

# BACTERIOLOGICAL STATUS OF MEAT DURING VARIOUS STAGES OF PROCESSING IN A.F.D. PACKING PLANT

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Studies on eight carcasses (sheep/goat) for microbial status of meat at different stages of processing viz dressed carcass before and after chilling, after boning, cooking, cooling, slicing, deep freezing, freeze drying, and packing have been carried out. No difference in microbial status has been observed in sheep and goat carcass. The lower (front body) portion of carcass has higher microbial load than the upper portion (hind body). No significant increase in total colony counts was observed on keeping the carcass for 24 hours at 5°C. The highest microbial load has been observed on boned meat. The total colony counts (TCC) gets reduced during the process of deep freezing and freeze drying. The precooked, freeze dried meat has TCC up to 266.

The low counts observed all through the various stages are mainly due to the hygienic measures adopted in the processing area.

The increase in the rate of centralized preparation of foods and the growth of prepared foods leading to instant foods and other dehydrated types of convenient foods, has been extremely rapid in the last few years. Ready-to-serve dehydrated foods are most suited for the Armed Forces. They should have excellent storage properties under all climatic conditions. Dehydration by freeze drying gives a quality that is almost equal to the fresh material.

The Department of Defence Production (INDIA), has started the manufacture and supply of precooked freeze dried mutton to the armed forces stationed at high altitudes where cooking and transportation of live animals is hazardous. This is a ready-to-eat product and the only preparation required is reconstitution in cold or simmering water and conversion into an edible dish.

In the manufacture of freeze dried mutton from live animals various operations are involved. These are stunning, guillotining, skinning, evisceration, washing, dressing, storing overnight (at a temperature of 5°C to overcome rigor mortis), boning, cooking, cooling, slicing, deep freezing, freeze drying, and packing the dehydrated product in A 2½ sanitary cans under nitrogen.

There are large number of potential sources of infection by microorganisms in the slaughter hall<sup>1</sup> and at other stages of processing. The quality of food product and its subsequent preservation depends upon preventing contamination by microorganisms before, during, and after the processing period.

The microbial status of freeze dried mutton is an important parameter in evaluating the quality of the product. While several authors<sup>2-8</sup> have discussed the effect of freeze drying on the microflora of animal based on freeze dried products, the aim of the present study is to examine the bacteriological quality of the dressed carcass at various sampling points and to systematically follow the various stages of processing to pinpoint a sensitive stage which requires stringent control measures to reduce the counts to the minimum.

## MATERIAL AND METHODS

Eight typical animals, comprising 5 goats and 3 sheep conforming to ASC specifications, were selected from a factory processing 600 to 700 animals (sheep/goats) per day for the production of Accelerated Freeze Dried (AFD) mutton. After removal of fascia from the fresh dressed carcass, ten sampling points, as

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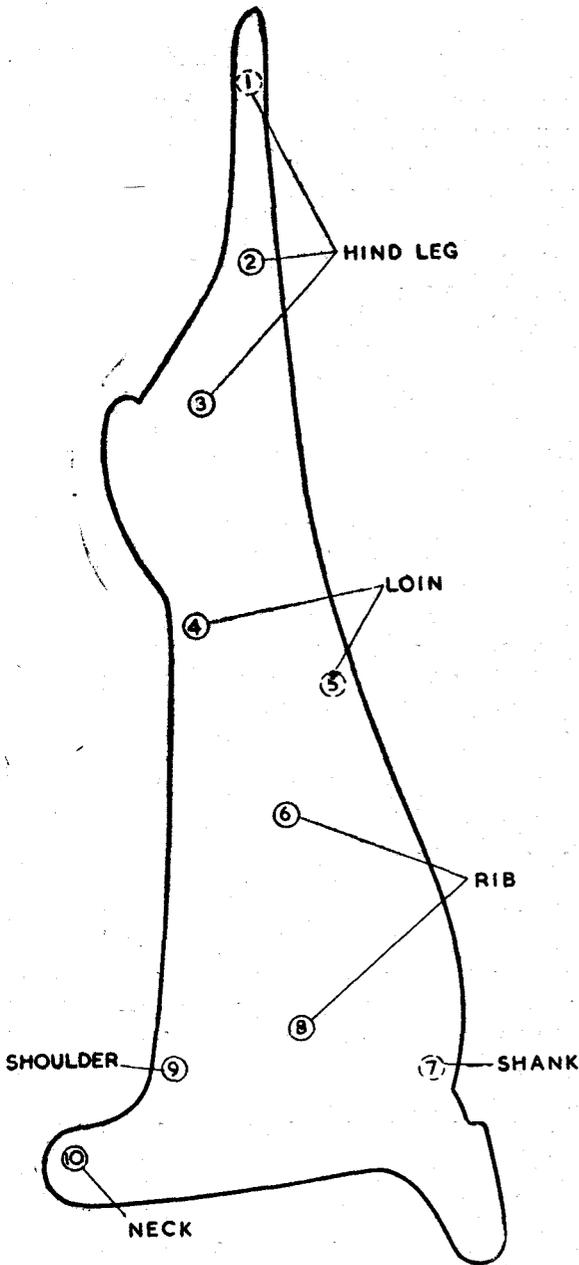


