Technical report on the effect of processing on the microbial assessment and safety of pork '*domedo*' sold in Accra Metropolis

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Abstract

Like any other red meat, pork contains a large amount of protein that helps improve the body's overall health, repairing worn out body tissues, preventing the body from infections and strengthening the immune system. It is also rich in vitamins A, B, and D and is a good source of bioactive compounds like Zinc, Iron and Selenium.

In recent times, consumption of pork '*domedo*' has become a trend with consumers even travelling a distance to purchase this delicacy. It is eaten either with fried yam chips and hot pepper or as a snack. This study therefore sought to assess the effect of processing on the microbial quality of grilled pork sampled from 8 drinking bars in the Accra Metropolis.

The results indicate the presence of enteric pathogens, *Bacillus cereus* and *Staphylococcus aureu*s in some samples of *domedo*. No *Salmonella* nor *Listeria monocytogenes* were identified in any of the samples analysed.

In some samples, the levels of bacteria identified were at satisfactory levels whilst others were unacceptable. There is therefore the need to train vendors of grilled *domedo* to implement good hygienic practices and proper temperature and process control to ensure safe ready-to-eat *domedo*.

Key words: pork, food safety, street food vending

1.0 Introduction

Meat is classed as a good source of protein for the human body, aiding in the repair of worn out body tissues. It is obtained from animals and eaten as part of healthy diets. It is composed of water, protein and fat, fatty acids, vitamins, very small amounts of carbohydrates and bioactive compounds (FAO, 2015; Sigrist & Beldoménico, 2012). It is a rich source of vitamin B12 and iron and is usually eaten cooked, seasoned or processed in several ways such as by grilling or frying. According to FAO (2015) statistics, the protein content of lean pork is 22.8g /100g. Meat that is not stored adequately or processed will undergo spoilage within hours and decompose.

Pork, chicken, mutton, lamb, beef are the commonly consumed types of meat. In recent times, there is the increasing pattern of consumption of pork popularly known as *domed*o in Accra. This is spicy pork / cured pork and it is fast becoming a popular choice among the street foods. This trend has caught up in urban towns such as Accra where *domedo* is eaten with *kenkey* or fried yam and freshly ground pepper, or as a snack.

Although well-cooked meat such as pork is safe to eat, on the down side, undercooked pork may harbour parasites such as *Taenia* spp, *Trichenella, Taenia solium* and *Toxoplasma gondii* (Gamble, 1997). Meat borne biological hazards can enter and persist in the food chain at any point. This could be in the pre-harvest, harvest, postharvest, processing or storage stage.
Due to the fact that consumption of *domedo* has become a food fad, this study sought to look at the food safety and quality issues linked with the slaughtering, handling, processing, and sale of *domedo*.

2.0 Preparation of *Domedo*

In the course of the study, it was realised that there are three main ways of preparation of the *domedo*. The traditional method involves cutting the pork into smaller sizes, seasoning it with a little salt and paprika so that the natural taste of the pork is enhanced. It is then baked in a mud oven for a period of 30mins. However, most vendors now resort to excessive seasoning and colouring before boiling the pork to make it tasty. The pork chops are then grilled and cut into smaller pieces on a chopping board with a knife, at the point of sale to the consumer. Other vendors also season and boil the cuts of pork and fry. At the point of sale, these are cut into bite-size pieces for consumers on a chopping board with a knife. With the last group of pork vendors, after boiling, and at the point of purchase, they cut the boiled pork chop into small bits and fry at the point of sale.

A review of literature indicated that worldwide, pork is the most commonly consumed meat and in Ghana, the situation is the same. Additionally, since 2008 to 2013, pork prices in Ghana rose rapidly between 115-120% (Banson *et al*., 2014). Some work was done on the microbial quality of pork khebab and was found to contain *Escherichia coli* and *Staphylococcus* spp (Agbodze *et al*., 2005) and *Streptococcus* spp., *Salmonella* spp., *Klebsiella* spp. in another study conducted in Bolgatanga on fresh and smoked pork samples (Anachinaba *et al*., 2015). However, studies have not been conducted on the microbial quality of pork (spicy pork) or *domedo* sold on the streets of Accra.

Fig. 1 Pig to be slaughtered for *domedo*.

Fig. 2. Pork meat to be cooked

Fig 3. Pork

Fig. 4 Boiled pork with flies

The objective of this study was therefore to conduct a microbial assessment on samples of *domedo* purchased randomly from vendors around Accra and to ascertain if the *domedo* is microbiologically safe for consumption.

