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Assessment of Microbial Load in Goat Carcass Kept at Different Storage Conditions

S. Karthika[1*], V. Chandirasekaran[2], V.V. Kulkarni[1] and G. Kumaresan[3]

[1]Department of Livestock Products Technology (Meat Science), [3]Department of Livestock Products Technology (Dairy Science), Veterinary College and Research Institute, Namakkkal-637 002, India
[2]Instructional Livestock Farm Complex, Veterinary College and Research Institute, Namakkkal-637 002, India

**Corresponding author*

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A B S T R A C T

Meat is a highly perishable food which is easily susceptible to microbial contamination. There are various factors which affect the freshness of the meat the most important factors are storage temperature, time of exposure of meat to extrinsic factors and handling of carcass during and after slaughter. Hence a study was conducted to compare the microbial load in chevon carcass hanged at room temperature for 6 hours and at chiller temperature for 30 hours. Twenty four numbers of 6 months old tellicherry young male goats were selected and they were slaughtered by the standard procedure. The carcass was vertically split into two halves and one half was exposed to room temperature and another half to chiller temperature. For 3 hours interval the samples were collected and microbiological analysis was done. The total viable count, coliform count, staphylococci count, streptococci count and campylobacter count was found to be increased under both the treatments during the entire storage hours. The total viable count and coliform count (log_{10}cfu/g) reached maximum of 5.24± 0.14 and 3.34± 0.13 under ambient temperature during 6 hours and 3.91± 0.07 and 2.78± 0.26 during 30 hours under chiller temperature. Under ambient temperature, the staphylococci count and faecal streptococci count (log_{10}cfu/g) were 3.68±0.13 and 2.79±0.08, respectively during 6 hours while under chiller temperature, the counts (log_{10}cfu/g) were 4.16±0.15 and 4.09± 0.09, respectively during 30 hours of storage. These counts were with in the recommended limits. It was concluded that keeping the carcass in the chilling conditions prolongs the shelf life.

Introduction

Meat is an excellent source of high quality protein, fat, carbohydrate, vitamins and minerals and is delicious, palatable and easily digestible food item and highly susceptible to microbial contaminations, which can cause spoilage and foodborne infections in humans. The tissue from healthy animals are sterile, however, it has been pointed that during

slaughter, dressing and cutting, microorganisms came chiefly from the exterior of the animal and its intestinal tract and cause contamination of meat. A great diversity of microbes inhabit fresh meat generally, but different types may become dominant depending on pH, composition, textures, storage temperature, and transportation means of raw meat.

The meat sold in the open markets are exposed to a number of microorganisms, this may be pathogenic or non pathogenic. The abattoir environment and slaughtering processes play a vital role in the wholesomeness and meat safety. Raw meat may harbour many important pathogenic microbes i.e. *Salmonella spp., Campylobacter jejuni/coli, Yersinia enterocolitica, E. coli, S. aureus* and to some extent, *Listeria monocytogenes*, making the meat a risk for human health, as without the proper handling and control of these pathogens, food borne ill-nesses may occur (Norrung *et al.,* 2009). The microorganism grow on meat cause visual, textural and organoleptic changes when they release metabolite. The factors affecting growth of micro organisms are intrinsic and extrinsic factors, however the factors having the greatest influence on growth of micro organisms in meat are storage temperatures and moisture and oxygen availability (Forest *et al.,* 1985).

This study was aimed to compare microbial contamination of goat carcasses kept at room temperature for 6 hours and chiller temperature for 30 hours.

Materials and Methods

The total of 24 numbers of 6 months old young tellicherry male goats were selected from Instructional Livestock Farm Complex, Veterinary College and Research Institute, Namakkal. The animals were allowed for overnight fasting and in the morning the animals were transported to the Department of Livestock Products Technology (Meat Science), Veterinary College and Research Institute, Namakkal for slaughter.

The animals were slaughtered by 'Halal' method. The flaying and evisceration was performed by adopting the standard hygienic procedure. Each carcass was vertically split into two half and exposed to two different post mortem conditions with one half of the carcass hanged at room temperature (T1) for 6 hours and another half of the carcass hanged inside the chiller at chiller temperature (4±1ºC) for 30 hours (T2). At 3 hours interval samples were taken from both the carcass up to 6 hours for room temperature carcass and up to 30 hours for carcass under chiller temperature.

