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Original Article

EVALUATION OF CHICKEN CARCASSES SOURCED FROM ORGANIZED PROCESSING UNITS FOR FOOD BORNE PATHOGENS

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Abstract: In the present investigation chicken carcasses were sourced from organized marketing sector; two super markets and two modern processing facilities in and around the Bangalore city and the samples were designated as brand A, B and C, D respectively. A total 120 samples i.e. 30 samples (50 g) were drawn from each of the brand consisting of the breast region and thigh region, equally and were subjected to microbial load for the enumeration of total viable count, Coliforms, Staphylococcus count, Streptococcus count and Salmonella count, There was a highly significant difference (P< 0.01) for TVC, Coliforms, Staphylococcus, Streptococcus and Salmonella counts among four different brands, but no significant difference in Salmonella counts was noted among 4 brands and between the sample locations. Prevalence rate was 100 per cent for Coliforms, Staphylococcus and Streptococcus but for Salmonella it was 43.33, 30.00, 20.00 and 23.33 per cent in brands A, B, C and D, respectively for breast region and 46.66, 33.33, 26.66 and 26.66 per cent in brands A, B, C and D respectively for thigh region. In general, counts were higher in brand A and B compared to C and D. The lower counts in brands C and D could be due to the fact that carcasses from processing facilities are maintained under strict hygiene and cold chain till they reached the consumer. The higher counts observed in brands A and B obtained from the supermarkets may be due to the fact that these carcasses were obtained from different unhygienic sources and packed for sale at the super markets.

Key words: Chicken carcasses, Food borne pathogens

INTRODUCTION

Poultry meat production in India is 2.3 million tons which constitutes about 3 per cent of total world meat production and is ranked fifth in the world preceded by USA, China, Brazil and Mexico. The latest report on per capita consumption of poultry meat in India is 1.8 kg compared to 49.8 kg per person per year in USA. Poultry meat industry in India has shown tremendous growth from 1.08 million ton in 2000 to 2.3 million tons in 2010 [1]. The popularity of poultry meat in India has been attributed primarily to its taste, health concerns and nutritional value followed by freedom from religious taboos, affordable price and easy availability [2]. Ensuring safe food supply has been a continuous challenge following the recognition of more and more pathogenic bacteria. In spite of modern innovations in slaughter hygiene and food production techniques, food safety has been the fore front public health issue [3]. The safety of commercially processed poultry products is a major area of concern for producers, consumers and public health officials alike worldwide for products excessively contaminated with microorganisms are

undesirable from the standpoint of public health, storage quality and general aesthetics [4]. The contamination of chicken meat with microorganisms during processing, handling and transportation is undesirable, though inevitable. A higher bacterial load on the carcass could be expected when carcasses are handled unhygienically at the abattoir [5]. Hardly 5 per cent of the poultry meat produced in our country is from organized processing units whereas, the rest is from the birds slaughtered in unorganized sector (retail shops) where due to poor hygiene there is ample scope for contamination. At the slaughter facility, the microbiological quality of freshly processed poultry carcass depends on the level of contamination from live birds, numbers and types of microorganisms introduced, cross contamination from handlers, soil and water, technical design of processing equipment, efficiency of processing methods, temperature control and sanitary practices followed [6]. Birds in general, are received at the processing plant with feces and dust picked up from litter and from other birds during transit. Consequently, the microorganisms including pathogens present on the surface increase in number during slaughtering, processing and handling. Several studies have indicated that consumption of poultry meat has been associated with incidence of outbreaks of food borne infections including *Salmonellosis* [7]. Vorster et al. [8] studied the incidence of *Staphylococcus aureus* and *E. coli* in broiler meat in Pretoria, South Africa and reported the incidence of *E. coli* as 79.1 per cent and *S. aureus* as 39.5 per cent.

The absence of centralized slaughter facility and the small volume of retail business, prohibitive capital costs on mechanized infrastructure and recurring expenditure have been the hurdles for hygienic production of chicken meat. The present work has been undertaken to know the microbial load of Chicken carcasses sourced from organized marketing sector; two super markets and two modern processing facilities.

MATERIALS AND METHODS

Preparation of media: All the media employed for the enumeration, isolation and identification of bacterial cultures were prepared as per the guidelines of Cruickshank et al. [9].

