Plate Count (CFU/g)
S5-048/Fishballs Sample A	Fried Fishballs, spherical shape and dirty white in color	<1
S6-048/Fishballs Sample B	Fried fishballs, spherical shape and light brown in color	<1
S7-048/Fishballs Sample C	Fried fishballs, spherical shape and light brown in color	<1
S8-048/Fishballs Sample D	Fried fishballs, spherical shape and light brown in color	<1

The microbial growth of street-vended fishballs and dipping sauce was analyzed by Food Testing Laboratory and are presented in separate tables for more emphasis of microbial content in certain food samples. The microbial growth of street-vended fishballs are presented in Table 1.

The laboratory test revealed that in terms of microbial growth in street-vended fishballs, all the samples were <1 CFU/g. It indicates that all fishball samples collected were less than 1 Colony Forming Unit/ gram (CFU/g).

Table 2. Analysis for Dipping Sauce Microbial Growth.

Sample and Lab Code	Sample Description	Aerobic Plate Count (CFU/g)
S1-048 /Dipping Sauce Sample A	Dipping Sauce of fishballs, light brown in color and viscous	3.82×10^4
S4-048/Dipping Sauce Sample D	Dipping Sauce of fishballs, light brown in color and viscous	2.09×10^4
S3-048/Dipping Sauce Sample C	Dipping Sauce of fishballs, orange in color, highly viscous	8.14×10^3
S2-048/Dipping Sauce Sample B	Dipping Sauce of fishballs, brown in color and viscous	<1

The microbial growth of dipping sauces is presented in Table 2. The laboratory test revealed that in terms of microbial growth in dipping sauces, Sample A has the highest microbial growth of 3.82×10^4 CFU/g, followed by Sample D with 2.09×10^4 CFU/g, Sample C with 8.14×10^3 CFU/g and the Sample B with lowest microbial growth of <1 CFU/g.

The results of the study revealed that the dipping sauce samples and the fishballs were within the acceptable or tolerable level of microbial load of 10^3 CFU/g (FDA Circular, 2013) and within the acceptable or tolerable level of microbial load of 5×10^5 CFU/g (Microbiological Criteria for Foods, 2009). Aside from the finding that fried fishballs were tolerable to eat, it was also negative from microbial load.

The findings imply that it was not about the physical characteristics that could make the street-vended fishballs and dipping sauce more susceptible to microbial growth, but it depends on how the foods are prepared and cooked. Fishballs which had been cooked contained a smaller number of microbes while dipping sauce which were been cooked for sometimes and put in a container had not been heat treated is susceptible for microbial growth since it was exposed in the environment for a long period of time.

It implies that eating fried fishballs was safe since it was negative from microbial growth, but it was not safe to dip the fishballs in the dipping sauce. It was appropriate if people would ask for a separate sauce to ensure the food safety.

This supports the findings of Halegoah et al. (2015) that when foods are served and eaten hot, they are considered safe because all the contaminants would have been destroyed through boiling or through long hours of cooking.

Widdel's Theory and Measurement of Bacterial Growth (2010) describe these results that microbial growth occurs through propagation or multiplication over a specific time. Le-Quemener et al. in their Thermodynamic Theory of Microbial Growth (2014) explained that growth rate more exactly depends on the spatial distribution of energy around microbes. Growth rate depends on the intrinsic thermodynamic/energy properties of molecules involved in the metabolism.

Microbial Contaminant in Street-Vended Fishballs and Dipping Sauce

The analysis of the microbial contaminant in street-vended fishballs and dipping sauce are presented in separate tables to clearly emphasize the microbial content of said street foods.

The microbial contaminant of the street-vended fishballs is presented in Table 3. The laboratory test revealed that in terms of microbial contaminant in street-vended fishballs, all the samples were <1CFU/g. All food samples were containing less than 1 colony forming unit per gram (CFU/g). It indicates that the said samples were negative from *Escherichia coli* contamination.

