



UNIVERSITI PUTRA MALAYSIA

**A STUDY ON THE HYGIENIC QUALITY OF BEEF PURCHASED
FROM THE LOCAL MARKETS**

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BY

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**THIS ANIMAL INDUSTRY PROJECT PAPER IS PRESENTED
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ABSTRACT

An investigation was conducted for the hygienic quality of fresh, chilled and frozen beef sold in open markets and supermarkets in the Kuala Lumpur and Petaling Jaya areas. The meat samples were analysed for the presence of microorganisms. The results showed that there were a considerable high counts of bacteria in all the three kinds of meat samples, although there were no visual sliminess and off-odour changes.

The range of counts fell between 10^2 and 10^6 cells per gram. Fresh beef from the open markets has the highest average number of Total Bacterial Count ($27.33 \times 10^6/g$), Total Coliform Count ($21.90 \times 10^6/g$), and Staphylococcus Count ($4.33 \times 10^2/g$). The supermarket beef showed that chilled beef had the highest average Total Bacterial Count ($8.86 \times 10^6/g$), Total Coliform Count ($1.99 \times 10^6/g$), Psychrophillic Count ($8.87 \times 10^4/g$), and Staphylococcus Count ($1.14 \times 10^2/g$), compared to the frozen beef : $1.30 \times 10^6/g$, $0.50 \times 10^6/g$, $6.03 \times 10^4/g$, $0.44 \times 10^2/g$ respectively.

Thus, in general, hygienic practice was not strictly observed by the retailers, either from the open markets or supermarkets which resulted in the high counts. Nevertheless, no Salmonella species and coagulase-positive Staphylococcus aureus were detected from all the meat samples.

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INTRODUCTION

Since time immemorial, the hygienic quality of meat and meat-products has been the basis of problems of protecting meat quality and public health. The nature of these contaminants, microenvironment of the meat and time span for action determine their fate.

With the rapid increase in urban population and living standards in Malaysia, there is a greater demand for meat. Malaysia import a major bulk of meat from Australia, New Zealand and India whilst the remainder is obtained from the various local abattoirs. The imported meat which are normally frozen and chilled are distributed by major, established companies to supermarkets whereas meat from the abattoirs are distributed to small retailers from open markets. Some retailers obtained fresh meat from cattle slaughtered in private homes.

Industrial meat processing in Malaysia is still in its infant stage and majority of the consumers still prefer fresh meat. More often than not, however a portion of the purchase meat is either chilled or frozen for later consumption, which can be served in various manner.

To date, little attention has been focused on the hygienic quality of fresh, chilled and frozen meat. Therefore, this investigation was conducted to determine the microbiological quality of fresh, chilled and frozen beef, with emphasis on the detection of Salmonella species and Staphylococcus aureus. Also, to study the effect of handling and storage technique on the quality of marketed beef.

LITERATURE REVIEW

According to Holland (1979), quality standards for meats at retail may be categorized as sensory attributes and chemical and microbiological criteria. Sensory quality standards may include appearances, such as colour, size, shape; kinesthetics—such as texture, mouthfeel, consistency—viscosity and flavour senses, that is taste and smell. Sensory attributes are buyer-seller specifications; thus are ultimately valuable purchasing tools of the consumer.

Chemical standards include protein content, moisture, fat, salt, nitrites. Frequently, chemical standards are buyer-seller specifications or an internal manufacturing specification. In all instances, chemical quality standards are relatively static figures, that is within experimental error, the result of analyses are the same throughout the entire food chain.

The third type of quality standards is microbiological. The rationale for this standard is the significance of microorganisms in foods; they are a source of spoilage and product loss and they are causes of some foodborne epidemics. Microbiological standards may be internal, store standards or buyer-seller specifications; or they may be federal regulations.

It is widely recognized that microbiological assays have large natural variances, strictly due to the biological distribution of bacteria and analytical techniques. Corlett (1974) and Hill et al (1975) reported that it is not uncommon to encounter a 10-fold variation for replicates. Thus, it is frequently suggested that only a difference in excess of 10-fold is significant.

