

Original Research Article

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Bacteriological Quality of Raw Pork Sold in Retailer Butcher Shops of Aizawl and Imphal

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ABSTRACT

A total of 200 raw pork samples (Aizawl=100, Imphal=100) were subjected for Total Viable Count (TVC), Coliform Count (CC) and Faecal Streptococcal Count (FSC). The overall mean TVC was recorded as $5.9985 \pm 0.0254 \log_{10}\text{cfu/g}$. However, the mean TVC were reported as 6.0577 ± 0.0406 and $5.9393 \pm 0.0295 \log_{10}\text{cfu/g}$ from Aizawl and Imphal, respectively with significant variation between Aizawl and Imphal at 10^{-4} dilution ($P < 0.05$) and at 10^{-5} dilution ($P < 0.01$). All the pork samples from Aizawl and 98.00% samples from Imphal showed positive for coliform organisms. The overall mean CC was recorded as $5.2727 \pm 0.0707 \log_{10}\text{cfu/g}$ with the mean values of $5.3828 \pm 0.0945 \log_{10}\text{cfu/g}$ from Aizawl and $5.1627 \pm 0.1045 \log_{10}\text{cfu/g}$ from Imphal. The overall mean FSC was recorded $2.7794 \pm 0.1219 \log_{10}\text{cfu/g}$ without any significant variation between Aizawl and Imphal.

Keywords

Raw pork,
Bacteriological, TVC,
CC, FSC, Aizawl,
Imphal

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Introduction

Food is the major need for the survivability of the all living organisms. Thus it acts as a major route of transmission for all types of contamination by chemical and microbiological contaminants. Bacterial contamination of food is the most common cause of food-borne illness resulting 70% of deaths associated with food-borne diseases (Adak *et al.*, 2002; Lynch *et al.*, 2006). Meat is considered as one of the most important

food items for human consumption from the ancient time and a major proportion of the worldwide population chiefly relies on meat as a potent source of good quality protein (Bradeeba and Sivakumar, 2013). All over the world, pork shares about 38% of meat production (Jeffries 2012). Pork, being the most important meat in North-Eastern Region of India, the pig population shares 38% of total pig population of India with contribution of 18.77% of India's total pork production and in hike with every passing year.

Of the total meat production of NER, pork meat contributes 36% (85.02 thousand tones out of 235.29 thousand tonnes) in 2012-13 (Basic Animal Husbandry Statistics 2013, AHDF, GoI).

Manipur and Mizoram are two states of North-Eastern Hilly Region with the pig population of 278 thousands and 245 thousands in Manipur and Mizoram, respectively (19th Livestock Census, 2012) and pork shares 27% and 57% of total meat production in Manipur and Mizoram.

Fresh raw meat contains high level of nutrients with water activity of 0.98-0.99, and a pH ranging from 5.5 to 5.6; which favour the growth of microorganism (Acuff, 2005).

Under the unhealthy and unhygienic practices in meat production chain, meat is subjected to microbial contamination (Kumar *et al.*, 2001) that comes in contact with meat during the production, processing, transportation and distribution and causes health problems of infection and intoxications (Ramasastry *et al.*, 1999; Dhanze *et al.*, 2012) and spoilage.

Meat is frequently contaminated with high level of *Klebsiella pneumoniae*, *Enterobacter* sp., *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella* spp., *Serratia marcescense* and *Protius vulgaris*, *Staphylococcus aureus* and *Bacillus* sp. (Ukut *et al.*, 2010; Ateba and Setona 2011).

Keeping this point in view, the present study was conducted on bacteriological quality of raw pork sold in retail butcher shops of Aizawl and Imphal, the capital cities of Mizoram and Manipur, respectively.

