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*Research article*

# ASSESSMENT OF MICROBIOLOGICAL QUALITY OF BEEF, MUTTON AND PORK AND ITS ENVIRONMENT IN RETAIL SHOPS IN CHIDAMBARAM, TAMIL NADU.

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**ABSTRACT:** Meat deterioration is one of the main sources of food-borne illnesses, possesing serious challenges in developing countries including India. In this study 75 meat (Beef, pork and mutton) samples were collected from retail shops in Chidambaram. The bacterial load was assessed on the samples collected at regular 3 h (6am-6pm) intervals. Meat and Surface swabs from meat processing equipment and the surrounding environment were analyzed for microbiological contamination. The mean of Total Viable Count, Psychrophilic count, *Pseudomonas*, *Staphylococcus* and *Bacillus* count were analyzed in beef, mutton and pork meat. The mean count of Total viable count was not significantly ($p>0.05$) difference in Beef, Mutton and Pork meat. The temperature and pH of the meat samples ranges from 36.20 to 39.04°C and 5.04 to 6.6. Significantly ($P < 0.05$) decreased the values of physicochemical composition of meat was observed at increase selling time (h). The presence of these organisms is a warning signal for a possible occurrence of food intoxication.
**Keywords:** Meat, contamination, *Pseudomonas sp.* Physicochemical, Intoxication

## INTRODUCTION

Meat has long been known for its nutritive composition which could explain why it is being consumed by many people worldwide. The protein profile of meat consists of amino acids that have been described as excellent due to the presence of all essential ones required by the body. A large proportion of the world's population rely on meat as a source of food. Enteric bacteria species can cause infections in humans when undercooked meat products are consumed [6]. It has also been proved that protein and vitamins (especially A and B12) in meat could not be substituted for by plant sources, further justifying the nutritive importance of the former.

India is the largest producer of animals in the world. India possess 48% though India possess 48% of the world's animal population comprising about 209 million cattle, 92 million buffalo, 121 million goats, 56 million sheep, 16 million pigs and 407 million poultry, it shares less than 1% of world's total meat production. Though 70% of Indian population is considered non-vegetarian, the per capita meat consumption is hardly 2.5 kg/annum due to several seasons. India produces 4.7 million tonnes of meat valued at Rs. 15,500 crores annually, which is only 2.13% of the 221.15 million tonnes of meat produced in the world [15].

Food habits of society have substantially changed due to rapid urbanization and hurried way of living, resulting in increased demand for ready to cook and ready to eat meat products. Consumers have become more selective conscious of quality, concerned about value for money, freshness and health aspects of meat food products [26]. Meat is not only highly susceptible to spoilage, but also frequently implicated to the spread of food-borne illness, various biochemical changes and microorganisms are associated with meat, during the process of slaughter, processing and preservation [25]. Approximately 69% of gram negative bacteria are known to cause bacterial food borne disease [23]. Several researchers have reported that the meats sample were contaminated with high level of Klebsiella pneumoniae, Enterobacter sp, Pseudomonas aeruginosa, E. coli, Salmonella sp, Serratia marcescens and Proteus vulgaris, Staphylococcus aureus and Bacillus sp [23, 6]. On the other hand, food-borne pathogens are able to disseminate from contaminated meat to the surfaces [11] and can spread infections in the community.

Retail shop meat contain higher microbial load because of the large amount of exposed surface area, more readily available water, nutrient and greater oxygen penetration [9].Meat is considered to be spoiled when it is unfit for human consumption. Meat is subjected to changes by its own enzyme, by microbial action and its fat may be oxidized chemically by microorganisms that are grown on the meat causing visual, textural and organoleptic change when they release metabolites [17]**.** According to the International Meat Secretariat Newsletter, (November 30, 2005) it is reported that as the standard of living improves, meat consumption also increases. These increases in meat demands is said to be due to increased urbanization, higher disposable income, and the human desire for a greater variety in their diets [27]. Therefore, the safety of meat has been in the forefront society concerns in recent years and evidence exists that the challenges of meat safety will continue in the future [27]. Consequently it is very important to implement proper hygiene and safety procedures not only during slaughter but also when handling and processing meat.

