EVALUATION OF REPRESENTATIVE MICROBIOLOGICAL SAMPLING SITES OF GOAT AND SHEEP DRESSED CARCASSES

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Statistical analysis of data of number of sampling points for microbial counts representing the entire goat/sheep carcass was carried out. Thirtytwo sampling points were evaluated out of which fourteen were found to represent the entire dressed carcass for assessing its hygienic efficacy.

Slaughter hall facilities in India are far from satisfactory. Modern well managed abattoirs are being established for hygienic slaughtering and for proper utilization of slaughter house by-products.

The surface bacterial load of a carcass is one of the criteria for assessing, hygienic conditions of a slaughter hall, quality of meat/meat products at various stages of processing[1], men, equipment and environment coming in its contact[2]. The estimation of bacterial numbers on meat, poultry, and other foods and the need of standardized techniques has been emphasized by various workers.[3—8]

An evaluation of representative sampling points for beef carcass has been made by Knead[9]. Similar studies in the case of sheep and goat carcasses have not been reported in India. The aim of the present study was to determine the minimum number of sampling points for microbial population in the carcass which could adequately represent the microbial load on the entire goat/sheep carcass.

EXPERIMENTAL PROCEDURE

The investigations were carried out at AFD Meat Packing Plant.

Four *Rajasthani* sheep and four *Jamunapari* goats in the age range of 3½-4 years and conforming to ASC specifications were selected at random from 700 animals for slaughter. The sequence of slaughter operations upto dressed carcass described earlier[2] was followed.

The dressed and washed carcass was divided into thirtytwo sampling sites representing evenly all the wholesale cuts as shown in Fig. 1. The thirtytwo points were distributed as twenty in the exterior region and twelve in the interior region. Out of twenty points ten were on the left and ten on the right side. Similarly in the interior region six points lay to the left and six points on the right. The following pairs denote the identical points on the left and right side of the carcass.

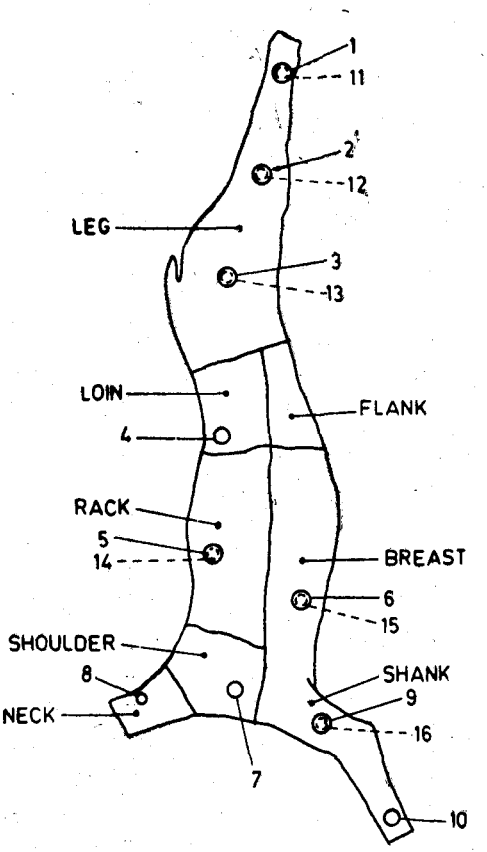

Fig. 1—Sampling sites selected initially.

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(a) Exterior region

Sampling points on the right side	Identical sampling points on the left side
1	17
2	18
3	19
4	20
5	21
6	22
7	23
8	24
9	25
10	26

(b) Interior region

Sampling points on the right side	Identical sampling points on the left side
11	27
12	28
13	29
14	30
15	31
16	32

TABLE 1

BACTERIOLOGICAL STATUS OF GOAT AND SHEEP CARCASS

Sampling No.	Location	Bacterial counts per cm² of Goat and Sheep		
		Goat female *Jamunapari* (average of four)	Sheep female Rajasthani (average of four)	Combined average
1	ER	2425	1569	1997
2	,,	1137	2160	1648
3	,,	2295	1535	1913
4	,,	1460	1900	1680
5	,,	881	2483	1682
6	,,	2295	1470	1882
7	,,	1573	1259	1416
8	,,	4708	4128	4418
9	,,	3698	3173	3435
10	,,	2043	2740	2391
11	IR	2420	2101	2261
12	,,	2210	3873	3042
13	,,	3688	1270	2479
14	,,	5530	2665	4098
15	,,	2990	1970	2480
16	,,	2170	2158	2164
17	EL	1703	1785	1744
18	,,	943	1266	1104
19	,,	2023	1270	1646
20	,,	1078	1641	1360
21	,,	1259	2475	1867
22	,,	1788	1081	1434
23	,,	2160	1580	1870
24	,,	5188	5380	5284
25	,,	3113	2674	2893
26	,,	2408	2673	2540
27	IL	2488	2355	2421
28	,,	2940	3195	3068
29	,,	5792	1588	3690
30	,,	5028	1914	3470
31	,,	2995	1844	2419
32	,,	2035	1976	2006

Sterile aluminium templates of known area were used for sampling by swab method as described by Ayres[10] and employed in earlier investigation[1,2]. The diluent used was ringer solution and nutrient agar media was used for culturing. The cultures were incubated at 37° C for 72 hours. The microbial counts were reported as number of colonies per cm^2 of the surface area.

