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Original article

Assessment of hygienic practices of selected "Lechoneros" and microbiological quality evaluation of pork "Lechon" in a locality of Leyte, Philippines

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ABSTRACT

Originally introduced as a Spanish pork dish, the "lechon" refers to a pig that is slow roasted. It is a well-liked cuisine that is always present during festivities. Since "lechon" is one of the most favorite dishes and is now being sold in retail (kilos), it is appropriate to highly consider its quality. This study aimed to assess the practices employed in the production and distribution of "lechon" and evaluate the microbial quality of the "lechon" sold in the retail market in a locality in Leyte, Philippines. Four randomly selected "lechoneros" were interviewed and actual assessment of the processing area and hygienic practices were done. Aerobic plate count on the raw and cooked "lechon" was conducted. Results showed that only one out of the four "lechoneros" would subject the animal to the slaughterhouse for slaughtering. Three out of the four "lechoneros" were non-compliant on the ante-mortem and post-mortem inspection of the pigs. Mean microbial load for dorsal, ventral, rostral and caudal areas of raw meat are $8.13x10^6$, $3.75x10^6$, $4.15x10^7$, $3.13x10^7$ CFU/g, respectively. Mean microbial load for cooked meat is $1.82x10^8$ CFU/g. Furthermore, the microbial load for the raw and cooked meat samples failed to meet the standards of the good manufacturing practice and microbiological standards for food which are 10^5 and 10^6, respectively.

KEYWORDS: *Hygienic practices, "lechoneros", microbial quality, pork "lechon", roasted pig*

1 INTRODUCTION

For consumers these days, access to safe and nutritious food is an essential requirement in maintaining their overall health and well-being. Accordingly, food producers make significant investments to ensure the safety of their food products and to reduce the risks associated with consumer exposure to contaminated or unsafe foods (Wacker, 2017). However, issues regarding foodborne illnesses are still prevalent and this is usually because of poor management and manufacturing practices employed by the food producers and manufacturers.

Foodborne pathogens are a major contributor to human illnesses, hospitalizations, and deaths each year (Baer et al., 2013). One food source of foodborne pathogens is pork. Although pork is less associated with foodborne illness than other meat sources, it remains significant due to its large consumption in a variety of products and because it is the most consumed meat in the world (Baer et al., 2013). In addition, the occurrence of most foodborne illness outbreaks is a result of improper handling or contamination of the food, raw materials and as well as the utensils and equipment used.

Originally introduced as a Spanish pork dish, the "lechon" refers to a suckling pig (2-6 weeks old) that is slow roasted, although nowadays "lechon" sizes vary from lechon de leche (5-10 kg), small (10-15 kg), medium (15-20 kg), large (20-25 kg), and extra-large (25-30 kg) (Bondoc et al 2017). It is a well-liked cuisine that is always present during festivities. To Filipinos, their fête is not complete without a "lechon" appearing on the table.

"Lechon" is prepared by marinating and stuffing the slaughtered and eviscerated pig with spices and several ingredients. It is then stuck in a stainless rod or bamboo pole and then roasted. In producing "lechon", contamination and microbial load proliferation can be introduced from the different processes involved in it and from the practices of the "lechoneros". Since "lechon" is a common dish and is now being sold in retail (per kilo), it would be appropriate to highly consider its quality. Thus, this study aimed to determine the quality of pork "lechon". Specifically, this study aimed to assess the practices used in the production and distribution of pork "lechon", and evaluate the microbial quality of raw and cooked pork "lechon".

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2 MATERIALS AND METHODS

Data Collection

A consent letter was sent to the selected "lechoneros" to conduct the interview and assessment. A questionnaire was formulated in order to gather the information necessary for the study. Questions were directly asked to the "lechoneros" and were interpreted into local dialect for respondents who did not speak English. Direct observations were also done for additional data.

The questionnaire that was developed covers the personal and business profile of the respondents, their mode of purchasing and transporting live pigs, how they receive the live pigs, condition of the lairage area, their hygiene of personnel, cleanliness of the slaughter area, method of scalding, dehairing and hoof removal of slaughtered pig, evisceration process, packaging of "lechon", manner of transporting "lechon", and method of selling "lechon".

Microbiological Analysis

Preparation of Media and Saline Solution

Plate Count Agar (PCA) (Scharlau, Spain) was prepared by diluting 23.5 grams of PCA powder with one liter of distilled water. The agar media was sterilized at 15 psi for 15 minutes together with the buffer dilution blank and cotton swabs which were used for the swabbing of food samples using the conventional autoclave.

0.9% saline solution was prepared by diluting 9 grams of NaCl in a 700 mL distilled water using the volumetric flask. Distilled water was then added to bring the solution volume to 1000 mL. After which, saline solution was transferred in sterile screw capped test tubes.