Table 3. Analysis for Microbial Contaminant in Street-Vended Fishballs

Sample and Lab Code	Sample Description	<i>Escherichia coli</i> Plate Count (CFU/g)
S5-048/Fishballs Sample A	Fried Fishballs, spherical shape and dirty white in color	<1
S6-048/Fishballs Sample B	Fried fishballs, spherical shape and light brown in color	<1
S7-048/Fishballs Sample C	Fried fishballs, spherical shape and light brown in color	<1
S8-048/Fishballs Sample D	Fried fishballs, spherical shape and light brown in color	<1

The microbial contaminant of dipping sauces is presented in Table 4. The laboratory test revealed that in terms of microbial contaminant in dipping sauces, all the samples were also <1 CFU/g. The data on the microbial contaminant for street-vended fishballs and dipping sauce revealed that all the food samples had <1 CFU/g which means that all the food samples were negative of *Escherichia coli* contamination. Moreover, the result revealed that all the food samples were within the acceptable level of $10^2 - 10^3$ CFU/g of *Escherichia coli* bacteria. Since it was negative on *Escherichia coli* testing, it means that the street-vended fishballs and dipping sauce were safe for consumption and present no food safety concern.

Table 4. Analysis for Microbial Contaminant in Dipping Sauce.

Sample and Lab Code	Sample Description	<i>Escherichia coli</i> Plate Count (CFU/g)
S1-048 /Dipping Sauce Sample A	Dipping Sauce of fishballs, light brown in color and viscous	<1
S2-048/Dipping Sauce Sample B	Dipping Sauce of fishballs, brown in color and viscous	<1
S3-048/Dipping Sauce Sample C	Dipping Sauce of fishballs, orange in color, highly viscous	<1
S4-048/Dipping Sauce Sample D	Dipping Sauce of fishballs, light brown in color and viscous	<1

It implies that street-vended fishballs and dipping sauce were safe to eat due to acceptable level of *Escherichia coli* bacteria in all the food samples. However, it did not indicate that the said food samples were free for further fecal contamination to ensure food safety and consumption. The result of this study confirms the findings of Barcelon et al. (2015) and Dela Cruz et al. (2013). Based on the research results of Barcelon et al. (2015), all the samples of dipping sauces were negative from *Escherichia coli* on all plates. In the research made by Dela Cruz et al. (2013), all the street-vended pork dim sum (siomai) samples that were tested were also negative of the presence of *Escherichia coli* and *Salmonella*. Chuang Yuan Chen's Unified Theory for Microbial Growth Controlled by Multiple Limiting Substances (2009) further explained that adjusting relative concentration of the nutrients in growth media of microbes determined the maximum cell density that can be obtained in a culture.

Tolerable/Acceptable Levels of Street Foods Microbial Contaminants

The tolerable/acceptable levels of street food microbial contaminants were based on the Department of Health – Food and Drug Administration (DOH – FDA) Circular No. 2013-010 called “*Revised Guidelines for the Assessment of Microbiological Quality of Processed Foods*” and Microbiological Reference Criteria for Food, 2009. The succeeding tables present the data on tolerable/acceptable levels of street foods microbial contaminants.

Table 5 shows or contains a description of food to which a criterion applied, the required test or the microorganisms considered to be acceptable, marginally acceptable, or critical, and the number of samples which should conform to the limits. Based on the table, the snack foods had an acceptable level of coliform content of 10 cfu/g for every 5 sample units. But beyond 10^2 cfu/g of coliform content in 5 sample units could be critical and indicates potential health hazard or imminent spoilage. It means that for every food sample, 2 cfu/g indicates the maximum allowable number of defective or marginally acceptable units in every number of sample units. In the Standard Plate Count (SPC) or Aerobic Plate Count (APC) of the given sample, the acceptable level of microorganisms is 10^3 cfu/g but beyond 10^4 cfu/g in each sample indicates a critical and potential hazard or imminent spoilage.

Table 5. Tolerable and Acceptable Level of Microbial Load.

