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BACTERIOLOGICAL PROFILE OF DRESSED BROILERS AND ITS PUBLIC HEALTH IMPLICATIONS

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ABSTRACT

Bacteriological study was conducted to determine the occurrence of bacteria in 52 dressed broiler with intact skin (n = 26) and without skin (n = 26) and to demonstrate the role of packaging and pretreatment chilling on the changes of carcass quality during the period from July to August 2000. The values of total viable count (TVC), total coliform count (TCC), total streptococcal count (TStC) and total staphylococcal count (TSC) were determined for meat samples of thigh and breast and swab samples of skin and visceral surfaces of the broilers with intact skin (n = 80) and without skin (n = 80). The values of TVC, TCC, TStC and TSC in both cases with intact skin and without skin were compared. The results indicate that the dressed broilers with intact skin kept in packed condition after prechilled and frozen could maintain the good quality of sensory characteristics up to a maximum period of 10 days storage. Of the160 samples examined bacteriologically, 39.06% had contamination with different bacteria, of which *Staphylococcus* spp. (90.63%), *Streptococcus* spp. (30.00%), *Escherichia coli* (60.63%), *Pseudomonas aeruginosa* (22.50%), *Micrococcus* spp. (18.75%) and *Salmonella* spp. (11.88%). It appears from these results that the current systems of pretreatment, sanitation, storing temperature and processing are necessary to be improved to ensure the quality assurance and quality control program and subsequently maintain the bacteriological and organoleptic quality of dressed broilers, thus minimizing the potential health hazards associated with contaminants gaining access to the dressed or processed broilers.

Key words : Dressed broilers, bacteriology, public health implications

INTRODUCTION

Undoubtedly the poultry slaughtered and dressed under Bangladesh conditions carry extremely high initial contamination loading from the point of slaughtering process to the point at which the consumers are offered the product. There occurs biomagnification at all levels of handling, poor transport and retailing conditions. Improved hygienic measures will reduce the initial contamination and the proper sanitary applications to the distribution and retailing conditions and the inherent cold chain through to the consumers could in fact meet the challenge to deliver a safe good quality product (Rahman and Rahman, 1998). Little is known about the microbiological aspects, shelf life, keeping quality and food safety of commercially processed chicken meat. Reports are also not available which concern with the interrelatedness between the status of microbial growth, sanitary quality and the keeping quality of broilers stored at different conditions. It is therefore, intended to assess the quality of broilers sold by farms and commercial enterprises and also to evaluate the storage life of this product even after crisis period that will be acceptable to consumers. Therefore, the objectives of this study are to determine the incidence of bacteria associated with dressed broilers, to investigate distribution of selected bacterial attributes relating to the sanitary quality of dressed carcass, to detect the types of spoilage flora which survive during storage, to assess the shelf life and keeping quality of the product and to demonstrate the roles of packaging and pretreatment-chilling on the changes of carcass quality.

MATERIALS AND METHODS

A total number of 52 broilers were collected from the Bangladesh Agricultural University Poultry Farm, Mymensingh during the period from July to August 2000. Birds were slaughtered and dressed with almost hygienic care and management. Dressing was operated in manner of birds with intact skin and without skin. All the dressed broilers were divided into two groups consisting of 26 broilers in each group before these were kept in frozen storage. In the first group, prior to freezing storage, prechilling at 2 to 3^0C for a period of 6 hours was performed and the broilers of second group were directly kept in the freezing storage. The dressed birds were kept in the freezing storage in packed and unpacked condition.

From each broiler four samples consisting of thigh, breast and swabs from skin surface and visceral cavity were taken. After collection bacteriological analysis of the samples were performed under two major principal assessments: Firstly, to evaluate the sanitary quality of meat, total viable count (TVC), total coliform count (TCC), total streptococcal count (TStC), total staphylococcal count (TSC) were determined by using Nutrient agar, Plate count

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agar, MacConkey agar, Blood agar, Eosin-Methylene-blue agar, Salmonella-Shigella agar, Crystal violate blood agar, Triple Sugar Iron agar, Streptococcus Selective broth, Staphylococcal Media No. 110 (SM-110). Secondly, various bacteria contaminating the meat samples were isolated and identified by using different biochemical tests such as Catalase test, Coagulase test, Haemolytic activity, Oxidation-Fermentation test, Oxidase test, IMVIC test, and API Identification system (Biomerieux, Lyon, France).