Therefore, this study was conducted to investigate the microbial quality of raw meat available in common retail shops of Chidambaram, Tamil Nadu. The objective of the study is to determine the hygiene status and to assess the various environmental factors associated with meat shops and spoilage potential of some of these microorganisms. This research is necessary to the public which will create awareness among the consumers.

## MATERIAL AND METHODS

### Sample Collection

This research was conducted in Chidambaram, Tamil Nadu. Meat samples were collected from small retail shops in Chidambaram, Tamil Nadu. Seventy environmental samples were collected according to [20]. From two to five surface swabs were collected from each outlet. Collection was dependent on the size of the premises as well as based on the cooperation of the shop owners**.** Butchers working in these outlets lack knowledge regarding the importance of disinfecting and sanitizing; consequently, they clean their shops once in 24 hours with detergent and water. No sanitizer medium was used before sampling. Environmental samples were taken using sterile swabs in 3 ml of peptone water and transported to the laboratory within one hour, of collection, and processed within two hours [8].

### Sample Preparations

Ten grams (10g) of meat sample was weighed out and homogenized into 90 ml of sterile distilled deionised water using a sterile warring blender. Ten fold dilutions of the homogenates were made using sterile pipettes as described by the methods of [8].

### Microbial analysis

Mean counts of total viable organism, Total visible count, Psychrophilic, Coliform, *Staphylococcus*, *Pseudomonas* organism and also the detection of Bacillus were determined in the collected samples by the method described by [3] Total viable aerobic bacteria count was performed on Nutrient Agar .Mac Conkey agar was used for coliform enumeration while Mannitol salt agar was used for the isolation of *Staphylococcus aureus*.*Salmonella spp* on Salmonella-Shigella Agar, *Pseudomonas spp* on Cetrimide Agar E.coli on Eosin methylene blue were utilized for the assessment of microbial quality.

### Identification of the isolates

Pure colonies were obtained by repeated streaking in the media and were characterized based on biochemical tests. The biochemically characterized isolates were identified based on Bergeys Manual of Determinative Bacteriology [13].

### Proximate and chemical composition of meat

The pH of meat was determined using a pH meter. Water holding capacity was determined filter paper press [18]. Protein content of the meat samples was determined by Kjeldahl method according to [1]. Crude lipid was determined by the procedure of [4] and expressed as (%) using the formula ¼ amount of lipid extracted (g)/weight of original sample (g) × 100.Total volatile basic nitrogen (TVB-N) was determined by the Convey micro-diffusion method according to the methods of [7] and expressed as mg N-100 $g^{-1}$ meat.

## RESULTS AND DISCUSSION

### Contaminated meat products

The main objective of the study was to isolate and identify bacterial pathogens in raw meat samples that were bought from some randomly collected from some retail shops in Chidambaram, Tamil Nadu. Out of the 75 meat samples examined, 45.3% of them were contaminated as presented in table 1.

**Total bacterial count on meat and environmental samples**

Table 2 show the potential pathogens in the surrounding environment and surface of retail shops were also examined. High viable counts and the presence of potential pathogens on meat (7.32) and meat-processing equipment followed by Knives, Wooden boards, and weighing scales were observed. Surface swabs from environment floors, walls and Customer platforms of retail shops, represent their environmental hygiene status. The presence of bacteria in meat has been widely reported from different parts of the world [12, 19].

**Table 1 Percentage of contaminated meat products**

| Sources of meat sample | Total Number of sample | Contaminated Sample |
|---|---|---|
| Beef | 25 | 18 |
| Mutton | 25 | 9 |
| Pork | 25 | 13 |
| total | 75 | 34 |

In the early survey meat processing and packaging at the wholesale or retail levels are likely to contribute to the higher levels of contamination in minced beef and pork products compared [29] to beef and pork carcasses. The presence of bacterial pathogens in meat-processing equipments and associated surfaces may contribute to the contamination of meat. On the other hand, food-borne pathogens that are able to disseminate from contaminated meat to such surfaces [11] can spread infections in the community