For this report, the microbial assessment was conducted on grilled *domedo*. Results from this study would give a clear picture of the food safety issues with the processing and consumption of grilled *domedo* / spicy pork and controls that can be put in place to ensure safe pork products to consumers.

3.0 Methods and Materials

3.1 Sampling

The grilled pork samples were bought from eight popular drinking spots within the Accra metropolis. The samples were collected in sterile polythene bags and kept in a stable condition in an ice chest and transported to the CSIR-Food Research Institute's laboratory for microbial analyses.

3.2 Microbiological analyses

For all samples, 10 g were homogenized in 90 ml sterile diluent (0.1% peptone, 0.8% NaCl, pH 7.2) in a stomacher (Lab Blender, Model 4001, Seward Medical, London, England) for 30 seconds at normal speed. From appropriate ten-fold dilutions, aerobic mesophiles were enumerated by pour plate on Plate Count Agar (Oxoid CM325; Oxoid Ltd., Basingstoke, Hampshire, UK), incubated at 30 ^{o}C for 72 hours according to NMKL No. 86 (2006). Yeast and moulds were enumerated by spread plate on Dichloran-Rose Bengal Chloramphenicol Agar (Oxoid CM0727), pH 5.6, containing Chloramphenicol supplement to inhibit bacteria growth and incubated at 25 ^{o}C for 48 to 120 hours in accordance with ISO 21527-1:2008. Total coliforms and *E. coli* were enumerated by pour plate on Trypton Soy Agar (Oxoid CM131), pH 7.3 overlaid with Violet Red Bile Agar (Oxoid CM107), pH 7.4 and incubated at 37 ^{o}C for 24 hours for total coliforms and at 44 ^{o}C for 24 hours for *E. coli*. Colonies suspected to be coliforms were confirmed on Brilliant Green Bile Broth (Oxoid CM31), pH 7.4, incubated at 37 ^{o}C for 24 hours according to NMKL No. 44 (2004) and suspected colonies of *E. coli* were sub cultured into EC Broth (Oxoid CM853), pH 6.9, followed by Tryptone Water (Oxoid CM87), pH 7.5, for indole test, all incubated at 44^{o}C for 24 hours according to NMKL No. 125 (2005). *Staphylococcus aureus* was determined by spread plate on Baird Parker Agar (BP, CM 275 Oxoid Ltd, Hampshire, England) with Egg Yolk Tellurite Emulsion (SR54) added and confirmed for coagulase positive on rabbit coagulase plasma (C14389). *Bacillus cereus* was enumerated by spread plate technique on Bacillus Cereus Agar

Base (CM0617) to which Polymyxin B supplement (SR0099E) has been added and confirm on Blood Agar Base (Oxoid CM0055), as described in NMKL No. 67, 2010. *Enterobacteriaceae* was enumerated according to NMKL No. 144, (2005), on Violet Red Bile Glucose Agar (Oxoid CM0485), pH 7.4 and over laid with another VRBGA. The plates were incubated at 37 ^{0}C for 24hours. Suspected colonies were confirmed by oxidase test. Detection of *Salmonella* was according to NMKL No. 71, (1999). 25 g of the sample and 225ml of Buffered Peptone Water (CM0509) was used as pre-enrichment broth and incubated at 37 ℃ for 21 hours. 1ml was sub cultured into Rapapport Vasiliadis Soya Peptone Broth (CM0866) broth and subsequently plated on XLD Agar (CM0469 Oxoid Ltd, Hampshire, England). *Salmonella* species was confirmed by biochemical test on Triple Sugar Iron Agar (Vm381715 214, Merck KGaA Darmstadt, Germany) and serological test using *Salmonella* Polyvalent Agglutinating Sera (30858501ZD01, UK). *Listeria monocytogenes* was determined by ISO 11290 1 (2004). 25g of the test sample was weighed into 225ml of half Frazer (CM 0895) as a pre enrichment broth and incubated at 30^0 C for 24hours. 0.1ml of the culture was sub cultured in to Frazer broth and incubated at 37^0 C for 48hours. The culture medium was plated out Palcam (CM0877) Agar and Oxford Agar media and incubated at 37^0 C for 24 hours. Suspected colonies were confirmed catalase, gram, motility test and Blood Agar Base to determine the presence of haemolysis.