The degrees of correlation between the bacterial counts and the quality of stored dressed broilers were measured by sensory tests. The stored broilers were examined periodically and organoleptically for defects of pigmentation in skin and muscles, firmness of meat, colour and odour. They were scored in a 0 to 10 point hedonic scale for quality, i.e., excellent 10, good 8, fair 6, poor 4, half-spoiled 2 and spoiled 0. Grade A corresponds 8 to 10 scores, Grade B 4 to 7, and Grade C 0 to 3. Birds with scores of 4 or less were considered unacceptable for human consumption.

The data on TVC, TCC, TStC and TSC obtained from bacteriological examination of meat samples of the poultry carcasses were analyzed using computer package MSTAT-C (Freed, 1992).

RESULTS AND DISCUSSION

Total viable count (TVC)

The data presented in Table 1 represents the mean values of TVC per gram of meat samples from breast and thigh regions of dressed broiler with intact skin at 0 day, 10 days, 20 days and 30 days of storage. The bacterial counts for the swab samples obtained from per square centimeter of skin surfaces of breast and thigh regions are shown in Table 1. At the storage conditions the highest count of total viable bacteria was found in thigh meat of broilers kept at 10 days storage and the bacterial counts were gradually decreased. These indicate that the initial contamination occurred at maximum level in that area and the contaminating organisms might have survived. The study of TVC per gram of meat samples from breast and thigh regions of dressed broiler without skin at 0 day, 10 days, 20 days and 30 days of storage revealed the similar results to those with intact skin. The swab samples of broilers without skin were obtained from the visceral cavities (Table 1). It is interesting to note that birds with or without skin depicted similar trend in respect to the bacterial load in meat tissues. The highest bacterial count was seen in meat tissues of thigh regions. Comparatively, there was a reduction of more than one logarithmic cycle of total viable bacterial count in breast region. Variations that occurred in TVC of dressed broilers kept at different prolonged storage periods are remarkable. The general reduction in numbers of organisms during storing might be attributed to unfavorable low temperature, whereas the variation in counts may be due to difference in sanitary conditions practiced and handling of birds during dressing operations.

The bacterial standard set for frozen chicken is 10^5 to 10^6 / g. The present study evidences the maximum recovery of log 6.65 count per gram, which although within the microbiological specification, but not within the maximum acceptable microbiological limit and therefore must be dealt with very cautiously. Numerous investigators conducted studies on incidence of microorganisms associated with dressed poultry. Mahizea (1994) observed the initial total viable count ($\log_{10}$ CFU / cm^2) which ranged from 3.8 to 5.5 with a mean of 4.67. Other investigators (Brune and Cunningham, 1971; Walker and Ayres, 1956) found initial counts of 10^4 to 10^5 CFU / cm^2) from fresh broilers all over the skin surface. The prechilling process was also found to be very effective in reducing bacterial load of dressed carcasses and this has been emphasized by many researchers (Thompson and Patterson, 1974; May and Pooni, 1974; Anand *et al.*, 1989 and Saffle *et al.*, 1961) found total bacterial counts ranged from 1.6 to 230 million / g in dressed broilers at various retail markets.

Total coliform count (TCC)

TCC per gram in meat of dressed broilers of breast and thigh regions with / without intact skin at 0 day, 10 days and 20 days of storage are shown in Table 1. The swab samples per square centimeter from skin surfaces revealed in Table 1. Coliforms were not detected in dressed broilers kept in any condition at 30 days storage.

Since coliforms generally fail to survive in freezing and frozen storage they have little or no value as indicators in frozen foods. In this study the dressed broilers were kept in frozen storage for 30 days and coliforms were not detected in any samples of muscles, skin or abdominal cavities at this period. Barness and Watts (1976) found that the numbers of *E. coli* had increased about 1000 fold on the surface of the eviscerated carcasses tested at four days and to a similar extent on uneviscerated carcasses tested after ten days.

Total streptococcal count (TStC)

The mean values of TStC per gram of meat of dressed broilers of breast and thigh regions with / without intact skin at 0 day, 10 days, 20 days and 30 days of storage are shown in Table 1. The bacterial count from swab samples per square centimeter from skin surfaces and visceral cavities are also shown in Table 1.