Materials and Methods

A total of 200 number of raw pork samples (100 gram each) were collected aseptically from unorganized local markets of Aizawl and

Imphal during the period of July 2016 to December 2016 and were processed immediately upon arrival in the laboratory for bacteriological quality. The TVC, CC and FSC were determined according to the procedure recommended by American Public Health Association (1976) and Quinn *et al.*, (1994). Twenty five grams of raw pork sample was weighed and placed into 225 ml one percent peptone water and placed in a stomacher for two minutes. Subsequently 10-fold dilutions of meat samples were made up to 10⁻⁶ and 0.1ml from appropriate dilution was transferred to sterilized plate using micropipette. The inoculated samples were spread on to the entire surface of the agar plates, Nutrient agar, MacConkey agar and Slantz & Bartley agar for TVC, CC and FSC, respectively with a sterile glass spreader and the plates were incubated at 37°C for 24-48 hours. Following incubation, plates exhibiting 30 to 300 bacterial colonies were counted. The average number of colonies in a particular dilution was multiplied by the dilution factor to obtain the TVC and the results of the TVC were expressed as mean log colony forming unit (cfu) per gram. Statistical analysis was done by one way ANOVA (Snedecor and Cochran, 1994).

Results and Discussion

All the enumerated values of TVC, CC and FSC were expressed in terms of log₁₀.

Total Viable Count (TVC) in raw pork

The overall TVC of raw pork samples from Aizawl and Imphal ranged between 3.35 and 6.46 log₁₀cfu/g with a mean value of 5.9985 ± 0.0254 log₁₀ cfu/g. However, the TVC of raw pork from Aizawl and Imphal ranged from 3.35 to 6.46 and 4.62 to 6.40 with a mean value of 6.0577 ± 0.0406 and 5.9393 ± 0.0295 log₁₀ cfu/g, respectively (Table 1; Fig. 1).

The overall mean TVC of pork samples varied significantly ($P < 0.05$) between Aizawl and Imphal with a significant difference in TVC at 10^{-4} ($P < 0.01$) and 10^{-5} ($P < 0.05$) dilutions. However, no significant difference was observed in 10^{-3} dilution between Aizawl and Imphal.

For detection of bacterial quality of raw meat, total viable counts (TVC) has been widely accepted measure of the general degree of microbial contamination and hygienic conditions of processing plants (Cohen *et al.*, 2007). It estimates the total numbers of viable micro-organism present in a set volume of meat sample and the results is considered as a level of magnitude against the prescribed standard. Inthvang *et al.*, (2006) reported the range of APC of fresh pork ranging from 4.44-5.3 \log_{10} cfu/g from Vientane, which was less than the ranges of TVC of pork found in Aizawl and Imphal. However, Lambey *et al.*, (2016) reported higher mean value of TVC (7.78 \log_{10} cfu/g) from Mathura region of India and the higher level of microbial contamination of pork in Mathura might be due to complex city life than North Eastern Hill states. In numbers of studies made by Bradeeba and Sivakumar (2013) and Singh *et al.*, (2014) also showed the high mean value of TVC 5.89 ± 0.17 and 6.86 ± 0.02 (\log_{10} cfu/g),

respectively in retailed pork samples from Chidambaram, TN and Agra region. In and around Anitsha, Nigeria, Nnachi and Ukaegbu (2014) showed much higher level of bacterial contamination of raw pork with a mean Total Aerobic Count of 9.84 ± 0.14 (\log_{10} cfu/g). Anachinaba *et al.*, (2015) showed the bacterial quality as microbial load of 5.13 \log_{10} cfu/g of fresh pork and 5.67 \log_{10} cfu/g of smoked pork, in Ghana which was lesser than the findings in the present study.

Coliform Count (CC) and Faecal Streptococcal count in raw pork

Other than TVC, Coliform Count and Faecal streptococcal count (FSC) are the two major parameters for determination of faecal contamination of raw meat. Faecal materials are major sources of meat contamination via direct deposition and indirect contact through contaminated equipments, tools, vehicles and even workers (Borch and Arinder, 2002). Coli form Count, especially *Escherichia coli* is the indicator of faecal contamination; whereas FSC is the unique determinant of recent contamination. High load of *E. coli* in raw meat from abattoirs and retail shops may contribute in spoilage and food-borne illnesses (Ahmed *et al.*, 2013) (Fig. 2).

