

Examination of Goat, Pig and Poultry Meat for *Salmonella* and Coliform Contamination

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The diversity of *Salmonella* and *E. coli* was studied from food of animal origin i.e. goat, pig and poultry meat. The quantitative estimation of colony forming unit, coliform count and Most Probable Number (MPN) was carried out. The identification of different strains of *Salmonella* and *E. coli* was carried out as per the keys given in Bergey's manual. Total 265 meat samples were surveyed for bacterial colonization. The analysis of ANOVA exhibited that Coli form Count varied significantly in different meat samples. Studies on the source of contamination indicated that *E. coli* had higher rate of contamination from the implements and the infected animals, and serves as the opportunistic organisms to the person consuming such contaminated meat from the foods of animal origin. It was observed that certain environmental factors such as temperature was also one of the regulatory factors in establishment and further growth of the bacterial pathogen in different foods of animal origin.

Key words: *Salmonella*, *E. coli*, Food animals.

Meat has been among one of the indispensable and versatile food item that man has relished since pre-historic times, but a wide array of microorganisms like bacteria, virus, rickettsia, helminths and fungi are transmitted through meat. Microflora primarily incriminating the fresh meat are *E. coli*, *Salmonella*, *Micrococcus*, *Streptococcus*, etc. Fresh raw meat while in distribution may be a source of zoonotic infection, which are insidious and go unnoticed (Bachhil,

1986). The ubiquitous nature of Salmonellae, *Salmonella* infection in man and animals is of complex nature. In man typhoid and paratyphoid, gastro-enteritis, enteric fever and food poisoning have often been encountered and in animals intestinal infections, septicemia; sub-clinical stage without any symptoms and such carriers in man and animals may disseminate infection to healthy population. Besides this, *E. coli* has been recognized as a specific pathogen in both intestinal and extra-intestinal disease. Cattles and pigs act as reservoirs but the organism colonizes readily in caeca of chickens and maybe excreted for several months (Baggesen *et al.*, 1993). Because of the current lack of liaison between livestock production and meat hygiene practice in most

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countries of the world, generally little attention is paid to the effect the former practice may have on the latter. Rapid deterioration of meat is entirely the result of microbial action and its prevention is primarily a problem in the control of microbial contamination with the growth of microorganisms (Duffy *et al.*, 2001). In the recent years meat borne infections and intoxication have assumed a significant and serious problems for mankind. The toxins produced by some of the bacteria lead to different types of food poisoning, which provokes the usual reactions of nervous sign, nausea, vomiting and diarrhoea and if not timely attended, it may result into death of the consumer. (Gracey, 1985).

MATERIALS AND METHOD

The materials were procured from retail shops of Mathura city, U.P, India. A total of 265 food samples were surveyed for bacterial colonization. Approximately 100g meat of the samples were collected from different parts of the slaughtered carcass (liver, heart, kidney, lungs and

muscle portions) of the food animals and processed immediately. Meat homogenate along with tenfold serial dilution were prepared. The inoculum was processed for culture on MacConkey's lactose agar and Eosin methylene blue agar for *E. coli* and Bismuth sulphite agar (BGA) and tetrathionate agar for *Salmonella*; incubated at 37°C for 24 h. Bacterial identification was done on basis of morphological, cultural and biochemical tests. Quantification of bacteria was done by Total viable count (TVC), Coli form count (CC) and Most probable number (MPN) methods. Details of meat samples & swabs from butchers hands & knives procured are given in table 1.

RESULTS

The standard plate counts were performed of 165 samples in total comprising of 60 goat meat, 55 pig meat and 50 poultry meat. The mean value was expressed in terms of log as presented in table 2. The mean value of SPC (cfu/g) for chevon was 7.84 ± 0.01 , pork 7.51 ± 0.01 and poultry meat 8.20 ± 0.01 . The range of standard

Table 1. Details of meat samples & swabs collected from butchers hands & knives

S. No	Materials collected	Goat	Pig	Poultry	Total
1.	Meat	60	55	50	165
2.	Swabs from butchers hands	16	17	17	50
3.	Swabs from butchers knives	16	17	17	50
	Grand Total	92	89	84	265