Food Description	Test/Microorganism Reference Criteria	n	c	m	M
Snack Foods	Coliform, cfu/g	5	2	10	10^2
	SPC/APC, cfu/g	5	2	10^3	10^4

Legend: n – number of sample units selected from a lot of food to be examined

m – acceptable level of microorganism determined by a specified method; the values are generally based on levels that are achievable under GMP

M – level which when exceeded in one or more samples would cause the lot to be rejected as this indicates potential health hazard or imminent spoilage.

c – maximum allowable number of defective or marginally acceptable units

Based on the given data from the cited source, the fishballs and dipping sauce laboratory test for aerobic plate count and coliform count were within the acceptable level of $10^2 - 10^3$ CFU/g and $10 - 10^2$ CFU/g, respectively. These data were necessary to give people the public information on the set microbiological reference criteria for the street-vended foods. This will give necessary information as to food description which a criterion applied, the required test or microorganisms considered to be acceptable and marginally acceptable that have been established.

This is significant especially for those in the health sector as their guide in determining the minimum and maximum allowable number of microbes in specific foods to ensure the quality and safety of street food. This will also entail significant part in the economic aspect that will help food manufacturers in complying with Good Manufacturing Practices (GMP).

Table 6 shows the reference criteria as a guide for regulators to assess when food can be considered unacceptable or unsafe. Based on the table, in terms of Aerobic Plate Count (APC) at 35°C, the acceptable level of microbial content is 5×10^5 cfu/g for every 5 sample units but beyond that value, it indicates a potentially hazardous sample. In terms of fecal coliform content, the acceptable level of microorganism is 10^2 cfu/g in every 5 sample units but beyond 10^3 cfu/g indicates a potentially hazardous sample or unacceptable.

The given data from the cited source will give the people an additional information about the microbial reference criteria for ready-to-eat food, specifically, fishballs and dipping sauce. This will serve as a guide in determining the acceptable and unacceptable level of microbes for aerobic plate count and fecal coliform count. Based on the results of laboratory test for aerobic plate count and *Escherichia coli* plate count, all the food samples tested were within the acceptable levels.

It implies that street-vended fishballs and dipping sauce were within the acceptable level of *Escherichia coli* bacteria, it entails that the food samples tested were safe to eat and it was negative from *E. coli* contamination.

Table 6. Tolerable and Acceptable Microbial Load for Ready to Eat Foods – requiring further cooking (>70°C)

Microorganism Reference Criteria	n	c	m	M
Aerobic Plate Count at 35°C (/g)	5	2	5×10^5	$> 5 \times 10^5$
Faecal Coliform (/g)	5	2	10^2	10^3

n – number of sample units which must be examined from a lot of food to satisfy the requirements of a particular sampling plan.
c – maximum allowable number of defective sample units. When more than this number are found, the lot is rejected by the sampling plan.

m – acceptable level and values above it are marginally acceptable or unacceptable in the terms of the sampling plan.

M – microbiological criterion which separates marginally acceptable quality from defective quality.

Perceived Effects of Too Much Intake of Fishballs and Dipping Sauce to Schoolchildren

The perceived effects of too much intake of fishballs and dipping sauce were determined using focus group discussion (FGD). The perceived effects were gathered from selected health professionals who participated in the focus group discussion. These health professionals: private nurse, medical dentist and sanitary inspector were one in saying that prolong eating of grilled street-vended foods could produce carcinogenic compounds that could lead to cancer.

Aside from cancer that may result from eating street-vended foods, second possible perceived effect is kidney problem. This could happen if consumers, especially students eat too much salty or sour street-vended foods. Cancer could be developed in a long run or excessive intake of this food, but it could be possible that kidney problems may be the short-term effect.

