PUBLIC HEALTH IMPACT OF POST-HARVEST CONTAMINATION OF BEEF CARCASSES SOLD AT BUTCHERS MEAT STALL

M. M. Khatun, M. A. Islam, M. M. Rahman and M. A. Rahman

[1]*Department of Microbiology and Hygiene, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh*

Abstract

To assess the extent of microbial contamination of beef carcasses dressed by butchers at slaughter yards and retail sales, meat samples collected from beef carcasses of meat stalls at BAU Campus and Mymensingh town were examined. The higher counts obtained in thigh muscle can be attributed to possible chances of more exposure to contamination from the feet and viscera. It is observed that equipment, working tools and other meat hygiene practices such as washings of carcass with water could introduce microorganisms during slaughtering, skinning, washing and dressing of carcasses .It is interesting to note that maximum microbial load of air was found at the location where customers usually stand to purchase retail cuts of meat. The highest contaminants with microbes were obtained during peak selling period between 10 a. m. to 11 a. m. The most commonly isolated organisms were *Staphylococcus* sp. 36.12% followed by *Streptococcus* sp.15.26%, *Bacillus* sp.12.71%, *Micrococcus* sp.11.23%, *Escherichia coli* 10.28%, *Proteus* sp. 5.24%, *Pseudomonas* sp. 3.56% and *Enterobacter* sp.3.25%.The-post-harvest contamination in meat samples with Coliform and Staphylococci at the present level presents potential hazard and alarm to public health. Improving slaughter hygiene and introduction of effective meat inspection programs are indispensable and urgently needed to maintain safety and wholesomeness of meat foods.

Introduction

Meat as a protein although provides an excellent source in human nutrient, but if unhygienically produced can serve as a common source of pathogens and may propagate to people via the "contamination chain". The important contamination comes from external sources during bleeding, handling and processing. The exterior of the animal harbors large numbers of diversified microorganisms from soil, water, feed, and manure, as well as its natural body surface and the intestinal contents. Knives cloths, air, hands and clothing of the workers can serve as intermediate sources of contaminants. During handling of the meat, contamination can come from carts, boxes, or other containers (Frazier and Westhoff, 1995). Special equipment such as grinders, sausage, stuffers casings, and ingredients in special products e.g. fillers and spices may add undesirable organisms in appreciable numbers. Unfortunately in Bangladesh, the consumers due to unawareness and lack of non-enforcement of legislation are the potential danger of having contaminated meat. The present study was therefore, undertaken to find out the

sources and extent of microbial contamination of beefs obtained from butcher's meat stall, which may likely to be a health hazards, when it entered into the food chain.

Materials And Methods

Preparation of meat samples and examination for bacteriological studies

The different samples for bacteriological examination were as follows:

1. Sample from air
2. Raw meat samples
3. Samples collected from carcass rinses and washes
4. *Samples from air*: To determine the evidence of bacterial pollution in the air of the meat market, petri-dishes of 110 mm diameter containing nutrient agar were kept at three different places of the sale corner, where the butchers usually prepare retail cuts and sells these to the consumers. The lids of the petri-dishes were made open at the selling period beginning from 8.00 am to 12.00 noon. The plates were exposed to the air for a period of five minutes.

The perti-dishes so exposed to the air of the meat market were later transported to the laboratory and kept in the incubator at 32^0C for 24 to 48 hours. After incubation the colonies developed on the media were counted with the help of a colony counter.

1. *Raw meat samples:* Raw meat samples of beef carcasses were collected directly from the retail hanging display of butchers.

Quantities of about 500 gm of meat cut samples were collected from the different regions of the carcass, such as thigh, chest, neck, and forelimb regions. Individual sample is minced and a quantity of 50 gm was transferred into sterile containers containing 450 ml of 0.1% peptone water. A homogenized suspension was made in a sterile blender and 1:10 dilution of the samples was obtained. Later on using whirly mixture machine different serial dilutions ranging from 10^{-2}–10^{-6} were prepared according to the recommendation of International Organization for Standardization (ISO, 1995).