Fig. 1—Sampling points in carcass.

indicated in Fig. 1, were selected as described by Danish Meat Research Institute<sup>9</sup>. Sterile aluminium templates of known area were used for sampling by swab method which is similar to that described by Ayres<sup>10</sup>. The cotton swab were moistened with 0.1% peptone solution.

The meat samples were weighed and blended in sterile 0.1% peptone solution. Serial dilutions were made from the homogenates to obtain bacterial counts. Total Colony Counts (TCC) were obtained after 72 hours of incubation at 37°C in nutrient agar medium. Coliform and staphylococci were also detected by using violet red bile agar and staphylococci 110 media respectively.

The figures expressed are microbial counts per square centimetre on the surface or per gram on minced meat. Each figure is an average of three or more replicates.

To ensure the hygienic quality of water used for washing the carcasses, routine analysis of water was done periodically. The TCC of water was of the order of 5/ml.

## RESULTS AND DISCUSSIONS

Dr. Surkiewicz<sup>11</sup>, in his bacteriological survey of various prepared food products, had asserted that line samples and finished product are necessary for proper evaluation of bacteriological quality of the finished product. It is a better way to assure<sup>12, 13</sup> safety in food products and for quality control programme of any precooked food material. No one group of bacteria could serve as an index for microbial quality of food products. The Total Colony Counts (TCC) adopted in these studies give the summation of many kinds of contaminants and is most useful for microbial quality control. Coliform and staphylococci were also determined at all stages of processing.

The details of the animals studied for the purpose are given in Table 1. The percentage of dressed weight to live weight varied from 33–44%. The dressed weight recorded was without head, knee, and hock joints, and organs viz. kidneys, testis, pancreas, liver, heart, viscera etc. No correlation of percentage yield of dressed meat over live weight to sex, age and weight, of the animal could be drawn in this case.

The sampling spots selected on the dressed animal are expected to give the best information regarding bacterial distribution on the carcasses.

The average TCC at various sampling points given in Table 2 are 1785. The low TCC were due to the good hygienic measures adopted in the processing area and the fact that the carcasses after post-mortem, were subjected to spray washing and jet washing at 100-150 p.s.i.

The TCC of the upper (posterior) portion of the carcass were low in comparison to lower (anterior) portion. The average counts at sampling points 1 to 5 varied from 566 to 1207 while at sampling points 6 to 10 counts varied from 1708 to 3541. This may be due to the fact that after washing, water continues to drip down this portion of the carcass and also due to its nearness to men and equipment on the floor. There was no difference of microbial load between sheep and goat carcass. For a hygienic carcass it is desired that no sampling point should give counts more than 500, and average should be within 300. With a better hygienic control it is possible to obtain considerably lower counts.