4.0 Results and Discussion

Table 1 shows the mean microbial counts of grilled pork sold at eight different drinking spots within the Accra metropolis. The table reveals that all the samples analyzed recorded counts within the range of 10^3 – 10^5 cfu/g. The table also shows that most of the samples were contaminated with coliforms bacteria and this ranged between 10^1 -10^3 cfu/g. *E. coli* counts were recorded in samples obtained from Osu (28 cfu/g), Lashibi (60 cfu/g) and Kwashieman (26 cfu/g) locations. Samples (62.5 %) analyzed did not record any counts for *E. coli*. The table also reveals that *Enterobacteriaceae* were not isolated from three locations (Tema, Odorkor, Labadi), meanwhile the rest of the pork joints had counts ranging from 10^1 – 10^3 cfu/g. With regards to *B. cereus* and coagulase positive *Staphylococcus aureus* only one location did not record any count (Sowutoum). About 37.5% of the pork joints visited indicated a count for both *B. cereus* and coagulase positive *Staphylococcus aureus* whiles 50% showed counts for either *B. cereus* and coagulase positive *Staphylococcus aureus*. Moulds and yeasts

counts were present within the limit of 10^2 – 10^3 cfu/g. whiles no counts were recorded for Sowutoum and Labadi.

Table 1 Microbial counts (cfu/g) of grilled pork sold at drinking spots

LOCATION	TVC	Coliform	*E. coli*	*Enterobac-teriaceae*	*B. cereus*	*S. aureus*	Mould & yeast
OSU	1.1×10^5	2.5×10^3	2.8×10^1	3.0×10^3	6.4×10^2	2.3×10^2	7.2×10^3
TEMA	3.0×10^4	$6.0. \times 10^3$	0	0	3.9×10^1	$3.8\ 10^1$	4.4×10^2
LASHIBI	1.5×10^5	3.0×10^3	6.0×10^1	8.0×10^3	4.2×10^2	0	1.2×10^3
ODORKOR	6.2×10^4	0	0	0	6.1×10^1	0	9.2×10^2
KWASHIEMAN	3.7×10^4	5.5×10^2	2.6×10^1	2.6×10^2	6.6×10^1	4.8×10^1	6.3×10^2
SOWUTOUM	3.8×10^4	0	0	1.0×10^1	0	0	0
LABADI	5.9×10^3	0	0	0	5.8×10^2	0	0
NUNGUA	6.5×10^4	2.3×10^1	0	1.3×10^2	0	5.0×10^1	2.6×10^2

Table 2 indicates the determination of *Salmonella* and *Listeria monocytogenes* of grilled pork sold at different drinking spots. From the results obtained, all the samples analyzed showed absence of both *Salmonella* and *Listeria monocytogenes* bacteria. Sofos (2008) indicated that *Salmonella* will continue to be a pathogen of interest affecting the safety of raw meat and *Listeria monocytogenes* a concern with respect to ready to eat processed products due to several factors including processing and changing consumer needs.

Table 2: Determination of *Salmonella* and *Listeria monocytogenes* of grilled pork sold at drinking spots

LOCATION	*Listeria Moncytogenes*	*Salmonella*
OSU	Not detected	Not detected
TEMA	Not detected	Not detected
LASHIBI	Not detected	Not detected
ODORKOR	Not detected	Not detected

KWASHIEMAN	Not detected	Not detected
SOWUTOUM	Not detected	Not detected
LABADI	Not detected	Not detected
NUNGUA	Not detected	Not detected

Table 1 shows the mean microbial counts of grilled pork sold at eight different drinking spots within the Accra metropolis. The table reveals that all the samples analyzed recorded counts within the range of $10^3 – 10^5$ cfu/g. The table also shows that most of the samples were contaminated with coliforms bacteria and this ranged between 10^1 -10^3 cfu/g. *E.coli* counts were recorded in samples obtained from Osu (28 cfu/g) Lashibi (60 cfu/g) and Kwashieman (26 cfu/g) locations. However, 62.5 % of the samples analyzed did not record any counts for *E.coli*. The table also reveals that *Enterobactriaceae* was not isolated from three locations (Tema, Odorkor, Labadi), meanwhile the rest of the pork joints had counts ranging from $10^1 – 10^3$ cfu/g. With regards to *B. cereus* and coagulase positive *Staphylococcus aureus* only Sowutoum location did not record any count. About 37.5% of the pork joints visited indicated a count for both *B. cereus* and coagulase positive *Staphylococcus aureus* whiles 50% showed counts for either *B. cereus* and coagulase positive *Staphylococcus aureus*. Moulds and yeasts counts were present within the limit of $10^2 – 10^3$ cfu/g, whiles no counts were recorded for Sowutoum and Labadi.