Meat sample preparation

Five grams of meat samples were taken aseptically and homogenized with 45 ml of 0.1 per cent sterile peptone water, using a sterile pestle and mortar to detain an initial dilution of 10^{-1}. Serial ten-fold dilutions were made up to 10^{-5} in pre-sterilized test tubes containing 9 ml of distilled water. The sample preparation and spreading were carried out under laminar flow.

Microbiological analysis

The microbial load of meat was assessed by total viable count (TVC), coliform count, staphylococcal count, streptococci count and campylobacter count. It was done by spread plate technique.

Duplicate 0.1 ml volume of inoculums of suitable dilutions were spread using sterile 'L' shaped spreader over the surface of pre-poured petridishes. The plates were incubated at 35 to 37°C for 48 hours. Counts were expressed as $\log_{10}$ cfu/g of sample.

Results and Discussion

Microbial load

The means (±S.E) for microbial load in chevon kept under ambient temperature and chiller temperature (4±1℃) were presented in the table 1 and 2.

Total viable count (log_{10} cfu/g)

The mean (±S.E) total viable count of chevon kept under ambient temperature for 0^{th} hour, 3^{rd} hour and 6^{th} hour (Table 1) was 3.57±0.03, 4.66± 0.07 and 5.24± 0.14, respectively and for chiller storage at 0^{th} hour, 3^{rd} hour, 6^{th} hour, 9^{th} hour, 12^{th} hour, 15^{th} hour, 24^{th} hour and 30^{th} hour (Table 2) was 2.83±0.19, 3.60± 0.03, 3.60± 0.04, 3.62± 0.05, 3.71± 0.05, 3.77± 0.05, 3.84± 0.06 and 3.91± 0.07, respectively. Between storage treatments, 0^{th} hour, 3^{rd} hour and 6^{th} hour showed a higher significant ($p<0.01$) difference and the total viable count was high in carcass kept at ambient temperature. Under ambient temperature and chiller temperature, the storage hours showed a higher significant ($p<0.01$) difference, as the storage hour increases the count also increases significantly. Similar to our result, Kandeepan and Biswas (2007) observed that in chilled buffalo meat after post slaughter showed an increase trend in standard plate count with the increase in storage period of 7 days. The standard plate count on 0^{th} day was 5.51 log cfu/g increased to 6.20 log cfu/g at 7^{th} day of chiller storage. Singh *et al.*, (2014) also found the mean values of standard plate count (SPC) (log_{10}cfu/g) were 6.96±0.78 for chevon in retail outlet of Agra, India, but in the present study, the TVC was 5.24± 0.14 log_{10} cfu/g at 6^{th} hour under ambient temperature and 3.91± 0.07 log_{10} cfu/g at 30 hours of chiller storage. Based on International commission on microbiological specifications for foods (ICMSF) recommendations, total viable count was within the limit of 6 – 6.69 log_{10} cfu/g in both storage treatments. The increase in microbial growth was mainly by utilizing moisture in the meat.

Coliform count (log_{10} cfu/g)

The mean (±S.E) coliform count of chevon kept under ambient temperature for 0^{th} hour, 3^{rd} hour and 6^{th} hour (Table 1) was 2.28± 0.23, 2.79± 0.16 and 3.34± 0.13, respectively and under chiller storage initially the count was absent up to 3^{rd} hour, then for 6^{th} hour, 9^{th} hour, 12^{th} hour, 15^{th} hour, 24^{th} hour and 30^{th} hour the coliform count (Table 2) was 1.60± 0.22, 2.28± 0.17, 2.34± 0.14, 2.39± 0.15, 2.62± 0.17 and 2.78± 0.26, respectively. Between storage treatments, 0^{th} hour, 3^{rd} hour and 6^{th} hour showed a higher significant ($p<0.01$) difference and the coliform count was high in carcass kept at ambient temperature. Under ambient temperature, the storage hours showed a higher significant ($p<0.01$) difference, as the storage hour increases the count also increases significantly. Similar to this Ahmad *et al.*, (2013) assessed the microbial load of raw meat at abattoirs and retail outlets in Lahore and found that the mean E. coli counts for goat meat from abattoirs and retail outlet were 2.86, 1.94 log_{10} cfu/cm^2. Kandeepan and Biswas. (2007) observed that in chilled buffalo meat after post slaughter showed an increase trend in coliform count with the increase in storage period of 7 days. Based on International commission on microbiological specifications for foods (ICMSF) recommendations, coliform count was 2 to 3 log_{10} cfu/g the meat, which is acceptable within the limit under chiller storage condition but slightly higher for ambient storage condition.