In another experiment, fresh meat samples were collected at different market hours. All these samples were subjected to bacteriological analysis such as determination of total viable count (TVC), total coliform count (TCC) and total staphylococcal counts (TSC). In case of TVC, TCC and TSC, Plate count agar, MacConkey agar, Staphylococcal media no. 110 were employed, respectively.

2. *Carcass rinses ad washes:* All the equipment and instruments used by butchers were kept immersed in sterile diluent, which was taken in a sterile container. These were rinsed and washed. Washing materials (10 ml) was introduced into 90 ml of the diluent, which were then considered to be 10^{-1} dilution. Serial decimal dilutions were prepared as required and transferred on Plate counts agar and MacConkey agar. The count represents per milliliter of washings.

In case of hand washing, samples were taken from two groups of butchers, one who take general hygienic measures and the other, who were indifferent to take hygienic measures. In each caseses, three samples were taken before beginning, at the peak hour and at the end of the work. The washed samples were obtained by allowing the butchers to wash their hands by rinsing in 500 ml of water.

In case of carcass washing, rinses and washes of carcasses were collected in the abattoir. The water used for rinsing and washing was municipal supplied tap water.

Isolation and identification

The isolates were identified on the basis of morphology, cultural characteristics and biochemical properties as described by the ISO, (1995); ICMSF, (1982) and Cowan, (1985).

Results And Discussion

The results as evidenced in Table 1 show the TVC, TCC and TSC of samples from beef carcass regions or sites, such as brisket, neck and thigh. The average values per gram of meat samples as found in these sites are log 5.65, log 2.66, log 3.26 and log 5.37, log 2.17, log 2.76 and log 6.31, log 3.17 and log 2.41 in brisket, neck and thigh regions, respectively.

Table 1. General viable counts of selected microbial groups contaminating meats of different regions of beef carcasses

Region of carcasses	**TVC**			**TCC**			**TSC**		
	Max	**Min**	**AV**	**Max**	**Min**	**AV**	**Max**	**Min**	**AV**
Brisket	6.27	5.03	5.65	3.00	2.32	2.66	3.86	2.66	3.26
Neck	571	5.03	5.37	2.50	1.84	2.17	3.20	2.32	2.76
Thigh	6.61	6.01	6.31	3.41	2.94	3.17	2.97	1.85	2.41

TVC: Total viable Count TCC: Total Coliform Count; TSC: Total Staphylococcal Count

* All counts are expressed in logarithms

The higher counts are obtained in thigh muscle, which is thought to be due to possible chances of more exposure to contamination from the feet and viscera. During dressing operations and inappropriate handling of beef carcasses the thigh regions had more chance to get contaminated with the vicinity of visceral cavity, as a result the organisms from these sources could have gained accesses to yield higher counts in the samples. Borse *et al.* (1998) found greater initial bacterial counts in the brisket and neck regions. Robert *et al.* (1980); Johanson *et al.* (1983); Charlebois *et al.* (1991); Perieto *et al.* (1991); Zeleke *et al.* (1994); Untermann *et al.* (1996) made similar views. They designated brisket and thigh as most contaminated sites and pointed out the indications of improper slaughter hygiene and operations and faulty meat handling and evisceration techniques.

Table 2 represents bacterial counts per ml of water of hand washings, instrument washings, carcass washings, meat from retail cuts, and table scraps rinses.

Unsanitary equipment provides a second source of contamination. Equipment become dirty when these were of poor designs and difficult to sanitize adequately. It is observed

from Table 2 that equipment, working tools and other meat hygiene practices such as washing of carcass with water can introduce microorganisms during slaughtering, skinning, washing, and dressing of carcasses.