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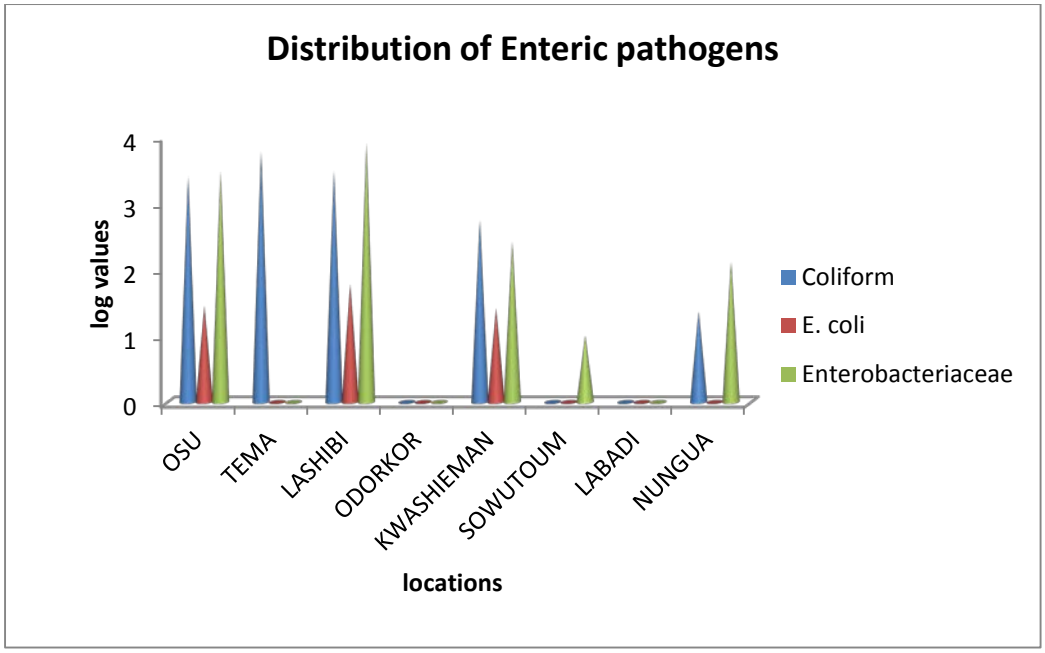

Fig 5 Distribution of enteric pathogens within the various locations

Figure 5 depicts the distribution of enteric pathogens isolated from the grilled pork samples. The figure reveals that Osu and Lashibi recorded the highest counts of enteric pathogens. Coliforms for instance is an indicator of the cleanliness and hygienic practices during processing, production and or handling of food. In *domedo*, that has been well cooked, these counts could be due to cross contamination from the hand of vendors, from the chopping boards and or from the knives used.

For a ready-to-eat food to be classed as satisfactory *Enterobacteriaceae* should be 10^2cfu/g and *E.coli* should be less than 20cfu/g (HPA, 2009). *Domedo* samples from Osu and Lashibi, were not satisfactory for *Enterobacteriaceae* counts and *E.coli* counts.