Table 1. Bacterial counts of samples obtained from different body regions of fresh and storage dressed broilers ∑

Type of samples	Source of sample (unit)	Bacteria isolated	Pre-storage (Fresh samples)	Post- storage samples											
				10 days				20 days				30 dyas			
				PC & F		DF		PC & F		DF		PC & F		DF	
				P	UP	P	UP	P	UP	P	UP	P	UP	P	UP
Dressed broilers with intact skin (n = 80)	Breast muscle (/ g)	TVC	5.95	2.21	2.39	2.34	2.56	1.89	1.95	1.92	2.01	1.54	1.81	1.69	1.91
		TCC	2.31	1.69	1.81	1.80	1.83	0.69	0.90	0.95	1.04	-	-	-	-
		TSC	2.30	1.25	1.41	1.46	1.93	1.07	1.27	1.34	1.75	0.84	1.11	0.95	1.21
		TStC	2.47	1.34	1.49	1.56	1.99	1.23	1.36	1.44	1.81	1.07	1.27	1.14	1.32
	Thigh muscle (/ g)	TVC	5.47	2.52	2.64	2.60	2.69	2.04	2.09	1.95	1.97	1.78	1.90	1.81	1.92
		TCC	3.17	1.79	1.85	1.89	1.94	0.91	1.08	1.08	1.18	-	-	-	-
		TSC	2.69	2.06	2.50	2.44	2.57	1.57	1.65	1.65	1.81	1.04	1.23	1.14	1.30
		TStC	2.77	2.07	2.58	2.49	2.61	1.63	1.69	1.72	1.85	1.23	1.39	1.25	1.46
	Skin surfaces (/ cm^2 of swabs)	TVC	5.47	3.62	3.94	3.81	3.07	2.47	2.69	2.54	2.77	1.88	1.94	1.85	1.93
		TCC	4.01	2.73	2.79	2.75	2.81	1.56	1.84	1.81	1.89	-	-	-	-
		TSC	2.61	2.11	2.23	2.20	2.40	1.90	2.04	1.05	1.14	1.63	1.76	1.69	1.79
		TStC	2.69	2.25	2.29	2.32	2.36	1.93	2.15	1.67	2.17	1.70	1.82	1.74	1.84
Dressed broilers without skin (n = 80)	Breast muscle (/ g)	TVC	6.50	2.35	2.63	2.61	2.68	2.02	2.13	2.09	2.24	1.83	1.92	1.95	2.04
		TCC	2.77	1.96	2.04	2.02	2.27	1.47	1.26	1.48	1.85	-	-	-	-
		TSC	3.32	1.49	1.69	1.95	2.06	1.30	1.74	1.54	1.87	1.20	1.46	1.25	1.49
		TStC	3.43	1.56	1.82	2.05	2.08	1.41	1.79	1.57	1.92	1.52	1.53	1.36	1.56
	Thigh muscle (/ g)	TVC	6.65	2.42	2.69	2.69	2.78	2.25	2.39	2.50	2.59	1.87	2.01	2.09	2.26
		TCC	3.76	2.01	2.11	2.04	2.31	1.61	1.34	1.65	1.78	-	-	-	-
		TSC	3.66	2.13	2.59	2.51	2.69	1.79	1.84	1.81	1.95	1.27	1.50	1.34	1.59
		TStC	3.70	2.15	2.62	2.57	2.71	1.77	1.89	1.85	2.04	1.36	1.61	1.44	1.66
	Visceral cavities (/ cm^2 of swabs)	TVC	5.69	3.41	3.66	3.62	3.97	2.54	2.81	2.60	2.84	1.65	1.87	1.91	1.85
		TCC	3.77	2.61	2.64	2.63	2.67	1.62	1.77	1.67	1.82	-	-	-	-
		TSC	2.30	1.74	2.01	1.91	2.14	1.62	1.81	1.74	1.90	1.43	1.57	1.46	1.61
		TStC	2.47	1.94	2.15	2.02	2.20	1.88	1.83	1.91	1.89	1.55	1.67	1.54	1.69

∑ All counts are expressed in logarithms, PC & F = Prechilled & frozen, DF = Dried frozen, P = Packed, UP = Unpacked.

A large number of investigators have conducted studies on the use of an *Enterococcus* index for food safety and indicated that it is a better index of food sanitary quality than the coliform index, especially for frozen foods. In the present study the findings were in agreement with those of many researchers. In frozen dressed broilers, *Enterococci* occurred in greater numbers than coliforms. These counts were more closely related to total counts than to coliform counts. During the storage period there was no appreciable decrease in the numbers of *Enterococci* in comparison to coliforms (Comi *et al.*, 1990). Experiments by Schothirst *et al.* (1972) have shown that the numbers of *Enterococci* increased during processing and these are only slightly reduced subsequently.