In this study, meat surface showed high viable bacterial counts compared to environmental surfaces sample of retail shops were also examined. Gram-negative and gram positive bacteria such as *Pseudomonas aeruginosa* 38 (50%), *Proteus mirabilus* 30(40%), *Bacillus cereus* 25(33%), *Salmonella sp*. 24(32%), *Klebsiella pneumonia* 21(28%) *and E. Coli* 18(24%) predominantly constituted the total viable count, whereas frequently observed bacteria included *Aeromonas* sp. 16 (21%), *Staphylococcus aureus* 8(10%) and *Acinobacter* 7 (9.3%). The findings of this study also agrees with a research work conducted by [2,14] that the dried meat samples were contaminated with microorganisms despite of the dried and hard texture of the meat .

**Table 2 Total bacterial count on meat and environmental samples of retail shops in Chidambaram, Tamil Nadu**

| Samples | Sample type | Total viable count (log of CFU/g or cm2) | | |
|---|---|---|---|---|
| | | Beef | Mutton | Pork |
| Surface swabs from meat cutting equipments | Meat | 7.32± 0.21$^{c}$ | 5.05± 0.15 $^{a}$ | 5.89± 0.17$^{b}$ |
| | Knives | 2.23± 0.06 $^{c}$ | 1.05± 0.03 $^{a}$ | 2.00± 0.06$^{b}$ |
| | Weighing scales | 0.81±0.02 $^{c}$ | 0.52±0.01 $^{a}$ | 0.64±0.01$^{b}$ |
| | Wooden boards | 2.89±0.08 $^{a}$ | 2.04±0.06 $^{a}$ | 2.05± 0.06$^{b}$ |
| Surface swabs from environment | Floors | 1.10±0.03$^{b}$ | 1.03±0.03 $^{a}$ | 1.01± 0.03$^{a}$ |
| | Walls | 1.89±0.05 $^{b}$ | 1.67±0.05 $^{a}$ | 1.70± 0.05$^{a}$ |
| | Customer platforms | 1.01±0.03 $^{c}$ | 0.70±0.02 $^{a}$ | 0.90±0.02$^{b}$ |
| | 12 inch long Steel meat anchors | 2.50±0.07$^{a}$ | 2.00±0.06 $^{a}$ | 2.15± 0.06$^{a}$ |

Means ± SE. Means with different superscript letters (a, b and c) within the same rows indicate significant differences (P < 0.05).

## Bacterial mean count of meat

In this study, beef showed high general viable counts(5.01-8.61 logcfu $g^{-1}$), whereas the other two meat products showed comparatively low general population count as indicated in table 3. In contrast to finding of presented study [16] reported a mean total viable count of 7.47 log organism $g^{-1}$ in minced beef. [30] reported similar result in pork sausages with the mean total viable count of 4.5 log organism $g^{-1}$. Furthermore, [21] also reported a significantly higher mean total viable count in minced sheep meat. However, in the presented study there was significant difference between beef and mutton products as well as between Beef and pork products. coliform count between 3.03-6.15 $\log_{10}$ cfu $g^{-1}$. In spite of this mean coliform counts of all the products assessed in this study were well within the maximum permissible limit of 2.69 log organism per gram as proposed by [10].Moderate count of Psychrophilic followed by *Pseudomonas sp.* and *bacillus sp.* were noted. Significant differences ($p>0.05$) were observed between samples for total viable counts, coliform and Psychophilic from 6: am to 6: pm.