Fig.1 Graphical representation of Total Viable Count (TVC) of raw pork in Aizawl and Imphal

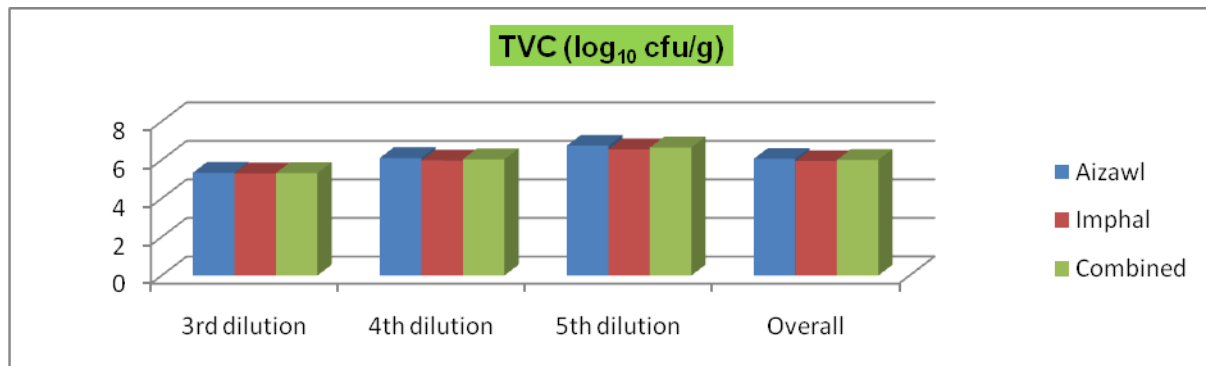


Fig.2 Graphical representation of Coliform Count (CC) of raw pork in Aizawl and Imphal

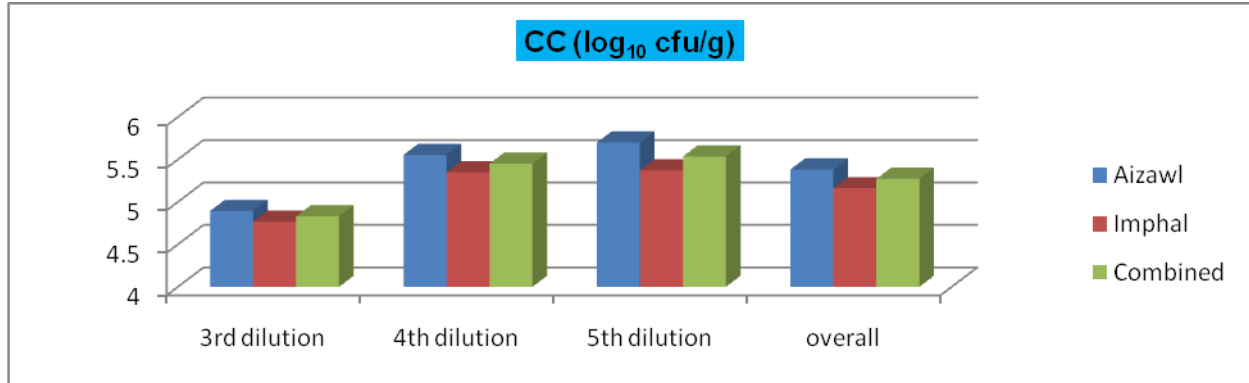


Fig.3 Graphical representation of Faecal Streptococcal Count (FSC) of raw pork in Aizawl and Imphal

