HYGIENIC ASPECTS IN MEAT PRODUCTION

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INTRODUCTION

The keeping quality as well as organoleptical acceptability of meat and meat products are related to the number and types of microorganisms found in or on the product. The microorganisms generally gain access to the product through raw meat, non-meat ingredients, working surfaces, equipment and utensils. Identifying the microbiological problems associated with the food processing is the right steps towards solving them. A routine microbiological monitoring covering the quality of the raw material, the quality of the raw meat emulsions before the final processing and the hygiene of the establishment may disclose a faulty production possibility at an early stage. For many years the Danish Meat Research Institute, Roskilde, and the Danish Meat Products Laboratory, Ministry of Agriculture worked together to develop methods suitable for rapid and easy monitoring which could be carried out by persons without microbiological education and without laboratory facilities. These methods have been described in detail by Baltzer (1964) at the 10th European meeting of the Meat Research Workers and afterwards by Wilhelmsen (1966). Almost at the same time Ten Caté (1965) described the agar sausage impression method for monitoring sanitation, an easy and effective method to disclose inadequate cleaning. This paper describes the effect of these simple monitoring tests on production hygiene practiced by the majority of the Danish meat processing establishments for a period of over 10 years

MATERIALS AND METHODS

The agar sausage impression method developed by Ten Caté in 1963 and described in English in 1965, to monitor sanitation efficiency, and the resazurin reduction method for the bacteriological monitoring of raw meat trimmings and raw meat emulsions as described by Balzer (1964) and Wilhelmsen (1966) was found to be quite suitable for the meat processing industry to monitor production hygiene. They were encouraged to perform these tests themselves after short training arranged by the Danish Meat Research Institute, Roskilde. The results coming out of the monitoring were sent to the above named institute for evaluation. Danish Meat Products Laboratory under the Ministry of Agriculture, which is a controlling and advisory organisation for the meat product industry in Denmark, was asked to take over the evaluation job. In 1965 at the Danish Meat Products Laboratory was established a kind of reporting center. The results of the monitoring of production hygiene by the meat product establishments were sent regularly to the center where it was arranged in tables and was sent back to the producers with the necessary remarks. Thus it was possible for the establishments to compare their own achievements in the field of hygiene with others without identifying these. The name of the different establishments were in code which was only known to the laboratory. Some criteria were imposed to deal with the incoming results. To begin with they were as follows:

1) Cleaning efficiency judged by agar sausage impression: Generally there were 3 impressions taken on the same site. The diameter of the agar sausage was approximately 10 cm^2. If 2 of the 3 impressions had 100 or more colonies the site was judged as not being sanitized properly. Afterwards a number of establishments tightened their own judgement and demanded that some of the production areas should be cleaner, as for example slicing areas, where the maximum number of colonies were set to be not more than 50 per agar sausage slice.

2) Resazurin reduction test on raw meat:

If the blue colour changes to red or colourless in less than 10 min, the raw meat is not acceptable.

If the blue colour changes to red or colourless in between 10-30 min: just acceptable.

If the blue colour changes to red or colourless in between 30-60 min: good quality.

If the blue colour changes to red or colourless in more than 60 min: prime.

3) Resazurin reduction test on raw mix:

The natural colour of raw mix makes it difficult to determine the time for the colour change. That is why a reference tube is set up just before checking. If ascorbic acid is added to raw mix, this must be taken into consideration. In the case of raw sausage-mix the addition of resazurin solution to tubes 2 and 3 is performed according to the table:

Addition of resazurin solution:

1. tube	2. tube	3. tube
0 min	15 min	45 min

The colour of the tubes is compared immediately after the addition of resazurin solution to the 3 tube. The raw mix is satisfactory if the 2. tube has the same shade of blue colour as the 3rd tube, and the 1st tube is not completely colourless. The mix is unaccep-

table if tube 2 is partly or completely discoloured as is the lst tube.

4) Monitoring of bacterial spores in raw meat, raw emulsion and specially non-meat ingredients including spices and herbs:

Using the "most probable number" technique (MPN) the number of bacterial spores in samples were determined in anaerobic peptone milk medium.

RESULTS

Figure 1 shows the result of sanitation check by agar sausage impression method. At the beginning, 12-15 establishments monitored their cleaning efficiency and the maximum number became gradually 24. Between 12-15.000 monitoring results per month were submitted to the laboratory for evaluation and comments. Table 1 and figure 2 describe the results of sanitation monitoring conducted on different production areas for a period of 5 years. Figure 3 shows the bacteriological quality of raw meat and raw meat emulsions determined by resazurin reduction method. The number of establishments doing this monitoring were only half the number of producers doing sanitation checks. Table 2 and 3 describe the distribution of viable bacterial spores in some of the non-meat ingredients and spices and herbs used in meat products. The effect of the increased monitoring programme and the improvement in sanitary indices as hygiene of surfaces and equipments and improved bacteriological quality of the raw meat and raw meat emulsions are (inter alia) reflected in certain end product specifications as demonstrated in figure 4 and 5 and table 4. Evidently other improvements in e.g. technology of meat processing have taken place at the same time, but it can be assumed that the improvement of hygiene has had a substantical influence.

