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Post-harvest safety issues, shelf life and sensory characteristics of duck meat in home freezer storage

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ABSTRACT

In Bangladesh, duck is considered as second in position, next to chicken, in terms of egg and meat production, and duck meat, which are sold in retail markets, are not frozen or chilled, but are sold raw and fresh. Since there is a great dearth of research works in duck meat preservation using low temperature in Bangladesh, the present study would demonstrate the cold behaviours of microorganisms present in duck meat, find out the presence of faecal indicators surviving during frozen storage and identify the recognizable organoleptic changes developing with prolonged storage and finally to assess the shelf life, keeping quality of duck meat during frozen storage and its impact on public health. A total of 40 samples (each weighing about 1200 gm) from two different regions (breast and shank) of 20 traditionally and 20 hygienically dressed carcasses were collected for the study. SAMPLES from each region were grouped into two categories. The first category was fresh sample (0 day storage), second one was first chilled at 2-3^{o} C for two hours and then kept in frozen storage and the third was directly kept in freezer storage. All these category samples were examined at 0 day, 3 days, 7 days, 14 days and 30 days of storage. The microbial loads obtained were relatively higher in case of meat samples of traditionally dressed carcasses than that of hygienically dressed carcasses and in samples under prechilled and frozen storage than samples under direct frozen storage. The total viable count (TVC) first increased at 14 days of storage then dropped and again increased at 30 days of storage. On the other hand, the total staphylococcal count (TSC) and total coliform count (TCC) decreased gradually with prolonged storage. No coliform was detected at 30 days of storage. The sensory attributes like colour, odour, consistency, texture, juiciness and the overall appearance were assessed. The total score obtained was lowest in meat samples of breast and shank region of both prechilled and frozen storage and direct frozen storage. In almost all cases prechilled and frozen storage samples attained comparatively higher sensory score at all prolonged storage periods than the direct frozen samples. The present research study emphasized the necessity for handling meat intended for frozen storage in a scrupulously sanitary manner. Moreover, in most instances, organoletptic evaluation suffices and bacteriological analysis confirm the expected acceptability and consumers' protection of the food product.

INTRODUCTION

Duck is a waterfowl and is still very popular and in strong demand in many area of the world, especially in Asia (Ali et al., 2007). More recently duck cuts, such as breast and legs, have become more available which offer more options for diet-conscious consumers. As a good protein source, duck meat can be considered as better alternative (Adzitey et al., 2012a). The consumption of white meats, including duck meat, is gaining more attention owing to recommendations for a reduced intake of red meat due to its association with cardiovascular pathologies (Adzitey et al., 2012b). However, the safety of food products has become a major issue of concern (Kim et al., 2014). The consumption of contaminated duck meat or products, like other types of meat, poses the risk of foodborne diseases. The contamination usually takes place during pre- and post-harvest handling which makes the preservation of meat more difficult than most other foods (Fraizer and Westhoff, 1995). Unfortunately, duck meat has received little attention by researchers compared to other poultry (Kim et al., 2016).

Unless proper preservation methods are adopted, deteriorative microbial activity, enzymatic chemical reactions along with physical changes obviously occur. Efforts are directed to attain

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maximum asepsis, to minimize contamination and delay decomposition of the food product as far as possible. Hence the preservation of meat is essential and this is usually accomplished by the use of low temperature, high temperature, moisture control, direct microbial inhibition etc. Various methods employed to prolong the shelf life of meat are chilling/refrigeration, freezing, curing, smoking, thermal processing, canning, dehydration, irradiation (Sharma, 1999).

Freezing has an effect on nutritional and microbiological properties of raw poultry meat and fish. Cidal effects of freezing on different types of organisms are associated with poultry meat are established (Berry, 2009). Preservation of meat by freezing is the most effective method if the storage temperature drops from -12.2 toward -28.9 °C. The quality of meat and meat products can be preserved for months together during frozen storage at -10°C. However, a storage temperature of -18°C is recommended because at this level almost all water in meat is frozen (Rahman, 2003). The shelf life of frozen meat can be determined by some physical observation such as discoloration, slime formation, stickiness, whiskers etc.

