# MICROBIAL SURVEILLANCE PROGRAMMES AT SLAUGHTERLINES: ARE THEY REALISTIC?

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## INTRODUCTION

"Quality" is a word often used in the producing and selling area. But is new that the term "microbiological" or "hygienic" quality of meat is used in the field of public relations to convince consumers. The reason is obvious. Producers, wholesalers and consumer organisations ask for a better hygienic standard of meat. Nowadays the administrative and visual control is obviously not sufficient to guarantee hygienic meat processing.

The slaughtering of the animals is the utmost point of insecurity during meat processing. The control of this procedure by microbiological means is of considerable importance. Hitherto no microbiological standards exist in the Federal Republic of Germany, but large slaughterhouses already started self control systems to achieve a good commercial practice of production conditions based on bacteriological specifications.

## MATERIAL AND METHODS

Three continuing investigation series (I, II, and III) with a total of 70 young bulls (YB, German "Schwarzbunte" breed) were carried out in the cattle slaughterhall and the cold-storage depot of the Berlin (West) slaughterhouse to determine the effects of manufacturing practises and the chilling at the abattoir in order to identify the critical points.

In series I (10 YB) the evidence of the dry and wet swab-technique and of a rinse method (manual rinsing apparatus Berlin) was proved on four sites (a: middle shoulder, b: shin, c: flank, d: innerside brisket) on carcasses after 24 h chilling in continous manner (swabbing-rinsing-excision). For control purposes the neighbouring area was sampled additionally by the destructive method.

The 45 carcasses in series II (19 YB end of slaughterline, 15 YB 24 h chilling, 11 YB more than 96 h chilling) were tested in the same manner on the same sites and on four additional sites (e: sticking f: silverside g: bed, h: topside,) in order to find typical contaminated areas and to analyse the microflora of the meat. The surface areas were sampled in accordance to the butchers' joints of different carcasses in an abrasive way in series III (15 YB, more than 96 h chilling). These parts joined together resulted in a complete pattern of a microbiological profile of a cattle carcass.

The microbiological analysis of the samples seized beside the total viable counts (TVC) all important bacteria groups. Ps: *Pseudomonadaceae*, Mc: *Micrococcaceae*, Eb: *Enterobacteriaceae*, Y: yeasts, Ec: *Enterococci*, Lb: *Lactobacilli* and Br: *Brochothrix thermosphacta*) of the meat microflora determined by selective media and varying incubation times and temperatures (TVC = Plate Count Agar, Fa Merck 10231, 72h/30°C; Eb: VRBG-Agar, Fa

Merck 7883, 72h/22°C + oxydasetest; Mc: KRANEP-Agar, Fa Merck 5395, 48h/37°C; Y: Worth Agar, Fa Merck 5448, 72-120h/22°C; Lb: Sorbic-Acid-Agar, Fa Merck 10451, 18h/37°C anaerobic; Ec: CATC-Agar, Fa Merck 10972, 48h/37°C; Br: STAA-Agar- Gardner 1966, 72h/22°C). The media used were based on the proposals of Reuter (1984) for the microbiological analysis of meat and meat products and ISO Method 2293.

RESULTS

With regard to the fundamental strategy to microbiological surveillance programmes, the following main results will be pointed out.

A consistently higher contamination was proved statistically for the lateral surface and within this area the most contaminated sites were concentrated in the front quarter. This analysis revealed a highly significant interaction between contamination and site. The following consistently contaminated sites became evident: shin, mid brisket, hind chuck, inner front brisket, followed in second position by front chuck, lower sticking, front brisket. These differences derived from technological conditions and stayed through the chilling procedure up to 192 hours.

Therefore the restriction of sampling to typical contaminated sites seems acceptable for the microbiological process control. When considering a different slaughterhouse technology, deviations may occur. Therefore it is advisable to recommend alternatively additional sites which can be selected by investigations which have taken place earlier than the original process control.

Results of the different sampling methods were as follows: During the "continuous sampling" only the final excision of the sampling area allowed the correct comprehension of the total contamination. Minor superficial defects (e.g. 4 x 40 cm²/carcass) resulting from the excision method were accepted by the owners.

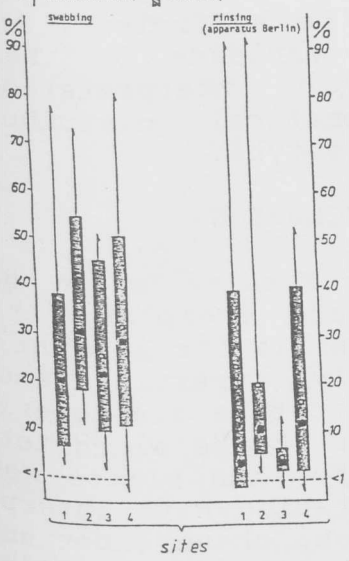
This way of continuous sampling was a suitable test model for evaluation of single non destructive sampling methods on identic areas. It is not suitable for routine investigations.