Sampling technique: About 5 g of meat sample was homogenized in 45 ml of 0.1per cent buffered peptone water as to form one in ten dilution of the sample. In order to estimate the bacterial load per g of the sample, one ml of 1: 10 dilution was transferred into nine ml of diluent to obtain 1: 100 and required serial dilutions of the samples were prepared. The selected serial dilutions of each sample of 1 ml quantity were then transferred to petri dishes with culture media to enumerate the load of bacteria per g of the meat sample and finally expressed in $\log_{10}$ cfu / g.

Bacterial count: The initial sample prepared from each carcass was used as test sample to estimate the total viable count, *Coliforms*, *Streptococcus*, *Staphylococcus* and S*almonella* counts.

Total viable count: TVC of each sample was estimated by pour plate technique. From the selected ten fold dilution of each sample, one ml of inoculum was transferred into duplicate Petri dishes 100×17 mm size. To each of the inoculated plates about 10-15 ml sterile molten standard plate count agar (HI-MEDIA®) maintained at 45^0 C was poured and mixed with the inoculum by gentle rotating movement i.e. clockwise and anticlockwise, forward and backward. The inoculated plates were left at room temperature and allowed to solidify and incubated at 37^{o}C for 24-48 hr. At the end of incubation, plates showing 30-300 colonies were selected and counts were taken with the help of a colony counter. The number of cfu was calculated by multiplying the mean colony count in duplicate plates with dilution factor and then converting them to log values.

***Coliforms* count:** Required dilution of 1 ml quantity was transferred in duplicate into the petri dishes. The sterile molten Mac Conkey agar, maintained at 45^{0}C was poured at the rate of 10-15 ml in to each of the petri dishes and mixed thoroughly. These Petri dishes, after solidification of media were incubated at 37^{o}C for 18-24 hr. The pink colonies were counted and expressed as log cfu per g of sample.

***Staphylococcus* count:** Required dilution of 1 ml quantity was transferred in duplicate into the petri dishes then sterile molten mannitol salt agar cooled at 45^{o}C was poured at the rate of 10-15 ml into each of the petri dishes and mixed thoroughly. These petri dishes after solidification of medium were incubated at 37^{o}C for 24-48 hr. Golden yellow colonies were counted and expressed as log cfu/ g of sample.

Streptococcus count: KF streptococcal agar was employed for enumeration & isolation of *Streptococcus*. The plates were incubated at 37°C for 24-48 hr in an inverted position. Colonies were counted and expressed as log cfu/ g of sample.

Salmonella count: Required dilution of 1 ml quantity was transferred in duplicate into the petri dishes and sterile molten Salmonella-Shigella agar cooled at 45°C was poured at the rate of 10-15 ml into each of the petri dishes and mixed thoroughly. These petri dishes after solidification of medium were incubated at 37°C for 24-48 hr. Black colonies were counted and expressed as log cfu/ g of sample.

Statistical analysis: The data obtained in the study were analyzed statistically for significance as per the procedure outlined by Snedecor and Cochran [10].

RESULTS AND DISCUSSION

The Mean ± SE values of TVC, Coliforms, *Staphylococcus*, *Streptococcus* and *Salmonella* counts ($\log_{10}$ cfu/g) have been presented in Table 1 to 5.

Prevalence rate was 100 per cent for Coliforms, Staphylococcus and Streptococcus but for Salmonella it was 43.33, 30.00, 20.00 and 23.33 per cent, in brands A, B, C and D, respectively in breast region and 46.66, 33.33, 26.66 and 26.66 per cent, in brands A, B, C and D respectively in thigh region. The prevalence of Salmonella has been presented in Table 6.

Total viable count: Study shows a highly significant difference ($P< 0.01$) in TVC among the brands, but no significant difference was observed between breast and thigh region samples. Among the four brands, brand C recorded lowest value for both thigh and breast region samples followed by brands D, B and A. However no significant difference was found between brands C and D. Higher values were obtained in the samples of thigh region compared to breast region. These findings were in agreement with Alvarez-Astorga et al. [11], who recorded total bacteria count of 5.79 log10 cfu/g in chicken drumsticks compared to 5.25 log10 cfu/g from breast.

The average TVC obtained in the present study was within the range of $\log_{10}$ 3 to 6 similar to the findings reported by Murungkar et al. [12] in whole dressed chicken and comparatively lower than the values reported by Pattnaik et al. [13]. The higher counts in brands A and B compared to brands C & D could be due to the fact that samples from A and B brands were procured from supermarkets; whereas samples from C and D were obtained from sources having modern plants where strict hygiene measures are practiced. Between C and D, brand C was from a relatively new and smaller facility where hygienic measures seem to be better. Likewise, Alvarez-Astorga et al. [11] reported that meat obtained from modern processing units had lower microbial load than those obtained from supermarkets.