RESULTS AND DISCUSSION

Average bacteriological counts of (a) four goats and (b) four sheep and the average of (a) & (b) are recorded in Table 1. The counts of thirtytwo sampling points were statistically analysed to find out whether all these points were necessary to represent the carcass or any reduction in these sampling points was possible. It was first examined whether any significant difference existed between the identical pairs on the right and left side of the carcass both in the exterior and interior region.

Analysis of variance was carried out to examine the difference between sites separately for exterior and interior region and between goat or sheep. It was found that the data from goat and sheep was identical.

The significance of the differences of each of the identical pairs had been examined at 5% level at *t* test. The results are recorded in Table 2 & 3. It is observed that there is no significant difference between identical

TABLE 2

SIGNIFICANCE BETWEEN IDENTICAL PAIR ON RIGHT AND LEFT OF THE GOAT CARCASS

Region	Identical Pair	Value of '*t*'	Remarks
Exterior	1, 17	3.80	Significant
,,	2, 18	0.92	Not significant
,,	3, 19	1.19	,,
,,	4, 20	2.27	,,
,,	5, 21	1.57	,,
,,	6, 22	1.11	,,
,,	7, 23	0.75	,,
,,	8, 24	1.02	,,
,,	9, 25	1.19	,,
,,	10, 26	0.68	,,
Interior	11, 27	0.38	,,
,,	12, 28	1.48	,,
,,	13, 29	2.04	,,
,,	14, 30	0.52	,,
,,	15, 31	0.01	,,
,,	16, 32	0.90	,,

TABLE 3

SIGNIFICANCE BETWEEN IDENTICAL PAIR ON RIGHT AND LEFT OF THE SHEEP CARCASS

Region	Identical Pair	Value of '*t*'	Remarks
Exterior	1, 17	0.90	Not significant
,,	2, 18	1.67	,,
,,	3, 19	1.07	,,
,,	4, 20	0.89	,,
,,	5, 21	0.03	,,
,,	6, 22	1.26	,,
,,	7, 23	0.81	,,
,,	8, 24	4.39	Significant
,,	9, 25	2.89	,,
,,	10, 26	0.23	Not significant
Interior	11, 27	0.92	,,
,,	12, 28	0.74	,,
,,	13, 29	0.66	,,
,,	14, 30	2.74	,,
,,	15, 31	0.51	,,
,,	16, 32	0.56	,,

points both for sheep and goat and for exterior and interior regions separately except for pair (8, 24) and (9,25) in the case of sheep (1,17) in the case of goat.

Thus for all practical purpose it was inferred that 19 sampling points i.e. 13 in the exterior region and six in the interior region of carcass were sufficient. The points (1,17), (8, 24) and (9, 25) are located at the extremities viz; hind leg, neck and foreleg respectively. These regions probably do not get properly cleaned/washed during dressing. This could be the reason for their significant values.

The analysis was carried out to examine whether further reduction in the number of sampling points was possible. Table 4 shows the combined analysis of variance of sheep and goat wherein, it has been observed that there was significant difference between sheep and goat.

TABLE 4

COMBINED ANALYSIS OF VARIANCE—GOAT/SHEEP

Source of variation	Degrees of freedom	Mean sum of squares
Between goats & sheep	1	11074336.03*
Within goats	3	128813.22
Within sheep	3	2999203.65
Different observation sites	31	7433466.64*
Error	217	1160336.58
Total	255	

*Significant at 5% level

This conclusion did not conflict with the earlier conclusion of combining goat/sheep for sampling points. There may be significant difference of bacteriological status between sheep and goat but still bacteriological status between left and right identical points could be similar as was observed earlier. Significant difference was also found between the sampling points. The variation within goat and within sheep were non-significant.