In a report by Nortje and Naude (1981), the first signs of putrefaction begin to appear when the bacterial counts reach 10^7 /g of

meat. The initial number of organisms in muscle tissue, immediately after slaughter has been found to be 0.1 or 0.01 per gram (Ingram, 1972). When the number of bacteria on the surface of chilled carcasses reaches a count of 5×10^7 to 10^8 per square cm., the meat develops an off-odour, discolours and finally the surface becomes sticky or slimy (Baltzer, 1969). The initial microbial count, therefore, generally greatly influences meat shelf-life (Ingram, 1972).

The Aerobic Plate Count (APC) has been used as a means of measuring the composite microbiological population before the onset of organoleptic deterioration (Holland, 1979).. However it needs to be defined carefully to account for the effects of processing, preservation and packaging. With fresh meat, when applied where numbers are not well correlated with quality, the APC has little use. High APC for aged beef do not indicate a potential health hazard or poor sanitation or handling violations. According to Foster (1974), Goepfert (1975) and Hill et al. (1975), APC of 5×10^6 or 10^7 per gram are neither quality nor hazard criteria. The APC does not provide differentiation, (i.e. cause-effect relationship), between the organoleptic acceptance and non-acceptance of processed meats. Nor do APC necessarily reflect product deterioration as determined by microbiological quality (Holland, 1979), Hill et al. (1976) found that an APC standard of 10 per gram would cause premature removal from the marketplace of a very large percentage of luncheon meats which are wholesome and consumer-acceptable.

Although we generally recognize that pathogens should not be tolerated in foods, even this statement must be considered in the light of practical experience. For fresh meats, a no tolerance level of Salmonella is not feasible because sampling techniques automatically involve certain tolerances, determined by sample size and sensitivity of method (Holland, 1979).

It is not yet commercially possible to market some foods in a condition that approaches the absence of pathogens. For example, most meats contain Salmonella at relatively high frequency and no immediate solution is in sight. A sampling plan adjusted to this situation would be more realistic and satisfactory than one based on an immeasurable ideal of complete absence (International Committee of Microbiological Standards. 1973).

Salmonella contamination of meat cannot be condoned because of the direct hazard to the health of consumers and indirectly by cross-contamination of all other meats in the butchery and its equipment (Meara et al. 1977). In the same year, he reported that, of the 244 carcasses sampled, 0.4% was positive for Salmonella. The serotypes (and number) isolated from beef samples were Salmonella london (6); Salmonella st. paul (5); Salmonella johannesburg (3); Salmonella typhimurium (3); Salmonella dublin (1); Salmonella poona (1); Salmonella sarajane (1).

Staphylococcus aureus cannot altogether be excluded from meat. Jay (1961) have shown that Staphylococcus aureus strains exist on almost every object and in most environments where man and certain animals exist. The organism is widely carried by many normal persons in the nasopharynx and on the skin and in septic foci like boils, carbuncles and skin infections. It is also common in animals on the skin and in wound infections and in the bovine udder. Therefore, a small number of Staphylococcus aureus in meat have to be tolerated because of the difficulty of excluding this form of contamination (Foster 1975). Meara et al. (1977) reported that 16% of 244 beef carcasses sample carried Staphylococcus aureus in excess of 100 organisms per gram. In another report by Nair et al. (1983), out of the 11 quarters of buffalo carcasses examined, 8 contained coagulase-positive Staphylococcus aureus and of the 115 isolates of Staphylococcus aureus subjected to coagulase test, 70 numbers gave a positive reaction.

Thus, in a statement by Ingram and Kitchell (1970), they stated that freedom from pathogens is the aspect which is usually paramount in the international discussion about microbiological standards. There is the implication of the intention by some public health authority, to use the standards statutorily to exclude foods which fail to comply. For commercially relevant quantities of material, absolute absence is a condition which neither can be attained by, nor verified by any practical means.

MATERIALS AND METHODS

A. Description of the open markets and supermarkets

The open markets studied include Chow Kit market and Sungei Besi market, whilst the supermarkets include City Chemist and Hock Choon supermarkets in Kuala Lumpur and Jaya and Asia Jaya supermarkets in Petaling Jaya. These markets open daily; the open markets from 6.00 a.m. to 6.00 p.m. whereas the supermarkets from 9.00 a.m. to 9.00 p.m. These markets are usually located in the central part of the city and some small towns.

At the Chow Kit market, meat sellers have crudely built stalls, arranged in several straight rows and the ground is cemented and surrounded with small drains littered with refuse; while nearby some stalls, they are provided with bins overflowed with garbage. To reach these meat stalls, one has to wade through wet, dirty grounds where mainly fish and vegetable stalls are being set up.