Total staphylococcal count (TSC)

The mean values of the total staphylococcal count (TSC) per gram of meat of dressed broilers of breast and thigh regions with / without intact skin at 0 day, 10 days, 20 days and 30 days of storage are also shown in Table 1. The swab samples per square centimeter from skin surfaces and visceral cavities were shown in Table 1.

Correlation between TVC, TCC, TStC and TSC

Results of correlation between TVC, TCC, TStC and TSC depicted some important facts. The levels of bacterial

contamination of dressed broilers with intact skin at 10 days storage showed highly significant correlation between TVC, TCC, TStC and TSC ($p < 0.001$). On subsequent storage at 20 days although highly significant relationship among TVC, TStC and TSC ($p < 0.001$) was found but not between TVC and TCC ($p > 0.05$). At 30 days storage the results showed highly significant correlation between TVC and TStC ($p < 0.001$) but not between TVC, TSC and TCC ($p > 0.05$).

In this study the values of TSC obtained were highly significant ($p < 0.001$) in meat samples with intact skin kept at 10 days storage. But in case of birds without skin there were no significant values ($p > 0.05$), whereas, TCC and TStC were highly significant ($p < 0.001$) in both cases. Our observation is more or less similar to the reports by Notermans *et al.* (1975), who concluded to the opinion that no statistical interactions occurred between temperatures of incubation and sampling site of frozen chicken carcasses.

Frequency distribution of different microorganisms

Percentage distribution of different types of bacteria of dressed broilers with skin and without skin are presented in Table 2, which were *Staphylococcus* 85% and 96%, *E. coli* 54% and 67%, *Pseudomonas* 31% and 48%, *Micrococcus* 31% and 36%, *Streptococcus* 27% and 32% and *Salmonella* 14% and 17% respectively. Presence of high percentage of pathogenic *Staphylococci* in both dressed broilers with and without skin is alarming for meat consumption. In both cases *E. coli* ranks the second position. The organisms gaining access to meat were not only the cause of deterioration and spoilage but also responsible for giving warning signal of indication of the presence of many food borne outbreaks. Presence of *Streptococcus*, *Pseudomonas* and *Salmonella* spp. in meats must receive sanitary measures, as these organisms are responsible for causing of public health problems. From this study, lower bacterial load was found in dressed broilers with intact skin than that of without skin, indicating the skin acted as barrier, while dressed broilers without skin were more prone to contamination.

Table 2. Frequency distribution of bacteria isolated from freshly dressed broiler chickens

S/N	Bacteria isolated		Intact skin (n = 80)		Without skin (n = 80)		Total (n = 160)	
	Genus	Species	No.	%	No.	%	No.	%
1.	*Staphylococcus*	*Staph. aureus, Staph. epidemicus*	68	85.0	77	96.0	145	90.63
2.	*Streptococcus*	*Str. pyogenes*	22	27.0	26	32.0	048	30.00
3.	*Escherichia*	*E. coli*	43	54.0	54	67.0	097	60.63
4.	*Pseudomonas*	*P. aeruginosa*	14	31.0	22	48.0	036	22.50
5.	*Micrococcus*	*Micrococcus* sp.	14	31.0	16	36.0	030	18.75
6.	*Salmonella*	*Salmonella* sp.	08	14.0	11	17.0	019	11.88
Mean			28.1	35.1	34.3	42.9	62.5	39.06

n = No. of samples

Correlation between sensory panel score (SPS) and different storage days

During this study higher bacterial load was found at 10 days storage than the subsequent storage period of 20 days and 30 days. This increase in growth of bacteria during 10 days frozen storage and it may be ascribed to the development of undesirable organoleptic changes. Under the conditions of storage, one would expect requirements to be more favorable for some organisms than others. Although there was a slight increase in numbers of *Streptococci*, *Enterococci* at the initial stage of storage but by the end of the storage period they were seldom recovered. The highest panel score was 288 of 400 scores at 10 days of storage. At 10 days storage panel score was higher than 20 days and 30 days storage. At 30 days storage the score was 43 of 400 only. This might occur due to organoleptic changes, and this changes need to be considered in the dressed broilers storage condition.

In conclusion, the results thus indicate the possibilities of use of different storage temperatures and packaging system which can improve the microbial quality and shelf life of dressed broilers.

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