Sample Collection

Sterile cotton buds were used for swabbing surfaces of meat. The samples for raw meat were taken from ventral, dorsal, caudal, and rostral areas. Cotton swabs were then filled into 0.9% saline solution. Moreover, the cooked meat samples that were bought from the vendors selling pork "lechon" were immediately placed in an ice bucket to prevent cross-contamination and hasty activity of the microorganisms until analysis was conducted.

Serial Dilution and Pour Plating

Serial dilution and pour plating methods were employed to determine the microbial count of the sample. Cotton swabs were transferred into a 9-mL dilution blank (0.1% peptone water) and were shaken thoroughly. One gram from each meat sample was weighed, homogenized and was transferred into 9-mL dilution blank. One ml aliquot was transferred to another dilution blank tube using a pipette to make 10^{-2} dilution. The process was repeated until 10^{-7} dilution. One mL for each of the dilutions was pipetted to a petri plate. The liquefied PCA was then poured at the petri plates at approximately 12 – 15 mL and was mixed thoroughly. Then, the agar media was allowed to solidify at surface level and incubated (Memmert incubator) at 37°C for 2 to 3 days (Association of Official Agricultural Chemists, 1995).

Counting of Colonies

After incubation, plates having 30 - 300 colonies were selected. Then, the values obtained from the plates were multiplied with the reciprocal of the dilution to obtain the colony forming units (CFU) per gram (AOAC, 1995) Moreover, distinct colonies were then isolated and were incubated for future use for its identification.

Analysis of Results

Results during the interview were tabulated using Microsoft Excel 2017. Mean for the aerobic plate count were analyzed using SPSS version 17.0.

3 RESULTS AND DISCUSSION

Transportation Practices

Three out of the four randomly selected "lechoneros" use tricycle for transporting pig to the slaughter area whereas one "lechonero" uses motorcycle for transporting pig (Table 1). According to Animal Transport Guides (2017), during transport of animals for slaughter, soiling and cross-contamination with fecal material should be minimized. Adequate ventilation should also be maintained for the animals as indicated. Transport vehicles and crates used should also be cleaned and if necessary, should be sanitized as soon as practicable after animals have been unloaded. In addition, vehicles intended to transport "lechon" should not be used to transport the live pigs to avoid cross-contamination. During the assessment, it was noted that all of the selected "lechoneros" did not wash and clean the vehicle after loading. Also, it was observed that the same vehicle is used for transporting live pigs and cooked "lechon" where cross-contamination may happen.

Table 1. Mode of transporting live pigs

Lechonero	Vehicle Used
1	Private Tricycle
2	Private Tricycle
3	Motorcycle
4	Private Tricycle

Ante-mortem Inspection

The slaughtered animals should be presented to ante-mortem inspection where competent personnel determine

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and carry measures and tests. Ante-mortem inspection is conducted to protect consumers and slaughter house personnel from zoonotic and/or meat borne diseases to promote animal health by monitoring animal diseases and promoting animal welfare practices [Codex Alimentarius Commission (Food and Agriculture Organization), 2005]. Moreover, only healthy and clean animals shall be allowed to be slaughtered. Table 2 shows the ante-mortem practices of the "lechoneros". Moreover, during the interview, it was noted that three out of the four "lechoneros" would still accept sick animals for slaughtering if consumers insisted. With this practice, diseases from the sick animals could contaminate the premise, equipment and carcasses.

Table 2. Ante-mortem practices of the "lechoneros"

Lechonero	Anti-mortem inspection
1	None
2	Conducts anti-mortem inspection
3	None
4	None

Health Condition of the "Lechoneros"

All personnel working in the "lechon" house must be healthy and free from transmissible diseases, hence, they shall pass medical examinations before hiring and annually thereafter. However, it was found out that all the randomly selected "lechoneros" failed to accomplish physical examination at least once a year (Table 3). It is important that all the personnel working in the "lechon" house are in good health as those with lying conditions or diseases may be carriers of pathogenic microorganisms. These microorganisms may then be transmitted to the meat/food with the risk of causing disease to the consumers (FAO, 2004).

Table 3. Yearly physical examination of the personnel in the "lechon" house

Lechon House	Physical Examination
1	None
2	None
3	None
4	None

Persons known or suspected to be suffering from, or to be carriers of illness likely to be transmitted through meat, shall not be allowed to enter "lechon" house premises (FAO 2019). "Lechoneros" must also take all necessary steps to prevent the contamination of meat by maintaining a high degree of personal cleanliness and wearing proper protective clothing. Yet, it was observed that workers were not wearing proper protective clothing and some were even observed not wearing shirts during slaughter and roasting of pig. Moreover, during the assessment, the personnel from the four "lechon" houses responded that they did not underwent training such as Good Manufacturing Practices (GMP) and Good Agricultural Practices (GAP), but when asked if they are willing to attend trainings on meat hygiene, all of them gave a positive response.