Several investigations revealed that bacterial pathogens such as *Salmonella* species, *E. coli*, *Listeria monocytogenes*, S*taphylococcus aureus*, and *Bacillus cereus* are associated with ducks, other food animals and meat products (Losito et al., 2005; Adzitey and Huda, 2010; Alonso et al., 2011). During freezing storage we are concerned with the possible survival of pathogenic and toxigenic microbes as well as saprophytic microorganisms that might play a part in the deterioration of the meat product. The numbers of organisms are of interest, but so is knowledge of the specific forms of perceptible organoleptic quality degradation.

In view of the fact it is therefore, intended to determine the microbial load, find out changes in specific chemical properties, evaluate organoleptic quality and assess public health safety of duck kept in frozen storage. Keeping these intentions as yardsticks of wholesomeness, the objectives of the present study were to demonstrate the cold behaviour of microorganisms present in duck meat, and to find out the faecal indicators surviving during frozen storage, along with the identification of the cognizable organoleptic changes developing with prolonged storage and assessment of the shelf life, keeping quality of duck meat during frozen storage and its impact on public health.

MATERIALS AND METHODS

Experimental design

A total number of 40 dressed ducks were collected from local market. For the research study each duck was portioned two cuts breast and shank aseptically were subjected to examination. The dressed birds were divided primarilly into two categories, category i) hygienically dressed, ii) conventionally dressed. After collection of dressed ducks, the breast and shank portions are excised and subjected to bacteriological analysis and sanitary quality determination. The TVC, TCC, TSC were determined by using NA, MA and MSA agar medium to find out the microbiological quality of dressed meat. The isolation and identification of various bacteria contaminating the meat samples of hygienically handled dressed bird and conventional dressed in retail markets were also undertaken. The organoleptic quality was also simultaneously determined by using taste panel expert scores. Birds under this study were slaughtered by halal (Islamic Manner) method and dressed with utmost hygienic care and management.

Sample collection and processing

All samples were collected from local market BAU campus and Mymensingh. These were purchased and brought to convenient slaughter points and killed by Halal method. The defeathering, skinning and evisceration were done in two ways: (i) using hygienically recommended techniques and (ii) with conventional care and usual handling and dressing technique. All these dressed birds were kept for microbiological and organoleptic examination. Breast and shank muscles were aseptically excised and subjected to experimental study.

All samples in the form of cut portions were aseptically obtained from each of the two regions

(Breast and Shank) of individual duck carcass using sterile instruments and transferred carefully to properly labelled sterile containers. After collection of the samples these were immediately brought to the laboratory if possible or within 30-45 minutes in ice packed condition.

In the laboratory 115 gm of duck meat was aseptically excised separately from each duck cut. This fresh sample is marked as for 0 day storage and subjected to examination. In the same way two more excised portions of duck were kept in polyethylene bag and then kept in frozen storage until 30 days. These two duck meat samples were marked into two different before they were kept in frozen storage. In one of the markings the sample was first chilled at 2-3^{o}c for two hours and then kept in frozen storage. The other marking was directly kept in the frozen storage. All these frozen samples were examined at 3 days, 7 days, 14 days and 30 days of storage. The control sample for the study is recognized as meat tissues of fresh cut portion prior to chilling or freezing that is sample at 0 day storage. The control and frozen storage samples obtained from cut portions were examined to determine the microbial attributes and evaluate the organoleptic quality.

Microbiological examination

Each of the fresh or stored meat samples was macerated in a mortar and pastel using sterile diluents as per recommendation of International Organization for standardization (ISO, 1995). Twenty five grams of the minced meat sample was taken aseptically with a sterile forceps and transferred into sterile containers containing 225 ml of 0.1% peptone water. A homogenized suspension was made in a sterile blender. Thus 1:10 dilution of the sample was obtained. Later different serial dilutions ranging from 10^{-2} to 10^{-6} were prepared according to the standard method (ISO, 1995).

Microbiological attributes assessment

The Total viable count (TVC), total staphylococcal count (TSC) and total coliform count (TCC) were calculated according to ISO (1995).

Cultural and Biochemical Examination of Samples

The cultural examination of suspension of minced meat samples, for bacteriological analysis was done according to the standard method (ICMSF, 1986). The examination followed detail study of colony characteristics including the morphological and biochemical properties. In order to find out different types of microorganisms in samples well isolated individual of bacterial colonies were fished out in pure culture from the NA, MA and SM-110, subsequently identified according to the Bergey's manual of determinative bacteriology (1994). The isolated organisms with supporting growth characteristics on various media were subjected to different biochemical tests, such as sugar fermentation test for acid or acid and gas, indole production test, catalase test, coagulase test, methyl-red and Voges-Proskauer (VP) test etc. In all cases standard methods as described by Cowan (1985) were followed for conducting these tests.