Few of the responses on the perceived effects as stated by the public nurses and municipal health officer of eating street-vended foods could lead to diarrhea, urinary tract infection, acute gastro-enteritis, and Hepatitis for prolong eating. According to the private and public nurses, eating fried street-vended foods will increase triglycerides that may cause cardio-vascular disease. Based on the information given by a diabetologist, the long-term effect of too much eating of street-vended foods on schoolchildren is malnutrition. These perceived effects could lead due to excessive eating of street-vended foods especially by the young learners. Eating contaminated street-vended foods could lead to food-borne diseases as mentioned by a gastroenterologist. However, if the food preparation of the street food vendors were clean, hygienic, and sanitized, there could be no harmful effects to the body.

Based on the responses of the health professionals gathered through FGD, the probable serious illness that may result from too much intake of fishballs and dipping sauce could lead to cancer in a long-term effect and least frequent responses of health

professionals were having Hepatitis, acute gastroenteritis, malnutrition, cardio-vascular disease, diarrhea and urinary tract infection (UTI).

In the given data, the perceived effects of too much intake of fishballs and dipping sauce could lead to diarrhea, urinary tract infection, Hepatitis, kidney problems, and cardio-vascular disease. Long term use could lead to malnutrition and cancer.

The finding implies that too much intake of fishballs and dipping sauce could lead to severe diseases and even malnutrition and cancer. It was necessary to ensure first the health and nutrition aspects of the students by always giving them health education and reminders on the possible effects of too much intake of these street-vended foods.

Based on the study of Halegoah, et al. (2015), when foods are served and eaten hot, they are considered safe because all the contaminants could have been destroyed through boiling or through long hours of cooking. If after eating, there were no immediate health problems or ailments, then foods are safe.

Health Education Campaign Strategies

These include the different health education campaign strategies that should be implemented to disseminate useful information about intake of fishballs and dipping sauce as suggested by health professionals.

Many of the health professionals emphasized that the first person to be educated are the street food vendors through conducting seminars on proper food preparation and handling, hygienic and sanitary practices on preparing foods, giving consumers separate sauce and prevent dipping sauces that could lead to microbial contamination and on taking their personal hygiene as one of the major aspects in promoting cleanliness and sanitation practices in their workplace.

The students could be educated using health alert flyers as an appropriate method to disseminate information as mentioned by the medical dentist. Aside from health alert flyers, other methods like health teaching through slogans reiterating the health concepts and the possible effects of eating street-vended foods. Classroom to classroom campaign on health awareness as suggested by the medical dentist, diabetologist, and the public and private nurses could also be done to increase students' knowledge on the issue at hand.

Since these children are under the guidance of their parents, the parents should also be educated regarding health aspects of their children as mentioned by one of the public nurses and this can be done through the PTA meetings in the school or by their respective municipal health officers to educate them about the risk of eating street-vended foods.

The school should also be one of the responsible agencies in disseminating proper information to students about the risk of eating street-vended foods. This can be done not only by integrating it in health education subjects but also in preparing food they serve their learners as suggested by one of the public nurses.

With the collaborative effort of every sector in the community, the local and national government could make necessary interventions on street vended foods by giving the street food vendors the guidelines for their operations. According to the gastroenterologist, the government should be strict as to the sanitation if food is concerned, sanitary inspector should inspect daily the food preparations especially leftovers. Aside from strict implementation on sanitation of the street food vendors, public and private nurses, municipal health officer and sanitary inspector suggested that street food vendors should have their regular medical check-up to ensure that the food they sell to the people are in utmost safety and security and to require and secure sanitary permits to operate as preventive measures.

Based on the given data, health professionals recommended different health education campaign strategies to be implemented. Street food vendors should be trained through conducting seminars on food preparation, sanitation, and practices of street-vended foods. The students should be educated by using health alert flyers and health teaching. The parents should also be educated on the effects of eating street-vended foods through PTA meetings. The school as the leading agency in molding the minds of young learners should disseminate useful information about risk of eating street-vended foods through integrated health education. The local and national government should make the possible interventions to maintain the sanitation practices for food preparation, regular medical check-up of street vendors and securing sanitary permits.