On the otherhand, the supermarkets are located in strategic areas, and car parks are provided for ease of parking. The condition in all supermarkets are better cleaner, neater, tidier and drier than the open markets.

B. Purchased of beef samples

Fresh beef samples were purchased from the open markets whilst chilled and frozen beef samples from supermarkets.

The fresh samples were wrapped in a plastic sheet, already attached to newsprint or newspaper and placed in a plastic bag. Likewise, with the chilled and frozen samples bought from Jaya and Asia Jaya supermarkets. Samples from the other two supermarkets were ready-packed, labelled with the name of the market and part of the meat

Samples were placed in flasks containing ice and rushed to the laboratory with minimum delay to avoid further proliferation of the organisms. The frozen samples were thawed overnight in the cold room at 7°C.

C. Preparation of meat homogenate

Methods of isolation and enumeration of the microorganisms present in all non-liquid foods usually require preliminary treatment of meat samples to release into a fluid medium those microorganism which may be embedded within the meat.

Into a sterilised, empty jar (blender) 50 g. of meat sample was placed. 450 ml. of Peptone Dilution Fluid was added to the blender jar which provided a dilution of 10^{-1} . The meat was blended for two minutes at high speed and then diluted promptly. The mixture was allowed to stand for 10 minutes for foam to disperse. Then 1 ml. of the homogenate was pipetted into 9 ml. dilution blank (as 10^{-2} dilution). Then, the 10 ml. suspension was aspirated ten times with a sterilised pipette. The process was repeated to give subsequent dilutions until 10^{-6} dilution.

D. Microbiological assays

The meat samples (seven of each kind) were assayed by procedures recommended by the American Public Health Association (APHA, 1976), with the following modifications. Violet Red Bile Agar (Difco, 1974) was used for enumeration of coliform and the plates were incubated at 37°C for 24 hours. Mannitol Salt Agar was used for the enumeration of Staphylococcus species. Plates for Psychrophillic count were incubated at 7°C for seven days.

E. Statistical Analysis

These statistical values and significance were obtained using the Duncan's new Multiple Range test: P less than 0.05.

RESULTS

Table 1 shows the comparative summary of the occurrence and variation in colony counts in different types of beef samples. It can be seen that all the three kinds of samples had considerably high counts in especially the Total Bacterial Count and Total Coliform Count. The Total Bacterial Count and Total Coliform Count for both the supermarkets and open markets is 10^6 /g of beef whilst the Psychrophillic Count is 10^4 /g and Staphylococcus Count is 10^2 /g of beef. Open markets fresh beef had the highest number per gram of beef, averaging about 27.33×10^6 (Total Bacterial Count); 21.90×10^6 (Total Coliform Count); and 4.33×10^2 (Staphylococcus Count). The supermarket counts showed chilled beef had the highest count: 8.86×10^6 /g (Total Bacterial Count), 1.99×10^6 /g (Total Coliform Count), 8.87×10^4 /g (Psychrophillic Count) and 1.14×10^2 /g (Staphylococcus Count), compared to frozen beef, which had counts of 1.30×10^6 /g, 0.50×10^6 /g, 6.03×10^4 /g and 0.44×10^2 /g respectively.

There was no significant difference found in the counts of fresh and chilled; chilled and frozen under Total Bacterial Count, but there was significant difference between fresh and frozen. Under Total Coliform Count, there were significant differences between fresh and chilled, and fresh and frozen. Likewise for the Staphylococcus Count where there were significant differences between fresh and chilled, and fresh and frozen. Under psychophillic count, there was significant difference between chilled and frozen.

However, Salmonella species and coagulase-positive Staphylococcus aureus were not detected in all the beef samples.

Table 1. Comparative summary of the variations in colony counts in different types of beef.

| Average no. of counts per gram of beef | Sample type | | |
|---|-------------|---------|--------|
| | Fresh | Chilled | Frozen |
| Total Bacterial Count ($\times 10^6$ /g) | 27.33 | 8.86 | 1.30 |
| Total Coliform Count ($\times 10^6$ /g) | 21.90 | 1.99 | 0.50 |
| Staphylococcus Count ($\times 10^2$ /g) | 4.33 | 1.14 | 0.44 |
| Psychophillic Count ($\times 10^4$ /g) | not done | 8.87 | 6.03 |

The average values obtained for each kinds of beef samples were from 7 samples tested.