***Coliforms* count:** The analysis of variance revealed a highly significant difference ($P< 0.01$) for *Coliform* count among the brands and significant ($P< 0.05$) difference was also observed between the samples obtained from breast and thigh regions. Higher values were observed in the samples of thigh region compared to breast region. Brand C recorded lowest value for both thigh and breast region samples followed by brands D, B and A, but no significant difference was found between brands A and B, B and C and C and D. Significant difference was observed between A and C, A and D.

The average *Coliforms* counts obtained in the present study were well within the range described by the provision of directives 88 / 657 / EEC. The results were in agreement with Nair et al. [14], who reported *E. coli* in the range of $\log_{10}$ 2 to 4 cfu/ g of meat. The lower counts of *Coliforms* in brands C and D could be due to the fact that carcasses from processing facilities are maintained under strict hygiene and cold chain till they reached the consumer and the findings are in agreement with Abu Ruwaida et al. [15].

***Staphylococcus* count:** The analysis of variance revealed a highly significant difference ($P< 0.01$) for *Staphylococcus* counts among brands A, C and D, whereas difference observed between the samples obtained from breast and thigh was not significant ($P > 0.05$). However, there was a no significant difference between brands B, C and D.

Among the four brands, brand C and D recorded lowest count in both thigh and breast meat followed by B and A. *Staphylococcus* was isolated from all the samples irrespective of the brands and location of sample. This may be due to contamination through

Table 1: TVC values of chicken meat procured from organized marketing sector (log10 cfu/g). Values bearing different superscripts (a, b, c) between rows and columns differ significantly (P < 0.01)

Parameters	Brand A	Brand B	Brand C	Brand D	Overall mean ± SE
Breast	5.20 ± 0.13	4.76 ± 0.15	3.96 ± 0.12	4.18 ± 0.14	4.52 ± 0.09 ^{NS}
Thigh	5.25 ± 0.11	4.67 ± 0.14	3.97 ± 0.16	4.26 ± 0.17	4.54 ± 0.10 ^{NS}
Overall mean ± SE	5.22 ± 0.08 ^{a}	4.71 ± 0.10 ^{b}	3.97 ± 0.10 ^{c}	4.20 ± 0.11 ^{c}	

Table 2 : Coliforms counts of chicken meat procured from organized marketing sector (log10 cfu/g). Values bearing different superscripts (a, b, A and B) between rows and columns differ significantly (P < 0.01 or P < 0.05)

Parameters	Brand A	Brand B	Brand C	Brand D	Overall mean ± SE
Breast	2.83 ± 0.16	2.39 ± 0.23	2.05 ± 0.15	2.23 ± 0.19	2.38 ± 0.18^{A}
Thigh	3.04 ± 0.17	2.73 ± 0.22	2.30 ± 0.18	2.55 ± 0.20	2.66 ± 0.19^{B}
Overall mean ± SE	2.93 ± 0.12^{a}	2.56 ± 0.16^{ab}	2.18 ± 0.12^{b}	2.39 ± 0.14^{b}	

Table 3 : Staphylococcus count of chicken meat procured from organized marketing sector (log10 cfu/g). Different superscripts (a, b) between columns differ significantly (P < 0.01)

Parameters	Brand A	Brand B	Brand C	Brand D	Overall mean ± SE
Breast	4.32 ± 0.03	4.00 ± 0.13	3.75 ± 0.10	3.77 ± 0.16	3.96 ± 0.10^{NS}
Thigh	4.27 ± 0.02	4.05 ± 0.24	3.81 ± 0.12	3.70 ± 0.15	3.96 ± 0.13^{NS}
Overall mean ± SE	4.29 ± 0.02 ^{a}	4.02 ± 0.14 ^{ab}	3.78 ± 0.08 ^{b}	3.74 ± 0.11 ^{b}	

Table 4: Streptococcus counts of chicken meat procured from organized marketing sector (log10 cfu/g)/ Different superscripts (a, b) between rows and columns differ significantly (P < 0.05)