**Table 3 Bacterial mean count of meat analysed at different times**

| Type of organism | Meat product | Different sampling time | | | | |
|---|---|---|---|---|---|---|
| | | 6a.m | 9a.m | 12a.m | 3pm | 6pm |
| TVC | Beef | 5.01± 0.15a | 5.20± 0.15 b | 6.45± 0.19 a | 7.53± 0.22 b | 8.61± 0.25 c |
| | Mutton | 4.90± 0.14 a | 4.57± 0.13 a | 5.35± 0.16 a | 6.23± 0.18 a | 7.08± 0.21 a |
| | Pork | 4.45± 0.13b | 5.01± 0.15 b | 5.94± 0.17 b | 6.33± 0.18 a | 7.54± 0.22 b |
| Psychrophilic count | Beef | 2.43± 0.70 b | 2.57± 0.07 c | 3.32± 0.09 c | 4.00± 0.12 c | 5.47± 0.16 a |
| | Mutton | 1.50± 0.04 a | 1.84± 0.05 a | 2.10± 0.06 a | 3.04± 0.09 a | 3.99± 0.11 c |
| | Pork | 1.67± 0.05 a | 2.00± 0.06 b | 2.92± 0.08 b | 3.52± 0.10 b | 4.17± 0.12 a |
| Coliform count | Beef | 3.03± 0.09c | 3.50± 0.10 c | 4.25± 0.12 c | 5.37± 0.16 c | 6.15± 0.18 c |
| | Mutton | 1.60± 0.04 a | 1.78± 0.05 a | 2.67± 0.08 a | 3.00± 0.09 a | 4.06± 0.12 a |
| | Pork | 2.00± 0.06 b | 2.80± 0.08 b | 3.75± 0.11 b | 4.51± 0.13 a b | 5.53± 0.16 b |
| Pseudomonas Count | Beef | 1.38± 0.04 c | 1.99± 0.05 b | 2.68± 0.08 b | 4.91± 0.14 c | 5.38± 0.16 c |
| | Mutton | 1.02± 0.03 b | 1.55± 0.04 a | 1.94± 0.05 a | 2.19± 0.06 a | 3.02± 0.09 a |
| | Pork | 1.12± 0.03 a | 2.02± 0.06 b | 2.61± 0.07 b | 3.02± 0.09 b | 3.77± 0.11 b |
| Bacillus count | Beef | 1.22± 0.03 b | 1.90± 0.05 b | 2.37± 0.07 c | 3.78±0.11 c | 4.14± 0.12 c |
| | Mutton | 1.01± 0.03 b | 1.48± 0.04 a | 1.91± 0.02 a | 2.15± 0.06 a | 2.97± 0.08 a |
| | Pork | 1.00± 0.03 a | 1.50± 0.04 a | 2.23± 0.06 b | 2.98± 0.08 b | 3.12± 0.09 b |

Means ± SE. Means with different superscript letters (a, b and c) within the same rows indicate significant differences ($P < 0.05$).

## pH and temperature of meat

The mean value of temperature and pH of meat products such as beef, mutton and pork at various times are presented in Fig 1. The temperature range from 36.20 to 39.04; and the pH values ranged from 5.20 to 6.70 with a mean value of 5.95.Our findings show that the lowest pH was recorded, when the sample are placed at the highest temperature. [22] reported the to increased meat pH above critical range of 5.5 to 6.0 in the meat product. There was a significantly different both 5% and 1% level of mean temperatures at 6: am and 9: am, concerning the pH, significant differences ($p<0.05$) was observed from 9: am to 6: pm.

## Chemical and physical characteristics of meat

Proximate compositions of meat product are given in Fig 2. The mean value of WHC, protein and fat in beef was found to be 74.90-73.01, 16.94-16.05 and 2.67-2.12 respectively. In general values of samples found in beef samples were higher compared to Pork and mutton. A significant reduction in the protein, and fat content was observed in beef product which is according to [31]. This present study also identified to the decreasing moisture content between 74.90-73.01 per cent. Previous reports by [2] haves showed that meat loses its moisture content on drying resulting increase in the concentration.

Changes in TVB-N were determined to investigate the effect of different sampling time on the chemical quality of meat products and the results are presented in table 4. The initial TVB-N value of beef was 10.84-13.32 mg N/100 g and at the end of selling time these values increased to 11.03-13.3. Significant (P > 0.05) differences were observed in TVB-N values for beef, Pork and mutton.