TABLE I  
DETAILS OF ANIMALS

| Srl No. | Animal | Age (years) | Sex    | Weight (kg) | Dressed Weight (kg) | Dressed Weight / Live Weight (%) |
|---------|--------|-------------|--------|-------------|---------------------|----------------------------------|
| I       | Goat   | 5           | Female | 33.0        | 14.5                | 44                               |
| II      | Goat   | 5           | Male   | 40.0        | 15.5                | 39.8                             |
| III     | Goat   | 1½          | Female | 33.0        | 14.5                | 44                               |
| IV      | Goat   | 2           | Male   | 25.0        | 11.0                | 44                               |
| V       | Sheep  | 5           | Female | 26.0        | 11.0                | 42.3                             |
| VI      | Sheep  | 5           | Male   | 37.0        | 14.5                | 39.2                             |
| VII     | Sheep  | 1½          | Female | 22.5        | 8.5                 | 38.0                             |
| VIII    | Goat   | 5           | Male   | 37.5        | 15.5                | 41.3                             |

TABLE 2  
TOTAL COLONY COUNTS ON CARCASS BEFORE CHILLING

| Sampling Points | Animals |      |      |      |      |      |      |      | Average |
|-----------------|---------|------|------|------|------|------|------|------|---------|
|                 | I       | II   | III  | IV   | V    | VI   | VII  | VIII |         |
| 1               | 466     | 1466 | 1733 | 1066 | 733  | 1466 | 1533 | 1200 | 1207    |
| 2               | 666     | 866  | 1733 | 200  | 1900 | 1000 | 1133 | 866  | 1045    |
| 3               | 200     | 1400 | 600  | 1266 | 400  | 1333 | 666  | 933  | 849     |
| 4               | 133     | 533  | 600  | 666  | 933  | 600  | 400  | 666  | 566     |
| 5               | 100     | 1133 | 333  | 1400 | 666  | 1333 | 1266 | 1000 | 903     |
| 6               | 400     | 3466 | 600  | 2066 | 1133 | 2866 | 533  | 2600 | 1708    |
| 7               | 733     | 5333 | 2466 | 5200 | 2866 | 5400 | 2200 | 4333 | 3541    |
| 8               | 1000    | 3200 | 2933 | 1133 | 4066 | 3066 | 3066 | 2933 | 2674    |
| 9               | 433     | 2266 | 2133 | 4333 | 3600 | 2866 | 3333 | 3133 | 2762    |
| 10              | 1866    | 866  | 4733 | 3333 | 2933 | 800  | 3066 | 3200 | 2599    |
| Average         | 599     | 2052 | 1786 | 2066 | 1903 | 2073 | 1719 | 2086 | 1785    |

Sampling was repeated from adjacent places of the same points after the carcass had been stored for 24 hours at 5°C, to overcome rigor mortis (See Table 3). No significant increase in TCC over the prechilled ones was observed. The trend of microbial load in the upper and lower portions was observed to have been maintained. The slight increase in counts was perhaps due to the fact that the carcasses touched each other and bacterial growth could take place inspite of drop in temperature. No increase in TCC was observed on sampling points 1 & 7 which lie in the interior and number 5 which is partially inside of carcass.

TABLE 3  
TOTAL COLONY COUNTS ON CARCASS AFTER CHILLING

| Sampling Points | Animals |      |       |      |      |      |      |      | Average |
|-----------------|---------|------|-------|------|------|------|------|------|---------|
|                 | I       | II   | III   | IV   | V    | VI   | VII  | VIII |         |
| 1               | 1066    | 1533 | 1866  | 200  | 466  | 400  | 333  | 666  | 816     |
| 2               | 2600    | 1466 | 2266  | 800  | 400  | 866  | 466  | 3800 | 1583    |
| 3               | 533     | 1933 | 1133  | 1200 | 1800 | 600  | 600  | 333  | 1016    |
| 4               | 533     | 3666 | 2400  | 133  | 1000 | 333  | 666  | 7331 | 1183    |
| 5               | 200     | 1333 | 1200  | 800  | 866  | 1400 | 933  | 133  | 858     |
| 6               | 1200    | 3133 | 1600  | 600  | 1933 | 600  | 1533 | 5533 | 2016    |
| 7               | 800     | 666  | 2933  | 1466 | 2266 | 600  | 2533 | 7533 | 2349    |
| 8               | 1466    | 3733 | 9133  | 1266 | 2933 | 1200 | 2066 | 1466 | 2907    |
| 9               | 333     | 3800 | 8666  | 1066 | 9933 | 1200 | 2933 | 4133 | 4008    |
| 10              | 2666    | 1000 | 10400 | 5800 | 2600 | 1466 | 3066 | 3133 | 3766    |
| Average         | 1139    | 2226 | 4159  | 1333 | 2419 | 866  | 1512 | 2746 | 2050    |