It implies that these health education campaigns were within the framework of government agencies such as the Department of Education (DepEd), Department of Health (DOH) and Food and Nutrition Research Institute (FNRI). In the DepEd, ensuring food safety to the students were stipulated in the DepEd memorandum Order No. 52 s. 2008, "Compliance with DepEd Policies on Food Safety in Schools", DepEd Order No. 8 s. 2007, "Revised Implementing Guidelines on the Operation and Management of School Canteens in Public Elementary and Secondary Schools", and DepEd Order No. 14 s. 2005 "Instructions to Ensure Consumption of Nutritious and Safe Foods in Schools". These memoranda or order cover only the school canteens. Street foods vendors outside the school premises were within the mandates of the local government units responsibility as stipulated in RA 10611 known as "Food Safety Act" and "Code on Sanitation of the Philippines".

The Department of Health (DOH) had the same manifesto as stated in the National Objectives for Health 2005 – 2010. Specifically, the KM4 Health Framework which highlighted the establishment of an environment in which people are encouraged to learn, share and use knowledge together to achieve the organization's goal. This was an emerging tool in the Philippine health sector which facilitated the acquisition, sharing and exchange, utilization of learnings and knowledge for more informed policies and responsive service delivery.

The Food and Nutrition Research Institute (FNRI) is primarily concerned about micronutrient deficiencies that results to malnutrition. The said agency engaged in the production of complementary foods and technology transfer of the project to all

regions of the country, particularly in provinces where malnutrition is high. This was made through S-T based Intervention to Address Malnutrition.

According to Md. Khairuzzaman et al. (2014), improved safety of street foods can be achieved through awareness raising programs involving several partners such as local authorities, food vendors, government departments, consumer organizations, standard setting bodies, and some non-governmental organizations.

To ensure that street-vended foods are safe to eat, information was disseminated by the Department of Health (DOH) through the Regional Consultation on Safe Street Foods in 2011 stating that some local government units (LGU's) required ambulant food vendors to undergo medical examinations. Certificates were issued and renewed on a yearly basis by local health authorities after physical and medical examinations and immunization and parasitological examination of food handlers. Local government units have established a registry for all street vendors; issuance of local ordinances designating a place for all street-vended foods; medical examination; and the participation of NGO's, academics, the media, and other stakeholders in promoting food safety.

Scudder's Communication Theory (2010) answered means of disseminating useful and relevant information through an Information, Education Campaign (IEC) material by means of health awareness brochure in which it contains information regarding signs and symptoms of excessive eating of street-vended foods, possible microbial contaminants, possible diseases, perceived effects of too much intake of eating street-vended foods and the ways to ensure food safety in street foods.

CONCLUSIONS

Since dipping sauces were not heat treated and most were not properly covered, they caused rapid microbial growth due to long exposure; while fishballs taken newly cooked from the street food vendors, the possible microbes present in the food were killed by deep frying. Fishballs and dipping sauce samples were negative from *E. coli* contamination. However, its absence did not indicate that these street-vended foods were free from other contamination. Since all the food samples were negative from *E. coli* contamination, the collected and tested fried fishballs were within acceptable level of microbial load and presented no food safety concern. If the food preparation was clean, there could be no problem as to health aspects but street foods that are contaminated could cause severe diseases. An Information, Education and Communication (IEC) material through health awareness brochure will be utilized to disseminate useful and appropriate information on the risk of eating street-vended foods to students and the community as a whole. From the information given, the community would be aware and conscious enough to regulate or prevent their eating habits on street-vended foods.