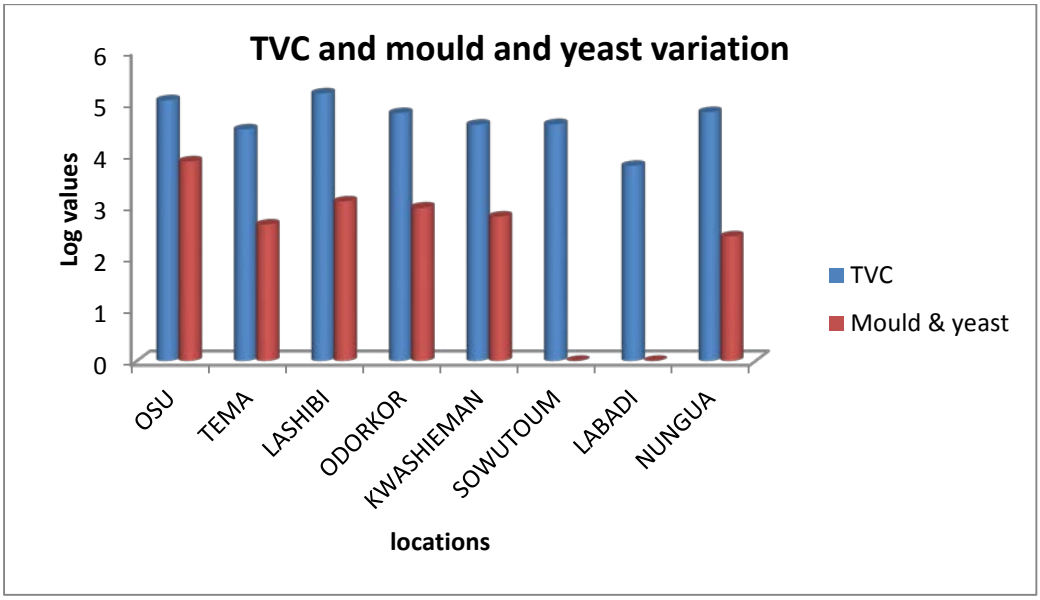

Fig. 6 TVC and mould and yeast variation

The counts for total viable bacteria and yeast and mould as shown in Fig. 6 could be from the khebab powder sprinkled on the grilled pork samples. Alternatively, the unhygienic practices could be a factor. There is therefore the need to take swabs of the surfaces during the production of the *domedo*. The crevices on the chopping boards used in cutting the pork chops into smaller pieces could also harbour bacteria (Alimi, 2016).

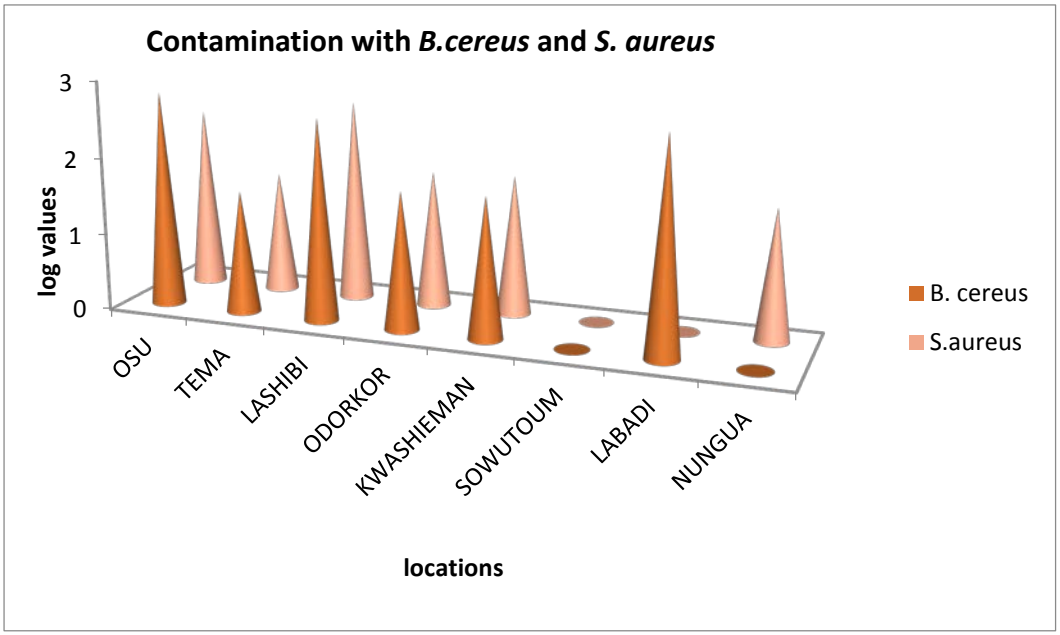

Fig. 7 Contamination with *B. cereus* and *S. aureus*

The *domedo* are usually prepared in advance and probably not consumed within a day. The temperature variations the pork chop goes through before and after cooking and its exposure to the environment could be responsible for the *Bacillus cereus* counts obtained as depicted in Fig. 7. *Bacillus cereus* are ubiquitious because of this, food and food ingredients can be contaminated by them. Research has shown that the spores can survive cooking. Samples taken had a maximum of 10^2 cfu/g which is less than the satisfactory level of 10^3 cfu/g of *Bacillus cereus* (HPA, 2009).

Additionally, holding the *domedo* samples at room temperature could result in the multiplication of microorganisms (Alimi, 2016; Umoh & Odoba, 1999).

Staphylococcus aureus contamination of foods is as a result of human contact. Unsatisfactory levels in food is as a result of time and temperature abuse as well as improper handling after preparation. Counts of less than 20 cfu/g are classed as acceptable. From the counts obtained in this study (Fig.7), samples from Osu, Tema, Kwashieman, and Nungua were not satisfactory. The counts obtained indicate a likely evidence of poor handling, and poor process and temperature control (HPA, 2009).

5.0 Conclusion

The *domedo* vendors need some training geared towards reducing microbial counts to very low levels, since there isn't further processing or cooking of the *domedo* after it has been purchased.

Further study will also be done on the knives and chopping boards and hand swabs of vendors to assess the extent of the sources of cross-contamination.

6.0 References

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