Organoleptic quality assessment

In this study and attempt has been made to determine the degree of correlation between the bacterial counts and the quality of birds were judged by sensory tests. Organoleptic evaluation consists in stating the attributes that can be perceived by the sense organs. The attributes included were appearance, color, flavor or aroma, consistency, texture, juiciness and overall acceptance. They were given scores in a 10 point hedonic scale for quality changes, such as for excellent 9-10 points; good 6-8 points; moderate/fair 3-5 points and Spoiled 0-2 points.

Statistical analysis

The data on total viable count (TVC), total coliform count (TCC) and total staphylococcal count (TSC) obtained from the bacteriological examination of meat samples collected from local market of Mymensingh sources were analyzed by employing factorial experiment in completely randomized design (CRD) using computer package MSTAT-C (Freed, 1992).The differences between means were evaluated by Duncan's Multiple Range Test (Gomez, 2002). Correlation between TVC, TCC and TSC were evaluated.

RESULTS AND DISCUSSION

Microbiological quality

Total viable count (TVC)

The mean values TVC per gram of meat samples were found always higher in traditionally dressed duck meat than hygienically dressed duck meat irrespective of cut position or whether with intact skin or without skin or storage strategy or storage periods. Another common finding was that the mean TVC values were in decreasing manner up to 7 days of freezing, and then gradually increased proportionately with the storage periods. An et al. (2017) found the initial mean TVC value as log 7.81, which is almost similar with the findings of the present research works, i.e., varies from 7.2 to 7.5 values. However, Abdullaha et al. (2014) found somewhat higher mean TVC value 9.27x $10^{4.}$ The details of the mean TVC values for different cut region with intact skin or without skin, either traditionally dressed or hygienically dressed, and different storage conditions and periods were shown in the Table 1.

There was a trend for the presence of higher microbial load in meat tissues of breast region than shank region. There was also a trend for the presence of higher microbial load in skinned duck meat tissues than without skin meat tissues. These phenomena can probably be ascribed to possible opportunities for getting more exposure to contamination. During handing of carcasses and dressing operations the breast in comparison to and shank regions might have received more handling and more contact surfaces with the vicinity of open visceral cavity as a consequence there prevailed resting the organisms to gain access the meat tissues and more optimum condition to get distributed. This caused ultimately more accumulation of microorganisms. It is more generally agreed that the sanitary quality of frozen foods depends largely on the manner and rapidity with which they are handled before freezing **(**Blair and McDowell, 1994).

The determination of total viable bacteria effectively evaluates the hygienic quality of foods. In frozen type foods total counts may be taken to indicate the nature of sanitary control measures to be exercised in its production prior to freezing and later transport and storage (Jay, 1978 and Murray, 1998).

Total staphylococcal count (TSC)

The mean values for TSC of breast and shank regions of hygienically and traditionally dressed carcasses of different storage days are presented in the Table 1, where it is revealed that the TSC values increased, regardless of cut region, dressing methods, with or without skin and storage conditions and periods, up to 7 days of preservation, then gradually decreased with the increase in the storage period, i.e., up to 30 days of preservation. Likewise the TVC values, the mean TSC values were always higher in traditionally dressed duck meat than the hygienically one. Though the mean TSC value of raw (fresh) ranges around 5.000, but in case of other two categories, the mean TSC valuea ranged around 2.000 which are in close agreement with the findings of Abdallaha et al. (2014) where the authors found staphylococcal count was log 2.20 in initial examination of duck meat samples.

Total coliform count (TCC)

The mean values of total coliform count of (TCC) different regions (breast and shank) of traditionally and hygienically dressed carcasses are presented in Table 1. The mean TCC values were ranged between 3.403± 0.182 to 3.563± 0.193 for the traditionally dress carcasses at 0 day (fresh sample), whereas, those of hygienically dressed carcasses were somewhat lower than traditionally dress carcasses and ranged between 3.221±0.164 and 3.347±0.246. The mean TCC values in the present study are in close similarity with the findings of Abdallaha et al. (2014) where the authors found log 1.70 for fresh beast meat sample but log 3.29 for shank meat samples. In most of the cases, the mean TCC values were found gradually decreased with the prolongation of the storage period and finally no coliform count was found at the 30 days of preservation which could be due to the lower pH of the samples (Abu-Salem and Arab, 2010; Naveen et al., 2016).