The investigation further revealed that the working surfaces or platforms of butchers preparing and selling meat in retail markets could be abodes of microorganisms where maximum microbial density is detected. The average microbial load per ml of

Table 2. Microbial agents from different sources contaminated beef carcasses

Nature of sample	Unit measure ment	TVC			TCC			TSC		
		Prior to work	Peak hour of work	End of the work	Prior to work	Peak hour of work	End of the work	Prior to work	Peak hour of work	End of the work
1. Hand washings	Per ml	5.16	5.65	5.45	4.19	3.32	2.31	3.69	3.87	3.67
2.Instruments washings	Per ml	6.00	5.65	4.03	3.67	3.41	3.70	3.89	4.25	4.29
3. Carcass washings	Per ml	5.74	–	–	4.58	–	–	3.38	–	–
4. Meat from retail cuts	Per gram	5.1	5.0	4.5	1.85	2.61	2.52	2.30	2.70	2.73
5. Table scraps rinses	Per ml	4.29	5.10	4.50	1.51	1.61	1.44	3.89	5.23	5.61

TVC: Total Viable Count; TCC: Total Coliform Count; TSC: Total Staphylococcal Count

* All counts are expressed in logarithms

Butcher hand washings, instrument washings, carcass washings, meat from retail cuts an table scraps rinses obtained from beef carcasses were log 5.42, log 4.22, log 5.74, log 4.86 and log 4.96, respectively. The result signifies that there is gradual increase in microbial load during every operation performed at the time of slaughtering and dressing. Gracey and Collins (1992) observed that blade of knives could carry 80,000 to 40 million bacteria per blade. The hands of meat operative could carry as many as 2 million bacteria and the unclean equipment could harbor millions of microbes (Rahman *et al.*, 1979 and Lasta *et al.*, 1992). Personnel and air in the environment can contribute additional microorganisms. Personals contribute contamination to meat either by transfer of microorganisms directly from person to product or by mishandling and practices such as cross contamination from raw to finished product.

Table 3 shows the microbial contamination of air in a butcher meat stall during different selling hours. It is interesting to note that the air during the maximum selling period at 10 am and 11.00 am had maximum contaminants with microbes.

It is clearly evidenced from the phenomena that the air in the location where customers usually stand to purchase retail cuts of meat accumulated the maximum

microbial load in comparison with other locations. This is due to the fact that the customers, who directly or indirectly transfer microorganisms from their own to the environment. Moreover, due to movement of people more dust turbulently accumulate and other contaminants in the vicinity could be potential sources of microorganisms gaining access to the air. Rahkio and Kordeala (1997) obtained similar findings. They conducted a study on the microbial contamination of air and found many transient bacteria.

Table 3. Microbial load of air in a butcher meat stall during different selling periods

Time of experiment	**Colony forming units on 110 mm diameter petri-dishes exposed for 5 minutes**											
	In the corner of cutting floor				**Beside the chopping wooden block**				**Adjacent to customers standing platform**			
	Plate no.			**Average**	**Plate no.**			**Average**	**Plate no.**			**Average**
	1	2	3		1	2	3		1	2	3	
8.00 am	370	420	330	373	300	360	450	370	350	430	370	383
9.00 am	450	560	500	503	350	390	320	353	500	470	380	450
10.00 am	420	500	405	441	520	750	610	626	900	720	931	850
11.00 am	300	280	310	296	400	390	350	380	600	505	630	578
12.00 noon	250	284	330	288	360	370	350	360	105	140	70	105

Distribution of selected bacteria present (%) in beef carcass, carcass washings, butchers hand washings, instrument washings, table scraps rinses and air are presented in Table 4. It is found that *Staphylococcus* sp. (36.12%), *Staphylococcus* sp. (15.26%), *Bacillus* sp. (12.71%), *Micrococcus* sp. (11.23%), *Escherichia coli* (10.28%), *Proteus* sp. (5.24%), *Pscudomonas* sp. (3.56%), and *Enterobacter* sp. (3.25%) were isolated and identified. These findings are in agreement with Rahman *et al.* (1979); Schuppel *et al.*, (1996) and Mukhopadhyay *et al.*, (1998). In these studies, Staphylococci showed the highest percentage of occurrence. The presence of high number of pathogenic Staphylococci in meat is alarming.