Table 2. Mean And Range of Standard Plate Count (SPC), Coliform Count (CC), and Most Probable Number (MPN) in terms of log

Sources	Attributes	SPC	CC	MPN
Chevon	Mean \pm SE	$7.84^b \pm 0.01$	$4.26^a \pm 0.01$	$2.55^a \pm 0.06$
	Range	7.74 - 7.79	4.14 - 4.43	2.00 - 3.25
	N	60	60	60
Pork	Mean \pm SE	$7.51^a \pm 0.01$	$4.36^b \pm 0.01$	$2.63^a \pm 0.07$
	Range	7.39 - 7.62	4.23 - 4.51	2.05 - 3.25
	N	55	55	55
Poultry $2.82^b \pm 0.06$	Mean \pm SE	$8.20^c \pm 0.01$	$4.23^a \pm 0.03$	
	Range	8.06 - 8.34	3.70 - 4.59	2.07 - 2.24
	N	50	50	50

Values with different superscript within column are different significantly from each other

plate count (cfu/g) was for chevon 7.74 to 7.97, pork 7.39 to 7.62 and for poultry meat 8.06 to 8.34. The permissible limit for total viable count for meat is 1×10^7 , ($\log_{10} 6.2$). The highest mean value of SPC (cfu/g) was recorded in poultry meat and lowest mean value in pork, i.e. 8.20 ± 0.01 and 7.51 ± 0.01 respectively. It is obvious from the mean value of SPC that the level of contamination of retail outlet meat was very high.

Similarly, the mean values of coliform count for chevon, pork and poultry meat were 4.26 ± 0.01 , 4.36 ± 0.01 and 4.23 ± 0.03 , and for MPN 2.55 ± 0.06 , 2.63 ± 0.07 and 2.82 ± 0.06 respectively. The range of coliform count was from 4.14 to 4.43 for chevon, 4.23 to 4.51 for pork and 3.70 to 4.59 for poultry meat and for MPN it was recorded as 2.00 to 3.25, 2.05 to 3.25 and 2.07 to 2.24 respectively. Also it was observed that the mean value of coliform count was recorded highest for pork and lowest mean value for poultry meat, i.e. 4.23 to 4.51 and 3.70 to 4.59, while value for chevon i.e. 4.14 to 4.43 was in between of these. In case of MPN it was recorded as 2.55 ± 0.06 , 2.63 ± 0.07 and 2.82 ± 0.06 for chevon, pork and poultry meat respectively. The analysis of variance (ANOVA) of SPC, coliform count (cfu/g) and MPN values indicated a significant difference in counts of retail outlet meat examined ($P < 0.05$).

A biochemical variation among few isolates of *Salmonella* and *E. coli* was observed which may be due to geographical conditions prevailing. It was observed that certain environmental factors such as temperature was also one of the regulatory factors in establishment and further growth of the bacterial pathogen in different foods of animal origin. Also it was observed that rate of contamination for *Salmonella* isolates was recorded lower than the rate of contamination in *E. coli*. The contamination percentage in chevon, pork and poultry meat was recorded as 68.3%, 29% and 36% indicating a high level of contamination which may be due to unhygienic condition in which meat was kept in; knives; meat handlers; cross contamination and other major environmental factors.

DISCUSSION

Isolation of *E. coli* and *Salmonella* from chevon, pork and poultry meat have been