REFERENCES

- Barcelon, Eufemio G., Collado, Dan Mark R., Eustaquio, Shekinah A., Luna, Maria Nikkita H., Santos, Kim Joshua C., Sombrano, Mary Chenneth S. and Villaceran, Danielle P. (2015). Consumer Perception and Microbiological Analysis on Safety of Street Food Dipping Sauces. *Asian Journal of Agriculture and Food Sciences*, Volume 3.
- Chung-Yuan Chen (1988). A Unified Theory for Microbial Growth Controlled by Multiple Limiting Substances, Volume 20, Issue 11-12 (513-515). IWA Publishing Alliance House. London, United Kingdom. Downloaded from: <http://wst.iwaponline.com/content/20/11-12/513>(August 14, 2016)
- Dela Cruz, Jeane, Punzalan, Mark Emile, Ramos, Susana, Reyes, Rosemarie and Barcelon, Eufemio (2013). Consumer Perception on Safety and Sensory Evaluation of Street-Vended Pork Dim Sum (Siomai), *Asian Journal of Food and Agro-Industry*.
- Eliot & Associates, Guidelines for Conducting a Focus Group, 2005. Retrieved from [How_to_Conduct_a_Focus_Group.pdf](#) (December 13, 2016).
- FDA Circular No. 2013-010, "Revised Guidelines for the Assessment of Microbiological Quality of Processed Food". Retrieved from [FC2013-010.pdf](#). (December 13, 2016).
- Food Administration Manual, "Microbiological Reference Criteria for Food", Version 2.0., October, 2009. Retrieved from [Microbiological Reference Guide Assessment.pdf](#) (December 13, 2016).
- Food and Nutrition Research Institute – Department of Science and Technology. 2012 Annual Report. Taguig City, Philippines. Retrieved from [AR2012.pdf](#) (February 22, 2017)
- Haleegoah, Joyce, Ruivenkamp, Guido, Essegbey, George, Frempong, Godfred, and Jongerden, Joost (2015). Street-Vended Local Food Systems Actors Perceptions on Safety in Urban Ghana: The Case of Hausa Koko, Waakye and Ga Kenkey, Scientific Research Publishing
- Helrich, Kenneth. OFFICIAL METHODS OF ANALYSIS of the ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS 15th Edition, Association of Official Analytical Chemists, Inc., Virginia, USA. 1990.
- Horwitz, William. Official Methods of Analysis of AOAC INTERNATIONAL 17th Edition, AOAC INTERNATIONAL, Inc., Maryland, USA. 2000.

- Khairuzzaman, Md., Chowdhury, Fatema Moni, Zaman, Sharmin, Mamun, Arafat Al and Bari, Md. Latiful (2014). Food Safety Challenges towards safe, Healthy and Nutritious Street Foods In Bangladesh, International Journal of Food Science, Volume 2014, Article 1D483519.
- Le-Quemener, Elie Desmond, Bouchez, Theodore (2014). A Thermodynamic Theory of Microbial Growth, The ISME Journal: Multidisciplinary Journal of Microbial Ecology, Volume 8.
- Krueger, Richard. Designing and Conducting Focus Group Interviews, University of Minnesota. October, 2002. Retrieved from [Krueger-FocusGroupInterviews.pdf](#) (December 13, 2016)
- National Objectives for Health 2005 – 2010, Department of Health (DOH). Manila, Philippines. Retrieved from [NOH2005\(DOH\).pdf](#) (February 22, 2017)
- Scudder, SF (1980). Communication Theory, Management Study Guide Presentations, 2016. Retrieved from <https://www.google.com.ph/search?client=ms-unknown&hl=en-US&oe=utf8&safe=images&q=Communication+Theory+-+Meaning+and+Examples&source=browser-type&qsubts=1479897579081&devloc=0> (December 12, 2016)
- Widdel, Friedrich (2010). Theory and Measurement of Bacterial Growth. *Grundpraktikum Mikrobiologie, 4. Sem. (B. Sc.), Universitat Bremen*.
- World Health Organization (WHO) 2010. International Food Safety Authorities Network (INFOSAN) Information Note No. 3/2010 – Safety of Street-Vended Food: Basic Steps to Improve Safety of Street-Vended Food. Downloaded from http://www.who.int/foodsafety/fs_management/info_sanarchives/en/ (December 14, 2016)
- World Health Organization (2011). Regional Consultation on Safe Street Foods, Bangkok, Thailand. Retrieved from [a-an037e.pdf](#) (December 14, 2016)