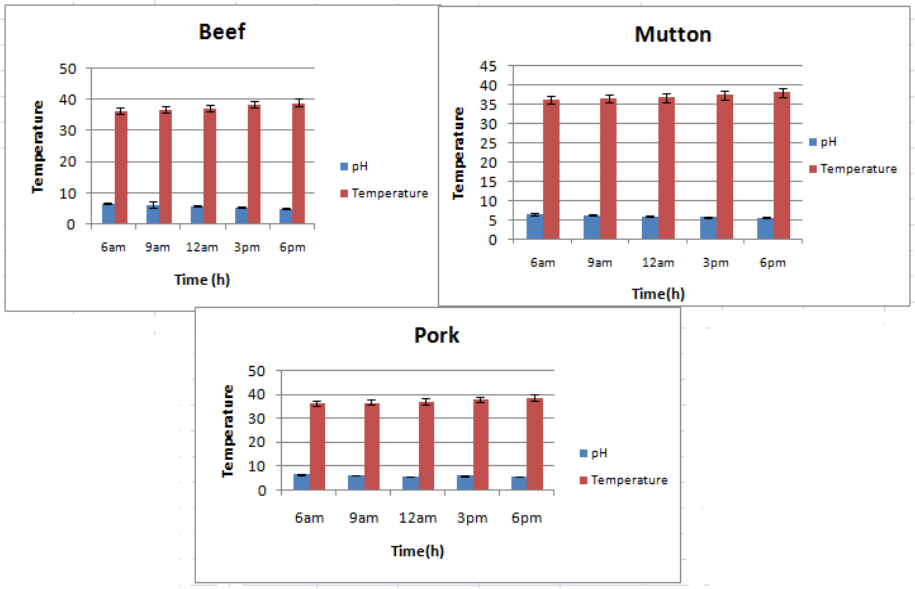


**Figure 1 pH and temperature of meat at different sampling times.**

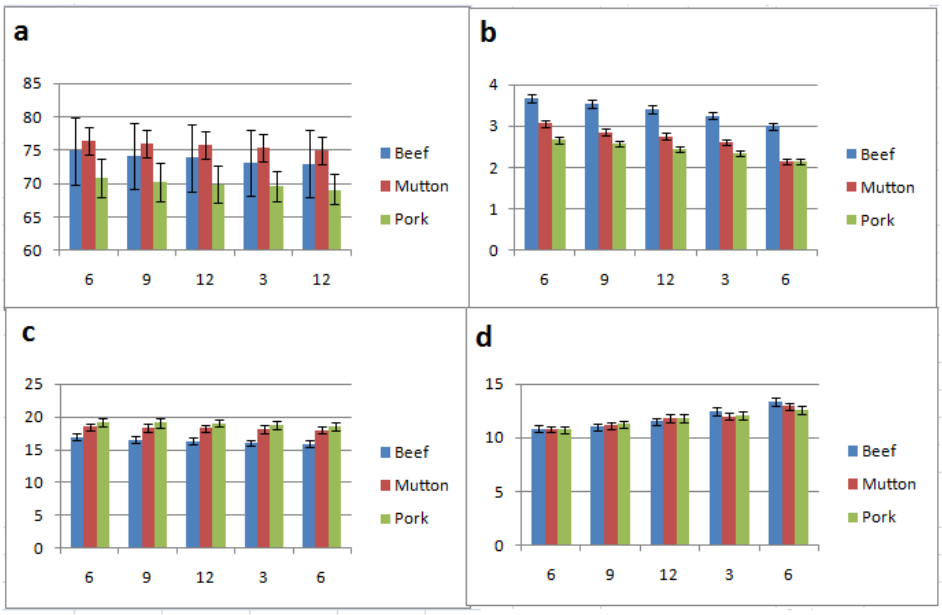


**Figure 2 Chemical and physical characteristics of meat analysed at different times**

(a)Water holding Capacity (b) fat (c) Protein(d) TVBN Values are a mean of three replications. Error bars indicate the minimum significant difference ((P < 0.05)) for comparing on each sampling time.

## CONCLUSION

This study concluded that both pathogenic and non-pathogenic enteric bacteria species were isolated from meat. Microbial contaminants in the retail meats (Beef, Mutton and pork) need to be taken care of for prevention of health hazards of the consumers by adopting proper sanitation, storage and retail practices. These contaminants not only hint the health hazards to indigenous consumers and to visitors to consumption of such meat beef, mutton and pork. The scientific community should join regulatory authorities to spread awareness about basic hygiene principles. It is especially important to provide training to meat handlers regarding food safety.

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