Table 1
Total microbial load in meat samples of different regions of traditionally T and hygienically H dressed duck carcasses at different storage days.

Parameters	Samples from carcasses of meat cuts	Examination for Total Viable Count (TVC)																	
		0 day (fresh samples)		Prechilled and frozen samples at storage days								Direct frozen samples at storage days							
				3 days		7 days		14 days		30 days		3 days		7 days		14 days		30 days	
		T	H	T	H	T	H	T	H	T	H	T	H	T	H	T	H	T	H
Total Viable Count (TVC)	Breast with intact skin	7.447± 0.147	5.920± 0.222	5.499± 0.108	5.356± 0.110	5.257± 0.103	5.023± 0.093	6.562± 0.295	6.513± 0.028	6.530± 0.190	6.021± 0.272	5.420± 0.148	5.174± 0.099	5.248± 0.089	4.940± 0.129	6.502± 0.268	6.491± 0.244	6.269± 0.224	6.129± 0.350
	Shank with intact skin	7.250± 0.020	5.832± 0.173	5.324 ± 0.062	5.259± 0.041	5.224± 0.117	4.852± 0.172	6.544± 0.300	6.493± 0.275	6.006± 0.293	5.962± 0.272	5.287± 0.097	5.168± 0.090	5.226± 0.110	4.745± 0.309	6.507± 0.255	6.318± 0.130	5.947± 0.145	5.771± 0.217
	Breast without skin	7.424± 0.105	5.840± 0.289	5.462± 0.093	5.285± 0.022	5.244± 0.109	4.940± 0.129	6.555± 0.303	4.940± 0.129	6.514± 0.179	6.051± 0.255	5.393± 0.067	5.170± 0.121	5.235± 0.096	4.820± 0.171	6.499± 0.301	6.485± 0.248	6.092± 0.222	5.846± 0.169
	Shank without skin	7.110± 0.083	5.579± 0.247	5.294 ± 0.057	5.266± 0.031	5.201± 0.101	4.820± 0.171	6.539± 0.292	6.487± 0.307	6.498± 0.149	6.036± 0.224	5.275± 0.059	5.179± 0.062	5.174± 0.099	4.745± 0.309	6.497± 0.255	6.479± 0.244	5.962± 0.272	5.873± 0.258
Total Staphylo-coccal Count (TSC)	Breast with intact skin	4.987± 0.542	4.978± 0.110	2.015 ± 0.227	1.949± 0.293	3.063± 0.143	2.793± 0.357	1.988± 0.069	1.571± 0.287	1.801± 0.204	1.770± 0.141	1.926± 0.269	1.721± 0.332	2.903± 0.164	2.911± 0.164	1.844± 0.316	1.509± 0.222	1.831± 0.225	1.593± 0.163
	Shank with intact skin	4.864± 0.302	4.820± 0.171	2.001 ± 0.173	1.854± 0.199	3.002± 0.175	2.804± 0.283	1.676± 0.165	1.496± 0.216	1.779± 0.132	1.739± 0.112	1.820± 0.304	1.703± 0.214	2.976± 0.167	2.819± 0.196	1.770± 0.275	1.391± 0.135	1.723± 0.251	1.483± 0.094
	Breast without skin	5.097± 0.416	5.032± 0.104	2.079± 0.213	1.922± 0.304	3.046± 0.127	2.936± 0.242	1.845± 0.107	1.571± 0.247	1.919± 0.077	1.670± 0.155	1.926± 0.269	1.708± 0.343	2.998± 0.160	2.831± 0.169	1.835± 0.252	1.521± 0.303	1.795±0 .234	1.658± 0.135
	Shank without skin	4.947± 0.391	4.769± 0.142	1.932 ± 0.242	1.830± 0.241	3.032± 0.105	2.827± 0.242	1.775± 0.126	1.416± 0.085	1.747± 0.126	1.656± 0.177	1.751± 0.254	1.684± 0.272	3.029± 0.190	2.731± 0.221	1.731± 0.215	1.388± 0.103	1.674± 0.182	1.583± 0.144
Total Coliform Count (TCC)	Breast with intact skin	3.563± 0.193	3.249± 0.142	1.741± 0.117	1.375± 0.126	2.810± 0.163	1.748± 0.184	1.249± 0.116	1.129± 0.023	-	-	2.111± 0.158	1.509± 0.222	2.733± 0.172	1.600± 0.258	1.660± 0.210	1.280± 0.168	-	-
	Shank with intact skin	3.535± 0.218	3.231± 0.116	1.658 ±0.135	1.333± 0.104	2.688± 0.165	1.635± 0.172	1.248± 0.089	1.096± 0.019			2.035± 0.182	1.481± 0.171	2.639± 0.184	1.577± 0.250	1.623 ±0.229	1.403± 0.182	-	-
	Breast without skin	3.535± 0.195	3.347± 0.246	1.729± 0.099	1.356± 0.131	2.772± 0.154	1.836± 0.122	1.236± 0.083	1.104± 0.032	-	-	1.968± 0.088	1.517± 0.193	2.761± 0.137	1.577± 0.250	1.628± 0.251	1.317± 0.170	-	-
	Shank without skin	3.403± 0.182	3.221± 0.164	1.687± 0.074	1.337± 0.072	2.574± 0.155	1.741± 0.117	1.226± 0.066	1.067± 0.047	-	-	2.014± 0.193	1.356± 0.131	2.726± 0.095	1.594± *0.218*	1.635± 0.172	1.265± 0.167	-	-