Parameters	Brand A	Brand B	Brand C	Brand D	Overall mean ± SE
Breast	4.14 ± 0.06	4.03 ± 0.12	3.90 ± 0.12	3.91 ± 0.12	3.99 ± 0.11^{NS}
Thigh	4.23 ± 0.03	3.99 ± 0.22	3.69 ± 0.22	3.64 ± 0.16	3.89 ± 0.16^{NS}
Overall mean ± SE	4.18 ± 0.03^{a}	4.01 ± 0.12^{ab}	3.80 ± 0.12^{b}	3.78 ± 0.10^{b}	

Table 5: Salmonella Counts Chicken meat procured from organized marketing sector (log10 cfu/g)

Parameters	Brand A	Brand B	Brand C	Brand D	Overall mean ± SE
Breast	0.66 ± 0.22	0.45 ± 0.20	0.24 ± 0.17	0.34 ± 0.18	0.42 ± 0.10^{NS}
Thigh	0.75 ± 0.22	0.52 ± 0.20	0.36 ± 0.16	0.44 ± 0.20	0.52 ± 0.10^{NS}
Overall mean ± SE	0.71 ± 0.15^{NS}	0.49 ± 0.14^{NS}	0.30 ± 0.11^{NS}	0.39 ± 0.13^{NS}	

Table 6: Prevalence of Salmonella in chicken meat procured from organized marketing sector

#	Brand	Breast			Thigh		
		No of samples	Positive cases	Per cent Prevalence	No of samples	Positive samples	Per cent Prevalence
1	A	15	6	40.00	15	7	46.66
2	B	15	4	26.66	15	5	33.33
3	C	15	2	13.33	15	4	26.66
4	D	15	3	20.00	15	4	26.66

the hands of the butchers during the processing, packing, and distribution. The results suggested that hygienic practices were better in brands C and D facilities probably in the form of utility of hand gloves during handling. The findings were in accordance with Capita et al. [16] who reported 100 per cent incidence of *Staphylococcus* in market samples of chicken meat in Spain. Similarly, Kreyenschmidt et al. [17] evaluated the chicken meat and reported isolation of *S. aureus* from samples of chicken meat stored at 10 °C (5×10^4 cfu/g). However, lower rate of incidence (16.6 per cent) have been reported by Rao [18] who evaluated a very small sample size for his report.

***Streptococcus* count:** The analysis of variance revealed a significant difference ($P< 0.05$) with respect to *Streptococcus* count for brands A and C, A and D and whereas no significant difference ($P > 0.05$) observed between from breast and thigh region samples. Among the brands, brand D recorded lowest counts for thigh and breast meat followed by brands C, B and A. However, there was no significant difference observed between brands A and B, B and C, B and D and C and D.

Presence of *Streptococcus* in meat and meat product is an indication of fecal contamination and poor hygiene during processing [4]. The higher counts observed in brands obtained from the supermarkets may be due to the fact that these carcasses were obtained from different unhygienic sources and packed for sale at the super markets, whereas those obtained from the processing units were processed under strict hygiene.

***Salmonella* count:** There was no significant ($P > 0.05$) difference in *Salmonella* count with respect to different brands and also between breast and thigh samples. However, the prevalence rate of *Salmonella* from different brands (A, B, C and D) was 40, 26.6, 13.33 and 20 per cent respectively in the breast meat and 46.66, 33.33, 26.66 and 26.66 per cent, respectively in the thigh meat. The results of the present study were in accordance with Plummer et al. [19], who reported *Salmonella* contamination at the rate of 18.4, 25.5, and 24.5 per cent in retail chicken products of supermarket chicken, fresh chilled and frozen chicken from local butcher shops, respectively. Similar findings were also recorded by Maharjan et al. [20] and Rao (2005) who reported a prevalence rate of 25-40 per cent in market samples of chicken meat. However, Bajaj et al. [21] reported a slightly higher rate (65 per cent) of prevalence, whereas Vaidya et al. [22] reported lower incidence of *Salmonella* in market samples of chicken meat compared to the present study.

CONCLUSION

The results of the study indicates microbial counts (TVC, *Coliforms, Staphylococcus, Streptococcus,* and *Salmonella*) of the samples obtained from super markets were higher compared to those obtained from modern processing facilities. Irrespective of the brands chicken thigh region samples contain higher bacterial load compared to chicken breast region samples. Hence maintenance of strict hygiene during slaughter and processing is of prime importance to produce good meat of microbial quality and better shelf life, thereby ensuring safety to consumers.

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