Slaughtering of Animal

Slaughter process involves five important steps which are stunning, bleeding, scalding and dehairing, evisceration, and carcass washing. During stunning, the animal should be killed as quickly and humanely as possible. In most slaughter plants, hogs are immobilized either by electrical stunning or carbon dioxide gas suffocation. On the farm, a hog can be stunned by striking it with one sharp blow with a mechanical stunner or by shooting it in the forehead midway between and slightly above the eyes. Improperly placed bullets could cause the animal much pain and injure helpers or other livestock. Animals that become excited during stunning will not bleed as well as those less excited (Handbook on Pig Farming and Pork Processing 2018). During the assessment, 75% of the "lechoneros" used the conventional method by hitting the animal's forehead (Table 4). However, it was observed during stunning that the animal was hit more than once, hence, pigs are not completely unconscious prior to slaughtering. In contrast, the lone "lechonero" applied electric stunning since the animal was slaughtered in the City's slaughterhouse.

Table 4. Method of slaughtering the animal

Lechon House	Method of slaughtering
1	Conventional
2	Electric Stunning
3	Conventional
4	Conventional

After stunning, bleeding then follows. The animal should be allowed to bleed within 2 minutes after it is down because the blood pressure may increase and thus break the capillaries and cause an unattractive condition in the meat called "blood splash" (Engineers, 2018). Although meat with this condition is safe for consumption, it is quite unpleasant in appearance. Based on the assessment, all the "lechoneros" followed the proper bleeding procedure.

Traditionally, hogs have been scalded and scraped, and the skin is left intact. For scalding, the most important consideration is maintaining an adequate supply of properly heated water. This water should be boiling before the animal is stunned and bled. After the hot water is placed in the scalding barrel, it can be adjusted to the proper temperature for scalding by adding cold water (FAO, 1991). During the assessment, all the "lechoneros" complied with the proper procedure in scalding, dehairing and hoof removal. However, it was

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perceived that the water used for scalding was not frequently changed before each operation.

Evisceration follows after stunning. With all species, care must be taken in all operations not to puncture the viscera. During evisceration, edible organs shall be handled hygienically. Red offal like heart, liver, lungs, spleen and kidney are handled and cleaned separately from white offal like stomach, small and large intestine (FAO, 2004). Yet during the assessment, red and white offal were not handled and cleaned separately which could pose contamination.

According to the FAO (2004), all viscera must be identified with the carcass until the veterinary inspection has been passed. After inspection, the viscera should be chilled on racks for better air circulation. Also, viscera should be loosened and rectum should be tied off. Furthermore, cutting should be through the pelvis and the bladder and other sexual organs should be removed. In males, the foreskin must not be punctured as the contents are a serious source of contamination. All these organs are considered inedible. Removing the abdominal and thoracic viscera intact should also be done and contact with the floor or standing platform should be avoided. However, it was observed that 75% of the "lechoneros" did not chill the viscera on the racks and that they were doing the slaughter process on the floor.

Post-mortem Inspection

Post-mortem inspection and test may be integrated and implemented to gather so as to attain public health and animal health objectives. This inspection should be made by competent personnel based on scientific knowledge and risk-based methods (FAO, 2019). The inspection of carcasses and parts shall be carried out systematically to ensure the detection of lesions and abnormalities. Only meat and edible offal fit for human consumption shall pass inspection. During the assessment, it was observed that 75% of the respondents did not comply with post-mortem inspection.

Figure 1. Pork "lechon" ready for delivery

Packaging used should protect foods including meat from adversary environmental factors that would otherwise cause quality degradation, and provides convenience for transportation and communication link between consumer and food processor; thus, expanding the supply chain and retail markets (Fang et al., 2015). Packaging used for roasted pig should minimize/prevent contamination especially during transport. Also, it should be durable and soundly safe for the consumers. During the discussion with the "lechoneros", they said that Manila paper is the commonly used packaging for "lechon" since it is readily available and cheaper compared to other types of packaging (Fig. 1). According to them, they would even sometimes use banana leaves if available. However, these materials are not intended for food and are not durable that may be torn during transportation which could pose cross-contamination to the finished product.