All counts are expressed in logarithms

Correlation between TVC, TCC, and TSC

The statistical analysis reveals that at day 0 storage that is in fresh meat there was a significant ($p<0.01$) correlation between total viable count (TVC), total coliform count (TCC) and total staphylococcal count (TSC) but at 3-day 7-day and 14-day of storage there was statistically insignificant correlation among the above counts. However, statistically no correlation was found among the values at 30 days of storage. The counts obtained in unfrozen fresh zero day storage meat samples held at ambient temperature exhibited as usual higher initial contamination in traditionally dressed duck carcasses than hygienically dressed ones. Similar results were obtained by Khatun el at., (2003). The difference of microbial load as noticed was about log 0.076 to log 0.054/gm depending on region, indicating the relation of sanitation practiced during handling and dressing operations. The highest count of total bacteria was recorded in breast meat tissues, demonstrating to specify that the initial contamination, which occurred at maximum level, was encountered in that area. Perieto et al., (1991); Zeleke et al., (1994); Hinton et al., *(*1998) and Murray et al., (2001) also obtained such findings result.

Organoleptic quality assessment

In this research study an attempt has been made to determine the interaction and interrelatedness between freezer storage preservation and survivability of selected bacterial profiles. Five organoleptic quality characteristics or attributes are taken into consideration for the judgment and giving scores by the taste panel experts. These attributes are: (1) color, (2) flavor, (3) juiciness, (4) tenderness (5) overall acceptance and appearance. For each of the characteristic or attribute marks scores were given on the basis of hedonic scale from 0 to 10 according to the following directive. The highest score was given 10. The total score for each sample with five attributes thus stands 50 marks.

Score 0 to 2 represent quality spoiled; Score 3 to 5 represent quality moderate; Score 6 to 8 represent quality good; Score 9 to 10 represent quality very good or excellent.
Total score:
41- 50 represent excellent quality, highly acceptable;
30 -40 represent good and acceptable quality;
21 - < 30 represent moderate and considerably acceptable quality;
10 -20 represent poor and unacceptable quality
< 10 represent spoiled

The scores given by the panel experts for the assessment of organoleptic quality of meat samples are presented in table 7. The result evidence that the highest score (80%) was obtained by the samples of breast and shank region at day 0 storage and lowest score obtained by breast samples of both prechilled and frozen storage and direct frozen storage at 30 days of storage. On prolonged storage the scores gradually dropped. At 3 day storage the scores fell from 40-33, at 7 day storage the scores decreased to 29, at 14 day storage the scores further got reduced to 25 and finally the meat samples at 30 day storage secured the lowest scores of 18. It is interesting to note that duck carcasses with intact skin was found to be of better quality irrespective of storage conditions and secured higher marks than duck carcasses without skin. Microbial growth leads to the development of undesirable organoleptic changes in various foods (Borch, 1992). Spoilage of fresh meat is directly associated with microorganisms. This development is attended by changes in flavor, appearance, colour and odour (Gracey and Collins, 1992). The rate of organoleptic degradation is influenced by a number of factors, particularly initial bacterial load and storage temperatures.

Table 2
Organoleptic quality assessment of fresh and stored meat samples obtained from various regions of hygienically dressed duck carcasses.