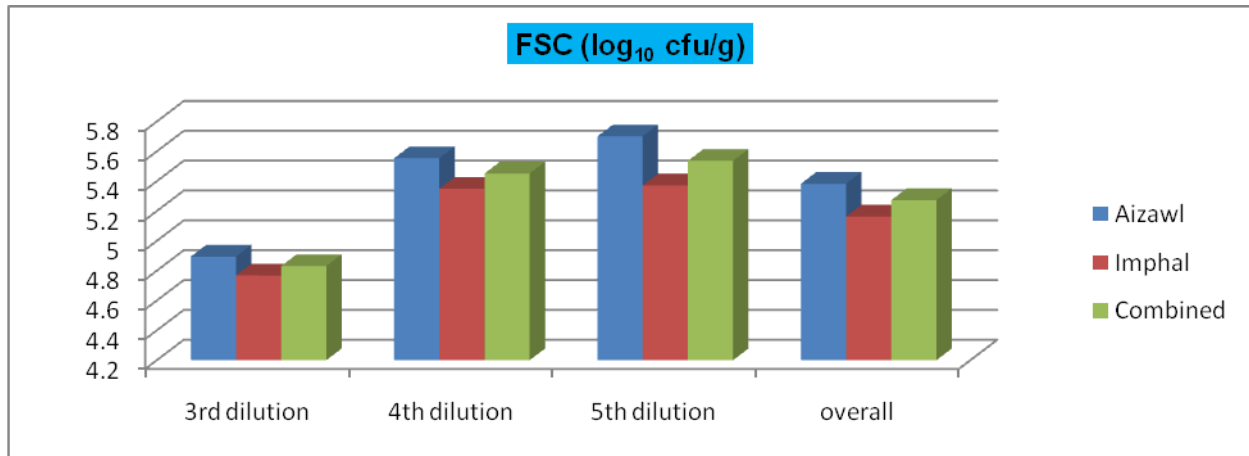


Table.1 Mean TVC of raw pork samples from Aizawl and Imphal in different dilutions

Parameter	Aizawl (n=100)	Imphal (n=100)	Combined (n=200)	F-value
TVC				
10 ⁻³	5.3336 ± 0.0267 (4.08-5.59)	5.2994 ± 0.0222 (4.08-5.56)	5.3165 ± 0.0173 (4.08-5.59)	0.973 ^{NS}
10 ⁻⁴	6.1016 ± 0.0350 ^a (4.70 - 6.48)	5.9706 ± 0.0284 ^b (4.78-6.51)	6.0361 ± 0.0229 (4.70-6.51)	8.439**
10 ⁻⁵	6.7379 ± 0.0821 ^a (0.00 – 7.35)	6.5479 ± 0.0447 ^b (5.00-7.26)	6.6429 ± 0.0471 (0.00-7.35)	4.130*
Overall	6.0577 ± 0.0406 ^a (3.35-6.46)	5.9393 ± 0.0295 ^b (4.62-6.40)	5.9985 ± 0.0254 (3.35-6.46)	5.553*

NS- Non-significant at P<0.05; * Significant at P<0.05; ** Significant at P<0.01; Figures within the parentheses indicates the range values.

Table.2 The details of CC of raw pork in different dilutions from Aizawl and Imphal

Parameter	Aizawl (n=100)	Imphal (n=100)	combined (n=200)	F-value
CC				
10 ⁻³	4.8940 ± 0.0427 (3.00-5.48)	4.7673 ± 0.0769 (0.00-5.40)	4.8307 ± 0.0442 (0.00-5.48)	2.073 ^{NS}
10 ⁻⁴	5.5539 ± 0.0785 (0.00-6.32)	5.3492 ± 0.0888 (0.00-6.23)	5.4516 ± 0.0596 (0.00-6.32)	2.981 ^{NS}
10 ⁻⁵	5.7005 ± 0.1988 (0.00-7.28)	5.3715 ± 0.1757 (0.00-6.90)	5.5360 ± 0.1328 (0.00-7.28)	1.538 ^{NS}
Overall	5.3828 ± 0.0945 (2.33-6.28)	5.1627 ± 0.1045 (0.00-6.09)	5.2727 ± 0.0707 (0.00-6.28)	2.444 ^{NS}

NS- Non-significant at P<0.05; * Significant at P<0.05; ** Significant at P<0.01; Figures within the parentheses indicates the range values.