DISCUSSION

All of the open markets had one thing in common, that is, the meat was not covered and placed on crudely-made chopping boards. Some of the meat were hooked above the table. At one stall in Sungei Besi market, there were considerable number of flies settling on the meat chunks. Also common with all the open market fresh meat sellers was the way they fumbled with the meat chunks at the arrival of a prospective customer. The pieces were handled with bare hands, placed on the table to show a different view, rolled again on the table to achieve the same purpose and sometimes tossed. The customer in turn did the same thing to verify the worthiness of the meat for the price.

In contrast, the chilled and frozen beef from supermarkets were placed in chillers and freezers respectively. In supermarkets from Petaling Jaya, beef to be purchased was handled with bare hands but in one supermarket, gloves were used. The beef samples from supermarkets in Kuala Lumpur were ready-packed.

The high recorded counts: total bacterial and total coliform counts in especially the open markets, 27.33×10^6 /g and 21.90×10^6 /g of beef, could be accounted for partly by extrinsic factors which include the methods of transportation of beef to markets; tables, knives and chopping boards used in the markets and the unhygienic habits of some of the retailers. Growth exposure in the open markets may also contribute to the high counts.

Nevertheless, the same observation may be true for chilled and frozen beefs from supermarkets in Petaling Jaya, where retailers had handled the beef bare-hands, using the same knives and chopping boards each time beef was purchased. Thus, the larger the bacterial count, the greater is the possibility of pathogens being present and the poorer the

keeping quality of the end-products with expectancy of spoilage loss. Nottingham (1971), suggested a limit of 10^4 /g initial count of carcass after slaughter and of 10 /g for carcasses after processing. Ayres (1963), stated limits in saleability of meat are associated with counts of $5-6 \times 10^7$ /g. According to the Australian Meat Board (1969), a count of 10^6 microorganisms/g was considered excessive for quality meat. The bacterial level at which decomposition changes may become evident to the human senses is usually from 10^6 /g upwards (Paul, 1963).

Equally, a high coliform count could indicate the poor sanitary quality of the meat. This is in accordance with a report by Meara et al. (1977) which stated that the coliform counts served as a useful indicator organisms of unhygienic food handling practices.

Psychrophillic counts in chilled and frozen samples could be considered low, in contrast with a report made by Mohd Ismail and Yu (1980) that the count as $147.8-1746 \times 10^3$ /g of beef. Although many psychrophillic bacteria are not harmful, they can cause spoilage of meat held under refrigeration (Gill and Newton, 1977). During frozen storage, there is a reduction in growth of viable bacteria and microbial death is slowed down (Roberts, 1973), and frozen meat are thawed before they are cooked. Thus, the thawing process is important as it may encourage the growth of spoilage and food-poisoning bacteria. It has been known that thawing of frozen meat under cool conditions is preferred to warm conditions to minimise the growth of undesirable bacteria (Mohd. Ismail and Yu, 1980). Therefore, the considerable high total bacterial and total coliform counts in frozen samples could probably resulted from thawing under tap water which is a good medium for bacterial growth and proliferation.

Failure to isolate any Salmonella species could probably be due either to the degree of contamination from handlers and other associated equipment were negligible so much so that Salmonella species was unable to be isolated during laboratory process or that the sample size was too small and method employed was insensitive.

Although, coagulase-positive Staphylococcus aureus was not detected, the levels of contamination might indicate some degree of unhygienic meat practice and defective hygiene of plant personnel (Meara et al. 1977).

CONCLUSION

In conclusion, this study showed that there was a considerable high counts of microorganisms in all the beef samples, especially the total bacterial and total coliform counts. This probably indicate that hygienic practice was not strictly observed. Nevertheless, it is safe to consume the meat but with proper cooking so as to eliminate the food-poisoning and other undesirable bacteria.

RECOMMENDATIONS

The microbiological quality and shelf-life of especially fresh beef can be improved by observing plant and personnel hygiene, regardless of time and place. This would include industry awareness and education of pertinent workers in hygienic handling of meats which will provide optimal quality of meat throughout the entire meat chain.

The public health officers from the Ministry of Health should make frequent and surprise visits to various markets in order to see that retailers observed the rules and regulations implemented by the Government and any foul-play by the retailers, their licence should be suspended.

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