Swabbing can be used without restriction regarding practical aspects. It is easier to practice the rinsing-method than the excision-method. Neither the average amount of bacteria won by swabbing (32%) nor by rinsing (31%) favoured one of these methods. Both showed a large range (1% - 96%) of single counts which resulted in an standard deviation of 11% resp. 13%. Single tests did not result in reliable evidences. The high standard deviation was still existing in the case of 10 repetitions. These facts are based on the non standardisable factors when handling these techniques, e.g. the press of the swab rinsing, angle of the swab (Fig. 1).

Fig. 1:

Demonstration of the mean ($\bar{x}_a$ = o/$\bar{x}$ = ■) of the total viable count by non-destructive methods (in%) of the surface contamination of 4 sites of chilled cattle carcasses (n=10)

( ⊢ : maximum-minimum; ▨ : 50% area)




Rinsing had to be slightly favoured because of the better statistical parameters. Data from rinse samples showed a high significant interaction site versus TVC and Eb. There was no corresponding interaction in the swabbing data (Tab. 1).

Tab. 1:

Results of the analysis of variance - comparison of 2 non-destructive methods from 8 carcass sites

| MANOVA | | SWABBING | | | | RINSING (apparatus Berlin) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Factor | site | | | | | × | | | |
| | bull | NS | | | | NS | | | |
| | | NS | | | | NS | | | |
| ANOVA | | Tvc | Eb | Ps | Mc | Tvc | Eb | Ps | Mc |
| Factor | site | NS | NS | NS | NS | × | × | NS | NS |
| | bull | NS | NS | NS | NS | NS | NS | NS | NS |
| Site max | | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| Site min | | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 |

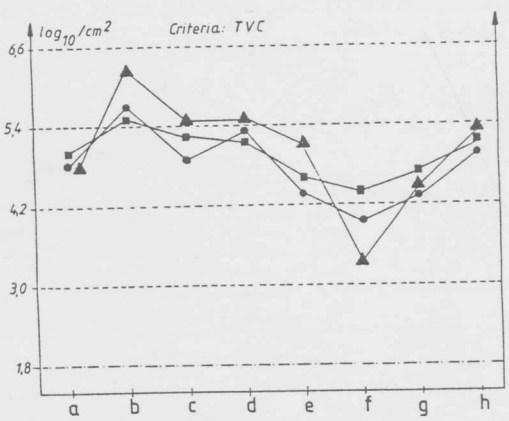
MANOVA = Multivariate Analysis of Variance
ANOVA = Analysis of Variance
× = significant
NS = non significant $P<0.05$
1 = shin
2 = flank
3 = middle shoulder

Tvc = Total viable count
Eb = Enterobacteriaceae
Ps = Pseudomonadaceae
Mc = Micrococcaceae

Trend data for the control of processing and chilling are as follows. They include the results of all sites after continuing sampling and the bacterial counts are expressed throughout as $\log_{10}$ cfu/cm².

The average TVC at the end of the slaughterline was x = 4.95 (s = 0.34) and raised at typical sites to x = 5.50 with s = 0.59, e.g., the shin. After chilling TVC raised only about half of a decimal step. This increase can only be regarded as a tendency, because within microbial analytics this ranges within the normal deviation. The surface contamination of carcasses raises only slightly under correct chilling conditions as they were found in the cold storage depot of the Berlin slaughterhouse. This would point to the conclusion that handling of carcasses in cases of higher bacterial levels was inappropriate (Fig. 2).

Fig. 2:




Average bacterial counts ($\bar{x}$g/cm²) of eight carcass sites sampled at the end of the slaughterline and after chilling ($n = 45$)

| Group | Sampling | After |
|---|---|---|
| ■ | 20' pm | $n = 19$ |
| ● | 24–28 h chilling | $n = 15$ |
| ▲ | 96–192 h chilling | $n = 11$ |
| ——·—— | fixed lower limit | |

The TVC was dominated in all processing stages by Ps (x = 3.81, s = =.25) and Mc (x = 4.07, s = 0.36). The first group showed a slight raise (x = 4.07, s = 0.79) and the latter did not decline during prolonged chilling (x = 4.25,