Table 4. Distribution of bacterial isolates obtained from meat samples

SL. No	**Name of isolates**	**Distribution (%)**
1.	*Staphylococcus* sp.	36.12
2.	*Streptococcus* sp.	15.26
3.	*Bacillus* spp.	12.71
4.	*Micrococcus* sp.	11.23
5.	*Escherichia* sp.	10.28
6.	*Proteus* sp.	5.24
7.	*Pseudomonas* sp.	3.56
8.	*Enterobacter* sp.	3.25
9.	*Salmonella* sp.	1
10.	Others	6

Next to Staphylococci, Streptococci ranked the second position. The high percentage *E. coli* indicates poor sanitary conditions during handling, slaughtering, dressing and transportation of meat. The presence of al these organisms in meat foods should receive particular attention, because their presence indicate public health hazard and give warning signal for the possible occurrence of food borne intoxication.

References

Borse, P. D., Sherikar, A. T. Waskar, V. S. and Paturkar, A. M. (1998). Microbiological analysis of carcass sites in sheep slaughtered at Deonar abattoir. Indian Veterinary Journal, 75: 141–143.

Charlebois, R., Trudel, R. and Messier, S. (1991). Surface contamination of beef carcasses by fecal coliforms. Journal of Food Protection, 54: 950–956.

Cowan, S. T. (1985). Cowan and Steel's manual for Identification of bacteria. 2nd edn. Cambridge University Press, Cambridge, London.

Frazier, W. C. and Westhoff, D. C. (1995). Food Microbiology. 4th edn. Tata McGraw-Hill Publishing Cimpany Ltd. New Dellei.

Gracey, J. F. and Collins, D. S. (1992). Meat Hygiene. 9th ed. Bailliere Tindall London, UK.

ICMSF (1982). Microorganisms in Food. Vol. 2. sampling for microbiological analysis: Principles and specific applications. Toronto University Press, Canada.

ISO (1995). Recommendation of the meeting of the subcommittee, international organization for standardization on meat and meat products. ISO/TC-36. SC. 6. The Netherlands, 10–18.

Johanson, L., Underdal, B., Grosland, k., Whelehan, O. P. and Roberts, T. A. (1983). A survey of the hygienic quality of beef and pork carcasses in Norway. Acta Veterinaria Scandinavica, 24: 11–23.

Lastsa, J. A., Rodriguez, R., Zanelli, M. and Margaria, C. A. (1992). Bacterial count from bovine carcasses as an indicator of hygiene a tslaughtering places. A proposal for sampling. Journal of Food Potection, 54: 271–278.

Mukhopadhyay, H. K., Puvarajan, B. and Dorairajan, N. (1998). Detection of microbial load in fresh mutton and its impact on public health. Indian journal of Animal Health, 37: 81–83.

Perieto, M., Garcia, M. L., Garcia, M. R., Otero, A. and Moreno, b. (1991). Distribution and evolution of bacteria on lamb carcass during aerobic storage. Journal of Food Protection. 54: 945–949.

Roberts, T. A., Hudson, W. R. and Smulders, F. J. M. (1987). Contamination prevention in the meat plant: the standpoint of an importing country. Elimination of Pathogenic organisms from Meat and poultry, pp. 235–250.

Rahkio, T. M. and Kordeala H. J. (1997). Airborne bacteria and carcass contamination in slaughterhouses. Jornal of Food Production, 60: 38–42.

Rahman, M. A. Choudhury, T. I. M.. F. R. and Rahman, M. M. (1979). Microbial contamination of meat and their public health significance . Bangladesh Veterinary journal, 13: 1–7.

Schuppel, H., Salchert, F. and Schuppel, k. F. (1996). Investigations into the influence of mastitis and other organs changes on microbial contaminations of the meat cows. Fleischwirtschaft, 76:61–63.

Untermannm, F., Stephan, R.,Dura, U., Hofer, M. and Heimann, P.(1996). Reliability and practicability of bacteriological monitoring of beef carcass contamination and there rating within hygiene. International Journal of Food Microbiology, 39: 67–77.

Zeleke, M., Ellerbroek, L. Weise, E., Arndt, G. and Zessin, K.H. (1994). The applicationof the hazard analysis critical control point to acattle slaughter line. Flieschwirschaft, 74: 735–737.