Table.3 The FSC in raw pork samples at different dilutions from Aizawl and Imphal

Parameter	Aizawl (n=100)	Imphal (n=100)	Combined(n=200)	F-value
FSC				
10 ⁻³	3.1317 ± 0.1874 (0.00-5.32)	3.8630 ± 0.0779 (0.00-4.92)	3.4973 ± 0.1045 (0.00-5.32)	12.989**
10 ⁻⁴	2.8820 ± 0.2357 (0.00-6.05)	3.3858 ± 0.1994 (0.00-5.69)	3.1339 ± 0.1550 (0.00-6.05)	2.663 ^{NS}
10 ⁻⁵	1.8698 ± 0.2638 (0.00-6.79)	1.5440 ± 0.2375 (0.00-6.04)	1.7069 ± 0.1774 (0.00-6.79)	0.843 ^{NS}
Overall	2.6278 ± 0.1982 (0.00-5.90)	2.9309 ± 0.1416 (0.00-5.52)	2.7794 ± 0.1219 (0.00-5.90)	1.549 ^{NS}

NS- Non-significant at P<0.05; * Significant at P<0.05; ** Significant at P<0.01; Figures within the parentheses indicates the range values.

Coli form count (CC)

In the present study, all the 100 raw pork samples from Aizawl and 98 samples from Imphal were found to be positive for coliforms. The overall mean CC from Aizawl and Imphal ranged from 0 to 6.28 with a mean value of 5.2727 ± 0.0707 log₁₀cfu/g. The mean value of CC of raw pork were 5.3828 ± 0.0945 log₁₀cfu/g and 5.1627 ± 0.1045 log₁₀cfu/g with a range from 2.33 to 6.28 and 0 to 6.09 log₁₀cfu/g from Aizawl and Imphal, respectively without any significant variation between Aizawl and Imphal (Table 2). The mean value of CC of raw pork between Aizawl and Imphal in different dilutions

showed no significant difference. In a study, Lambey *et al.*, (2016) and Singh *et al.*, (2014) reported the Coliform count of 4.29 and 3.40 ± 0.10 (log₁₀ cfu/g), respectively for pork which was lower than the present study. Nnachi and Ukaegbu (2014) showed a very high Total Coliform Count in raw pork, 9.65±0.10 (log₁₀ cfu/g). The coliforms organisms are considered as primary and most reliable indicator for water quality. So, the presence of coliform in pork denotes the poor quality of water used in dressing and unhygienic environment for selling of pork. The presence of coliform organisms was high in raw pork in Aizawl and Imphal indicating poor hygienic condition of market pork and

water borne contamination in both the places. Bradeeba and Sivakumar (2013) reported that mean Coliform Count increased with the advancement of time from 2.00 ± 0.06 to 5.56 ± 0.016 (\log_{10} cfu/g).

Faecal streptococcal count

The present study indicated that 80 and 97 numbers of raw pork samples from Aizawl and Imphal were positive for the Faecal Streptococcal organisms, respectively. The FSC were found in a range from 0 to 5.90 \log_{10} cfu/g in Aizawl and Imphal with overall mean value of 2.7794 ± 0.1219 \log_{10} cfu/g. The mean value of FSC in raw pork samples from Aizawl was found to be 2.6278 ± 0.1982 with a range from 0 to 5.90 \log_{10} cfu/g whereas the mean value of FSC of raw pork sample from Imphal was recorded as 2.9309 ± 0.1416 \log_{10} cfu/g with a range from 0 to 5.52 \log_{10} cfu/g (Table 3) and there was no significant difference between Aizawl and Imphal at any dilution. Detection of Faecal Streptococci indicated the recent contamination of water by human excreta or faecal materials (Fig. 3).

A great diversity of microbes inhabits in fresh meat generally, but different types may become dominant depending on pH, composition, texture, and storage temperature and transportation means of raw meat (Adu-Gyamfi *et al.*, 2012).

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