Stored days	Duck regions	Types of storage	Taste panel scores of different attributes					
			Colour	Flavour	Tenderness	Juiciness	Overall acceptance appearance	Total score obtained (%)
0 day (fresh sample)	Breast with skin	Fresh	8	8	8	8	8	40(80%)
	Breast without skin	Fresh	8	8	8	8	8	40(80%)
	Shank with skin	Fresh	8	8	8	8	8	40(80%)
	Shank without skin	Fresh	8	8	8	8	8	40(80%)
3 days	Breast with skin	CF	7.5	7.5	7	7	7	36(72%)
		DF	7.5	7.5	7	6	6	34(68%)
	Breast without skin	CF	7.5	7.5	7	7	6	35(70%)
		DF	7.5	7.5	6	6	6	33(66%)
	Shank with skin	CF	7.5	7.5	7.5	7.5	7	37(74%)
		DF	7.5	7.5	7.5	6.5	6	35(70%)
	Shank without skin	CF	7.5	7.5	7.5	7.5	6	36(72%)
		DF	7.5	7.5	7	7	5	34(68%)
7 days	Breast with skin	CF	6.5	7	6.5	6.5	6.5	33(66%)
		DF	6.5	7	6.5	6.5	5.5	32(64)
	Breast without skin	CF	6.5	7	6.5	6	5	31(62%)
		DF	6.5	6	5.5	6	5	29(58%)
	Shank with skin	CF	7	7	6.5	6.5	7	34(68%)
		DF	7	7	6.5	5.5	6	32(64%)
	Shank without skin	CF	7	7	6.5	5.5	6	32(64%)
		DF	7	7	5	5	6	30(60%)
14 days	Breast with skin	CF	6.5	7	6	5.5	5	27(54%)
		DF	6	5	6	5	4	26(52%)
	Breast without skin	CF	6	5	6	5	3	25(50%)
		DF	6	5	5	5	3	25(50%)
	Shank with skin	CF	6	5	6.5	5.5	5	28(56%)
		DF	6	5	6	5	5	27(54%)
	Shank without skin	CF	6	5	5	5	5	26(52%)
		DF	6	5	5	5	5	26(52%)
30 days	Breast with skin	CF	4	5	4	4	4	21(42%)
		DF	4	4	4	4	4	20(40%)
	Breast without skin	CF	4	4	3.5	3.5	4	19(38%)
		DF	4	4	3	3	4	18(36%)
	Shank with skin	CF	5	5	4	4	4	22(44%)
		DF	5	5	4	4	4	22(44%)
	Shank without skin	CF	4.5	4.5	3.5	3.5	4	20(40%)
		DF	4.5	4.5	3.5	3.5	4	20(40%)

Total score:
41- 50 represent excellent quality, highly acceptable; 30 -40 represent good and acceptable quality;
21 - < 30 represent moderate and considerably acceptable quality; 10 -20 represent poor and unacceptable quality
< 10 represent spoiled CF = Chilled frozen; DF= Deep frozen.

Table 3
Frequency Distribution of bacterial isolates from meat tissue of freshly dressed duck carcasses.

Genera	Number isolated and identified, and Percentage of isolates obtained from meat tissues of duck carcasses							
	Hygienically handled				Traditionally handled			
	Breast		Shank		Breast		Shank	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Staphylococcus	71	39	66	38	77	40	70	39
Escherichia coli	51	28	45	27	54	29	49	28
Bacillus spp.	22	10	16	13	22	15	19	13
Non specific	38	23	35	22	53	22	45	24
Total	N_1= 182	100 %	N_2= 162	101%	N_3= 206	106 %	N_4 = 183	103 %

Legends: N_1=182 (Hygienically handled from breast meat tissue); N_2= 162 (Hygienically handled from breast meat tissue); N_3= 206 (Traditionally handled from breast meat tissue); $N_{4=}$ 183 (Traditionally handled from breast meat tissue)

Isolation and identification of bacteria

In the present study, *Staphylococcus* spp., *E. coli*, *Bacillus* spp., and few non-specific bacteria were isolated and identified on the basis of conventional microbiological techniques which were mentioned in the Materials and Methods section. Haslia et al. (2015) also found the same organisms and *Listeria monocytogenes* and *Salmonella* as well. The findings of the present study is in close agreement with the results of Abdallaha et al. (2014). The name of the organisms and their frequency distributions are represented in the Table 3.

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