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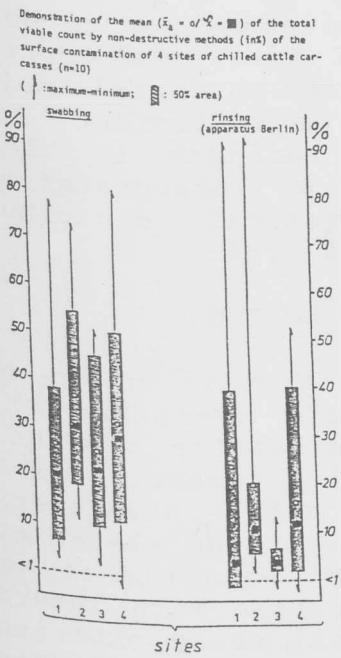


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| | | NS | | | | NS | | | |
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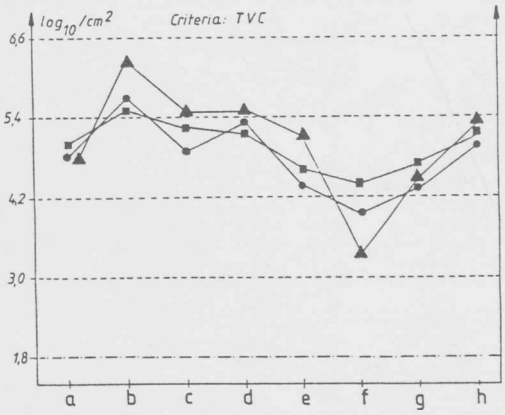


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s = 0.36). Eb was only registered by counts of x = 2.90 (s = 0.20), but showed a raise within the range of a half up to one decimal step nearly parallel to the TVC. The rise of Br was slightly minor, starting from (x = 2.87, s = 0.12) at the end of the slaughterline. The remaining parts of the microflora tested like Ec (x = 2.21, s = 0.10), yeasts (x = 2.84, s = 2.20) and Lb (x = 2.39, s = 0.17) ranged always within the decimal step of the free fixed limit of proof (1.99) to 3.00. they did not develop to more dominating parts of the microflora (Fig. 2).

The biometrical parameters showed a high significant interaction of Ps and Eb to TVC. Because fo this aspect and the ecological situation an indicator function can by attributed to these microorganisms in regard to slaughterhouse hygiene, keeping quality, and spoilage (Tab. 2).

Tab. 2:

Testing the Effect of Time (*T*) and Site (*S*) and Their Interaction (*I*) on the Microflora of Cattle Carcasses after Different Chilling Periods by Analysis of Variance* ($n = 45$)

| *Groups of microflora* | *Effects* | | |
|---|---|---|---|
| | *T* | *S* | *I* |
| TVC | 0·047 | 0·000 | 0·025 |
| Eb | 0·001 | 0·000 | 0·019 |
| Ps | 0·000 | 0·000 | 0·016 |
| Mc | 0·000 | 0·000 | 0·134 |
| Y | 0·001 | 0·000 | 0·087 |
| Lb | 0·555 | 0·002 | 0·990 |
| Ec | 0·000 | 0·000 | 0·397 |
| Br | 0·000 | 0·000 | 0·131 |

* $P < 0{\cdot}05$/significantly different.

The distribution of the bacteria on the surface of a carcass is essentially a "lognormal-distribution". Thereafter neighbouring areas show a similar contamination. Therefore, the exact anatomical definition of the sampling area seems not to be an implicit fact. The mentioning of exact butchers' joints seems to be sufficient. An analysis of variance is the suitable way of interpretation for mathematical distributions of this type.

CONCLUSIONS

The results shown here illustrate exemplary that it is possible for a plant to internally supervise and control the cattle slaughtering procedure at the slaughterline itself. When plants would start operating with internal guidelines, these experiences could be used to establish future microbiological standards.

Microbiological standards for carcasses have vast consequences. Meat in its original sense is exposed to strong deviations during the maturation. Furthermore, technological processing influences the biochemical and microbiological dynamics of the carcass. Such effects on the surface contaminations can only be jugded by expanded techniques in extremely well equipped laboratories. These methods still seem to be too much of an effort for the routine slaughtering of today.

The microbiological surveillance programme in abattoirs can be recommended, because it can be a useful source of information for the working staff and supervising veterinarians at the lower level in order to improve the hygienic standards. Moreover, these programmes are a realistic way to achieve a higher level of hygienic conditions, not only in the establishments as well as within the intra-community and world wide trade.

## REFERENCES

1.) Reuter, G. (1970): Die mikrobiologische Analyse von Lebensmitteln mit selektiven Medien. Arch. Lebensmittelhyg. 27, 30.

2.) ISO Method 2293: Aerobic count at 30°C for Meat and Meat Products (reference method), doc.no. ISO/TC 34/6N247.