Staphylococci count (log_{10} cfu/g)

The mean (±S.E) staphylococci count of chevon kept under ambient temperature for 0^{th} hour, 3^{rd} hour and 6^{th} hour (Table 1) was

2.94± 0.17, 3.40±0.15 and 3.68±0.13, respectively and for chiller storage at 0th hour, 3rd hour, 6th hour, 9th hour, 12th hour, 15th hour, 24th hour and 30th hour (Table 2) was 3.03±0.12, 2.96±0.15, 3.25±0.10, 3.34±0.14, 3.73±0.10, 3.66±0.14, 3.77±0.20 and 4.16±0.15, respectively. Between storage treatments, 3rd hour and 6th hour showed a significant ($p<0.05$) difference. Higher count was noticed in chevon stored at ambient temperature. The count increased as the storage hour increased both under ambient temperature and chiller temperature. Haque *et al.,* (2008) found that the total staphylococcal count in meat stalls was increasing as the storage period increases, initially the count was log 3.31 and total staphylococcal count obtained from delayed sample of goat meat sold in meat stalls is log 3.82. Between treatments, higher count was noticed in chevon stored at ambient temperature. Ahmad *et al.,* (2013) assess the microbial load of chevon at abattoirs and retail outlets in Lahore and found that the mean *S. aureus* counts were 2.80 and 3.07 log10 CFU/cm2 and it was present in almost 72 per cent samples. Singh *et al,* (2014) also found the mean values of staphylococci count (log10cfu/g) were 3.93 for chevon in retail outlet of agar which is almost similar to the present study. Based on International commission on microbiological specifications for foods (ICMSF) recommendations, staphyloccoi count should be 2 to 3 log $_{10}$ cfu/g of meat but in our present study there was higher staphyloccoi count in both treatment, Clarence *et al.,* (2009) reported that *Staphylococcus aureus* is a normal flora in human and animals, their presence in meat from butcher shop indicate of excessive human handling.

Table.1 The mean (± S.E) of microbial load of goat carcass kept under different storage conditions

Parameters	Storage treatments	0 h	3rd h	6th h
Total viable count (log_{10} cfu/g)	T1	3.57^{aC} ± 0.03	4.66^{aB}± 0.07	5.24^{aA}± 0.14
	T2	3.13^{bA}± 0.14	3.60^{bA}± 0.03	3.60^{bA}± 0.04
Coliform count (log_{10} cfu/g)	T1	2.28^{C}± 0.23	2.79^{B}± 0.16	3.34^{aA}± 0.13
	T2	0.00	0.00	1.60^{bA}± 0.22
Staphylococci count (log_{10} cfu/g)	T1	2.94^{aB}± 0.17	3.40^{aA}± 0.15	3.68^{aA}± 0.13
	T2	3.03^{a}± 0.12	2.96^{b}± 0.15	3.25^{b}± 0.10
Faecal streptococci count (log_{10} cfu/g)	T1	1.79^{aC}± 0.07	2.40^{aB}± 0.06	2.79^{aA}± 0.08
	T2	1.02^{aB}± 0.14	1.98^{bB}± 0.12	2.54^{bA}± 0.08
Camphylobacter (log_{10} cfu/g)	T1	1.30^{aC}± 0.05	2.21^{aB}±0.21	3.01^{aA}± 0.20
	T2	1.03^{bC}± 0.09	1.37^{bB}± 0.04	1.53^{bA}± 0.05

T1 – Room temperature storage, T2 – Chiller temperature

[ab] Means bearing different superscript in a column differ significantly ($P<0.05$) for treatments,

[A-C]Means bearing different superscript in a row differ significantly ($P<0.05$) for storage hours.

n= 24 for each treatment

Table.2 The means (±S.E) of microbial load of goat carcass kept under chiller temperature (4±1℃)