The critical differences of any two means of sampling points at 5% level of significance was calculated by using the formula:

$$t\,5\% = \frac{\bar{x}_i - \bar{x}_j}{\mathrm{Sd}\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Wherein $\bar{x}_i$ and $\bar{x}_j$ are the means of biological counts on left sampling points and right sampling points respectively. n_1 and n_2 are number of observations on which $\bar{x}_i + \bar{x}_j$ are based, $t\,5\%$ means 5% value of t from the Table. Sd is the estimate of standard deviation as found from error variance of combined analysis of variance Table 4. Various zones desired there from are given in Table 5. It is inferred from Table 5 that all the sampling points can be divided in three zones viz, I, II and III which consist of 23, 7 and 2 sampling points respectively.

From Table 5 the representative sampling points can be further reduced below 19 points as evaluated earlier. The three identical sampling points viz.; 1, 17 in zone I; 9, 25 in zone II; and 8, 24 in zone III alone have been found significant. These have to be incorporated for any representative sampling. Of the remaining 26 points, 21 are in zone I, and 5 points in zone II.

Keeping in view the ratios of number of points falling in each zone and that these points should be evenly distributed throughout the carcass and average microbial load at various points, the following 14, sampling sites are expected to adequately portray the microbial counts of goat or sheep carcass.

Zone wise

I : 1, 5, 7, 13, 17, 20, 26, 31.
II : 9, 25, 28, 30.
III : 8, 24.

TABLE 5

ZONES FROM SAMPLING POINTS IN A CARCASS

Sampling No.	Position location	Average of goat and sheep Microbial counts	Zone
18	EL	1104.37	I
20	"	1359.37	
7	ER	1415.62	
22	EL	1434.37	
19	"	1646.25	
2	ER	1648.37	
4	"	1680.00	
5	"	1681.62	
17	EL	1743.75	
21	"	1866.87	
23	"	1870.00	
6	ER	1882.50	
3	"	1912.75	
1	"	1996.87	
32	IL	2005.62	
16	IR	2163.75	
11	"	2260.62	
10	ER	2391.25	
31	IL	2419.37	
27	"	2421.25	
13	IR	2478.75	
15	"	2480.00	
26	EL	2540.00	
25	"	2893.12	
12	IR	3041.25	II
28	IL	3067.50	
9	ER	3435.00	
30	IL	3470.62	
29	"	3690.00	
14	IR	4097.50	
8	ER	4417.50	
24	EL	5283.75	III

ER=Exterior right
IR=Interior right
EL=Exterior Left
IL=Interior Left

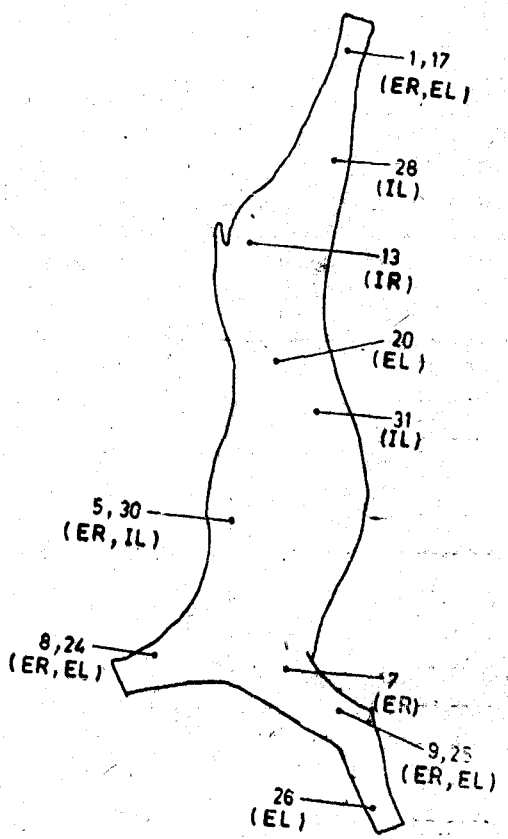

Fig. 2—Sampling sites evaluated as representative sites for the whole carcass.

These above points are located in the various regions of the carcass as follows and are shown in Fig. 2.

Region wise

Right exterior	:	1, 5, 7, 9, 8.
Right interior	:	13.
Left exterior	:	17, 20, 24, 25, 26.
Left interior	:	28, 30, 31.

It is also seen from Table 1 that the overall microbial counts on carcasses are appreciably low ranging from 880/cm² to 5800/cm². Same level of surface bacterial load was obtained in earlier studies[1] on eight carcasses and on men and equipment coming in contact[2]. These low counts serve as guidelines for assessing the hygienic condition of carcasses, processing area, equipment and men.

The representative sampling sites (14) have been evaluated from a study of eight carcasses with 32 sampling points on each. On statistical analysis appreciable consistency in the values have been established. The data from sampling sites evaluated are also in broad agreement with those obtained by Knead[9]. However, large scale studies may be desirable to establish its efficacy.

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