Selling of "Lechon"

"Lechon" should be marketed within 12 hours after roasting and unsold "lechon" should not be sold the following day (National Meat Inspection Service, 2014). According to the distributors, their "lechons" are easily sold within 4 - 5 hours after display. In addition, the product must be free from any contaminants such as houseflies and other pests. Vending areas must also be enclosed to protect from contaminants like flies and dust (Food and Drug Administration, 1997). During the assessment, it has been observed that the vending area is exposed to contaminants such as flies and dust since it is sold along the street which could contaminate the ready-to-eat food product.

Microbial Quality of Raw Meat

Table 3. Mean of the microbial load (TPC) for raw meat expressed in CFU/g

Area/ Points	Lechonero 1	Lechonero 2	Lechonero 3	Lechonero 4
Dorsal	$1.05x10^7$	$5.0x10^6$	$7.0x10^6$	$1.0x10^7$
Ventral	$5.5x10^6$	$2.5x10^6$	$2.0x10^6$	$5.0x10^6$
Rostral	$1.4x10^8$	$9.0x10^6$	$8.0x10^6$	$9.5x10^6$
Caudal	$9.7x10^7$	$1.2x10^7$	$7.0x10^6$	$9.5x10^6$

Results of microbial load analysis for the different areas of the slaughtered pig are shown in Table 3. The number of colonies forming units per gram were based on the total plate count regardless of the morphology of the colony. According to Melngaile et al. (2014), to monitor microbiological quality of meat preparations and meat products, guidelines and recommendations of international and national level have been developed in addition to legal requirements. According to the guidelines of good manufacturing practice as cited in the study of Melngaile et al. (2014), the level of total microbiological contamination of raw meat and raw meat preparations should not exceed 10^5 cfu/g. However, based on the data gathered, meat samples taken from the different areas of the meat were greater than 10^5 cfu/g. This result is useful in indicating the quality, shelf-life

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and as well as post heat-heat processing contamination of the meat. The high microbial load of the meat samples is greatly influenced by several factors which includes the practices of the personnel and as well as the sanitation of the premise, equipment and materials used during slaughtering. Microbial contamination of meat can occur at several points throughout the processing operations. Meat tissues get contamination during the various stages of slaughter particularly by the use of the utensils and equipment for slaughtering and during transportation. Thus, it would be best to use potable water, clean and disinfected utensils and equipment, and area should be maintained and cleaned throughout the slaughtering process to ensure that microbiological contamination is prevented/minimized.

Microbial Quality of Pork "Lechon"

Table 5 Mean of the microbial load (TPC) for cooked meat samples expressed in CFU/g

	Lechonero 1	Lechonero 2
"Lechon"	$2.5x10^8$	$1.1x10^8$

Table 5 shows the mean total plate count of meat samples obtained from randomly selecting the part of "lechon" expressed as CFU/g. Meat samples were only taken from two "lechoneros" since they are the only ones that sells their product in retail. It can be observed that the microbiological count of the meat samples was higher compared to the raw meat samples. This may have happened since the area for selling pork "lechon" is exposed to dust and other debris as the area for selling "lechon" of both vendors are located near the road. According to the Microbiological Standards for Food (2014), cooked meat products that may be displayed for sale at ambient temperature for a limited period of time should only contain a total plate count of 10^5 – 10^6 CFU/g. Beyond this range would be considered unsatisfactory. Based on Table 5, microbial count was unsatisfactory. Nevertheless, since total plate count only provides the total number of bacteria from an aerobic environment and is only an indicator of quality but not of the safety of food, it would be best if these colonies would be isolated and identified to know as to what these types of microorganisms. With the gathered data from roasted pork, it provides useful information about the general quality and remaining shelf-life of the food in question, and thus highlights potential problems of storage and handling since production.

4 CONCLUSIONS AND RECOMMENDATION

Based on the assessment of the practices of four "lechoneros", 3 out of 4 (75%) still use the conventional way of stunning pig, only 25% of them were found to submit pigs to slaughterhouse for slaughtering, and most of the "lechoneros" and/or vendors failed to comply proper management and manufacturing practices. During the microbiological assessment, total plate count of the raw meat obtained from different sources failed on the standard load for raw pork meat (10^5 CFU/g). Microbiological load of roasted pork "lechon" sold was found to have high microbiological count (> 10^6 CFU/g). Though total plate count only provides the total number of bacteria from an aerobic environment and is only an indicator of quality but not the safety of food, nonetheless, these data provides useful information about the general quality and remaining shelf-life of the food in question, and thus highlight potential problems of storage and handling since production.

It is recommended that "lechoneros" be trained on specific training such as food handling and safety, Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP) and others. Also, a scheme may be developed to monitor and assess the practices done by the "lechon" houses and lechon vendors in the municipality. It is also recommended that there should be an identification of the microorganisms present in the raw meat and "lechon" so as to know what these types of microorganisms are.

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