The TCC of other stages of processing are given in Table 4. In deboned meat (1 g) high counts were observed which may be attributed to handling conditions viz. use of cutting machine, conveyor, belt, knife and unhygienic conditions of workers all contributing to bacterial load. The highest bacterial load observed was 40,000/g. In the case of two carcasses hygienic control measures were adopted during deboning and the counts obtained were 458 and 560.

TABLE 4  
TOTAL COLONY COUNTS DURING VARIOUS STAGES OF PROCESSING

| Sampling Stage      | Animals  |      |     |      |      |      |      |       |
|---------------------|----------|------|-----|------|------|------|------|-------|
|                     | I        | II   | III | IV   | V    | VI   | VII  | VIII  |
| Boned Meat          | 4333     | 458  | 560 | 1377 | 2444 | 2888 | 1999 | 40000 |
| After Cooking       | Nil      | Nil  | Nil | Nil  | Nil  | Nil  | Nil  | Nil   |
| Before Slicing      | 66       | Nil  | 66  | 1111 | 1000 | 33   | Nil  | 1200  |
| After Slicing       | 200      | 1133 | 350 | 7000 | 5222 | 160  | 800  | 1633  |
| After Freezing      | not done | 66   | 88  | 171  | 175  | 50   | 50   | 25    |
| After Freeze Drying | 100      | 50   | 50  | 83   | 83   | 55   | 55   | 66    |
| After Packing       | 266      | 166  | 166 | 200  | 200  | 200  | 200  | 233   |

The deboned meat becomes sterile during cooking in steam cabinets at 85° to 90°C for a specified period, this is then pressed into blocks and cooled overnight to facilitate slicing. The sliced pieces are steamed for a couple of minutes to minimise bacterial build up due to manual handling during this operation. An average TCC of 2062 was observed at this stage. The TCC reduces during freezing at -30°C and freeze drying. The average TCC of the packed product was 204.

In order to assess further the microbial quality of carcasses/meat at various stages of processing, incidence of staphylococci and coliforms was also determined along with the TCC on four different carcasses. The average values obtained are as follows:

ENUMERATION OF MICROBIAL COUNTS

| Sampling stage  | Microorganisms/cc <sup>2</sup> or gm |               |           |
|-----------------|--------------------------------------|---------------|-----------|
|                 | T.C.C.                               | Staphylococci | Coliforms |
| Dressed Carcass | 2170                                 | 760           | 380       |
| Set Carcass     | 2000                                 | 640           | 70        |
| Deboned Meat    | 30000                                | 1600          | 1600      |

Coagulase +ve and staphylococci were observed in very small numbers. In subsequent stages of processing no staphylococci, streptococci, or coliforms was observed. The batches produced during the last three years were regularly analysed for total counts and the figures obtained are less than 2000 counts/g. Coliform and micrococci have never been observed.

The total counts obtained at different stages of processing were low which indicates a high standard of personnel and establishment hygiene. A bacteriological survey of the processing area and its environments has been communicated<sup>14</sup>.

These TCC may not be taken as a guide line for specification purposes as the production as yet is half of its stipulated capacity. When the capacity is increased, the standard of hygiene may not be tenable due to increased traffic of men and materials within the processing area. The Commonwealth Food Specification for identical products is: bacterial counts not more than 20,000/g, coliform less than 10/g, yeast and moulds less than 100, coagulase positive, saphylococci and salmonella nil. It is also pertinent to point out that these figures relate to temperate and cold climate where generally it is easier to have reduced TCC, when compared with tropical areas.

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