considered as most frequently found as these are the major etiological agents of food poisoning. Murthy (1986) along with others also found that the combination of tetrathionate broth, brilliant green agar, Mac Conkey Lactose agar and Rapaport-Vassidialis broth proved to be very useful for isolation of salmonellae (Baggeson, 1993; and Korsak, 2003). In this study it was observed that the mean values of standard plate count (cfu/g) were 7.84 ± 0.01 , 7.51 ± 0.01 and 8.20 ± 0.01 for chevon, pork and poultry meat, respectively, indicating that the level of contamination in poultry meat was the highest followed by chevon and pork. Over all findings of SPC of retail outlet meat showed a much higher level of contamination when compared to ISI standard of 1×10^7 cfu/g for meat, indicating that meat was of poor hygienic quality. There was significant difference in SPC value for chevon, pork and poultry meat. Similar findings were also recorded by earlier workers (Hall *et al.*, 1967; McCulloch and Whitehead, 1981; Rao and Rao, 1983; Narshima Rao and Ramesh, 1988; Turtura, 1991; Barbuti *et al.*, 1992; Niamy *et al.*, 1997; Duffy *et al.*, 2001 and Bialasiewicz *et al.*, 2002). The source of contamination indicated that *E. coli* had higher rate of contamination from the implements and the infected animals, and serves as the opportunistic organisms to the person consuming such contaminated meat from the foods of animal origin. The mean value of coliform count (cfu/g) for chevon, pork and poultry meat was 4.26 ± 0.01 , 4.36 ± 0.01 and 4.23 ± 0.03 respectively. There was significant variation between chevon, pork and poultry meat. Pork revealed highest coliform count and poultry the least, where as the count for chevon was in between pork and poultry. These values when compared with ISO standards (1979) were found to be higher indicating poor sanitary quality of meat samples. The mean value of most probable number /g for chevon, pork and poultry meat was 2.55 ± 0.06 , 2.63 ± 0.07 and 2.82 ± 0.06 , respectively. The level of contamination was high when compared to ISO (1976) standards. The value encountered in the present investigation was found to be higher than those reported by Adinarayanaiah *et al.* (1984) and Russel (2001 and 2002). Biochemical tests were found to be indispensable for the confirmation of cultures. A biochemical variation among few isolates of *Salmonella* and *E. coli* was observed which may

be due to geographical conditions prevailing. In the present study 265 samples comprising of chevon, pork and poultry meat and swab samples from butcher's hands and knives were investigated. A total of 146 isolates of *E.coli* and 82 of *Salmonella* were procured. Distribution of *E. coli* isolates in chevon, pork and poultry meat was recorded as 49, 41 and 35, and that of *Salmonella* isolated as 41, 16 and 18 respectively. Out of total 146 isolates of *E. coli* and 82 from *Salmonella*, a total of 28 isolates were recorded from swab samples of butcher's hands and knives from chevon, pork and poultry meat shop.

The reasons associated with higher rate of contamination of meat may be due to use of contaminated water, unclean floors, unhygienic handling of meat by the meat handlers, use of same knives for cutting of various carcasses, cross contamination of meat. Environmental conditions are also highly conducive and responsible in contribution to contamination of meat to a greater magnitude as the sellers keep the carcass hanging for hours together for sale in the shop openly, which leads to multiplication of pathogenic and spoilage organisms. This further, enhances the greater risk of food poisoning among the meat consumers. Trustwell (1978) assessed that the risk of microbial contamination was 1000 times greater than that of environmental pollution. Assurance of safety of meat and meat products to the consumers requires continuous monitoring of all the operations involved in production of meat of high quality.

Earlier workers, Murthy (1986), Bachhil (1986) expressed the needs for proper quality control and development of microbial methods for identification and enumeration of microorganisms in meat on the lines of standard ISI for *E. coli*. Bachhil (1986) underlined the magnitude of temperature and humidity ideal for microbial multiplication of meat and thus stressed the need for a well planned and careful monitoring of meat production and processing.

CONCLUSIONS

The results indicated that functional diversity in terms of virulence exists in the genera of *Salmonella* and *Escherichia* which is responsible for the seasonal variation and the level of infection

to different types of foods of animal origin. Some isolates procured were pathogens and some opportunistic pathogens to human being. Thus, it is a matter of great public health concern as meat contaminated with such bacteria when ingested may be responsible for food borne infections and intoxications. The level of contamination of standard plate count and coliform count was found to be higher than that of permissible limit under ISO (1979) under this present investigation. Besides public health implications, higher total viable count also influences the economy of meat industry as it indicates likelihood of spoilage of meat. In the present changing global scenario, the consumer's awareness has to be increased, and the consumer expects that the meat should be safe and wholesome.

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