Treatments	0 h	3rd h	6th h	9th h	12th h	15th h	24th h	30th h
Total viable count (log_{10} cfu/g)	3.13^{C}± 0.14	3.60^{C}± 0.03	3.60^{C}± 0.04	3.62^{C}± 0.05	3.71^{BC}± 0.05	3.77^{AB}± 0.05	3.84^{AB}± 0.06	3.91^{A}± 0.07
Coliform count (log_{10} cfu/g)	0.00	0.00	1.60^{D}± 0.22	2.28^{C}± 0.17	2.34^{B}± 0.14	2.39^{B}± 0.15	2.62^{A}± 0.17	2.78^{A}± 0.26
Staphylococci count (log_{10} cfu/g)	3.03^{D}± 0.12	2.96^{D}± 0.15	3.25^{D}± 0.10	3.34^{CD}± 0.14	3.73^{BC}± 0.10	3.66^{BC}± 0.14	3.77^{AB}± 0.20	4.16^{A}± 0.15
Faecal streptococci count (log_{10} cfu/g)	1.02^{F}± 0.14	1.98^{E}± 0.12	2.54^{D}± 0.08	3.08^{C}± 0.10	3.41^{B}± 0.09	3.54^{B}± 0.11	3.86^{A}± 0.09	4.09^{A}± 0.09
Camphylobacter (log_{10} cfu/g)	1.03^{F}± 0.09	1.37^{E}± 0.04	1.53^{DE}± 0.05	1.59^{CD}± 0.04	1.72^{BC}± 0.05	1.86^{B}± 0.08	2.02^{A}± 0.05	2.07^{A}± 0.04

Means bearing different superscripts on row wise differs significantly (P<0.01).

Faecal streptococci count (log_{10} cfu/g)

The mean (±S.E) faecal streptococci count of chevon kept under ambient temperature for 0th hour, 3rd hour and 6th hour (Table 1) was 1.79±0.07, 2.40±0.06 and 2.79±0.08, respectively and for chiller storage at 0th hour, 3rd hour, 6th hour, 9th hour, 12th hour, 15th hour, 24th hour and 30th hour (Table 2) was 1.02± 0.14, 1.98± 0.12, 2.54± 0.08, 3.08± 0.10, 3.41± 0.09, 3.54± 0.11, 3.86± 0.09 and 4.09± 0.09, respectively. Between storage treatments, 3rd hour showed a higher significant ($p<0.01$) difference while in 6th hour significant ($p<0.05$) difference was noticed. Higher count was noticed in chevon stored at ambient temperature. Under chiller temperature and ambient temperature, as the storage hour increased significant increase in count was noticed. Bhandare *et al.,* (2007) found that the in retail shop of Mumbai the streptococcal count was 3.75 cfu/g but in our present study the faecal streptococci count was high. Supportive to this Chandirsekaran (2014) also found the faecal streptococci count of chevon in retail shops of tier II cities of Tamilnadu was 2.132±0.175 (log cfu/g). The increase in count may be due to the frequent handling of carcass.

Campylobacter count (log_{10} cfu/g)

The mean (±S.E) campylobacter count of chevon kept under ambient temperature for 0th hour, 3rd hour and 6th hour (Table 1) was 1.30± 0.05, 2.21±0.21 and 3.01±0.20, respectively and for chiller storage at 0th hour, 3rd hour, 6th hour, 9th hour, 12th hour, 15th hour, 24th hour and 30th hour (Table 2) was 1.03± 0.09, 1.37± 0.04, 1.53± 0.05, 1.59± 0.04, 1.72±0.05, 1.86± 0.08, 2.02±0.05 and 2.07±0.04, respectively. Between storage treatments, highly significant ($p<0.01$) difference was noticed in all storage hours. Higher count was noticed in chevon stored at ambient temperature. Under ambient temperature, as the storage hour increases, significant ($p<0.01$) increase in count was noticed. Under chiller temperature, as the storage hour increases significant increase in count was noticed up to 24 hours while no significant difference was noticed between 24th hour and 30th hour of storage. Ebrahim Rahimi *et al.*, (2010) isolated Campylobacter spp. from retail chevon meat in Iran. About 9.4% of the retail goat meat samples were Campylobacter positive. Based on International commission on microbiological specifications for foods (ICMSF) recommendations, Campylobacter count should be absent in meat but in our present study it was present in chevon stored at both the temperature. This higher prevalence of Campylobacter-positive samples in this study may be due to cross-contamination during manual evisceration, and processing.

It is concluded in both storage treatments the microbial load was increasing but the increase was faster under ambient temperature than in chiller temperature. But total viable count and coliform counts were within the limits. An appropriate hygienic measure during handling and thorough cooking of meat was needed for safeguard the health of the consumer.

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