DISCUSSION

The importance of food plant quality control has never been greater than it is to-day. Product quality assurance and consumer satisfaction are the two essentiel ingredients for success in to-day's competitive market place (Bianco, 1977). There was a time when the quality control function was considered to be a luxury, not absulutely necessary for a successful business operation. When we started our campaign for a better hygiene in the Danish meat producing establishments in the middle of the sixties we met undoubtly certain amount of scepticism, but very soon the industry recognized the importance of achieving a better production hygiene. The establishment of the reporting center, the quick and effectiv monitoring system, like the introduction of agar sausage impression to monitor cleaning efficiency and the resazurin reduction tests for checking the raw material and raw mix had its positive effect on the advancement of better hygiene in the Danish meat processing industry. The number of factories participating in the monitoring system grew from 10-12 in 1965 to 23-24 by end of sixties. Through the effective control of cleaning efficiency, sanitation in general was improved. There was keen interest for better cleaning and disinfection agents, better planning for sanitation and as the whole, cleaning of the production areas became a part of the daily job like any other production activity. Instead of workers cleaning their own area after day's work, special cleaning teams were introduced. The results of sanitation monitoring (fig. 1 and 2 and table 1) shows very clearly the improvements gained through these efforts. Improvements in the quality of raw meat and raw mix were the next important achievement. The number of establishments monitoring raw material with resazurin test was not as high as it was in case of sanitation. But all the exporting establishments, which are generally big producers, were monitoring their raw material. The number of factories participating was highest by the middle and end of 60's and the number was reduced slowly with time as the quality of raw meat and raw mix became more and more stable. In the meantime some of the big producers had built up their own laboratories and the monitoring and evaluation of the results was performed by themselves. The introduction of resazurin reduction test for controlling the microbiological quality of raw meat and raw mix had its effect on the organoleptical quality of finished products. Table 2 shows clearly how the percentage of finished canned meat products with sour or putrid taste diminished between the period of 59-61 (before the test was introduced) and 64 to 68. Here we must recognize the fact that because of the detection of inferior raw material by resazurin reduction test an alartness on the part of the manufacturer to use raw material quicker than earlier period was aroused. Another fact, better control of chilling and freezing of raw material had also influenced the quality of raw material in general. The monitoring of non-meat ingredients including spices and herbs should share a good portion of the improvements achieved in the keeping quality of shelf-stable canned products with the general improvement of the bacteriological quality of raw meat, a better understanding of principles of heat treatment etc. There are a few other perspectives which could be realized from such a program. If the data is not too heterogeneous, it can be computerised. These information could be used internationally by the establishment of a data-bank of microbiological character which in time could be used in teaching, specially to the food industry of developing countries.

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P.S. The author intends to present the methods mentioned in this paper in detail during the poster session.

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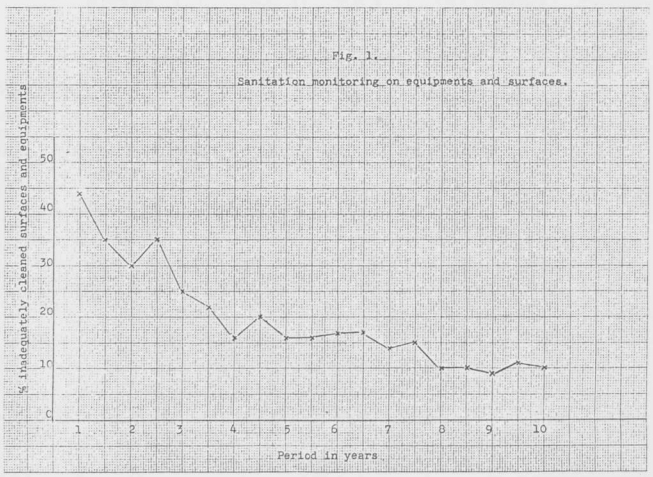

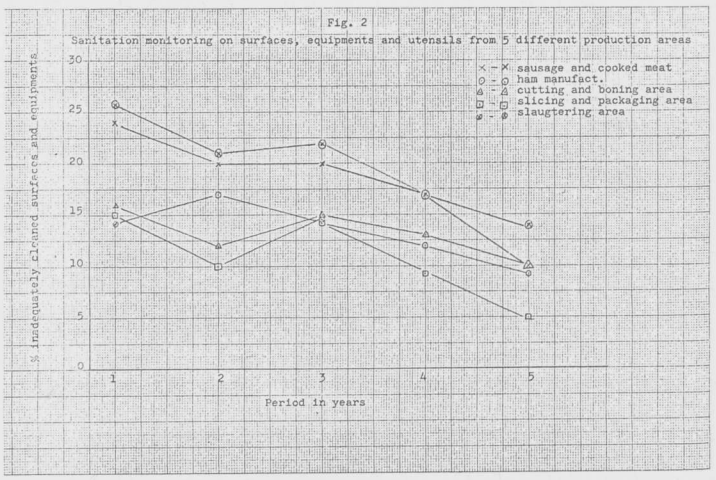

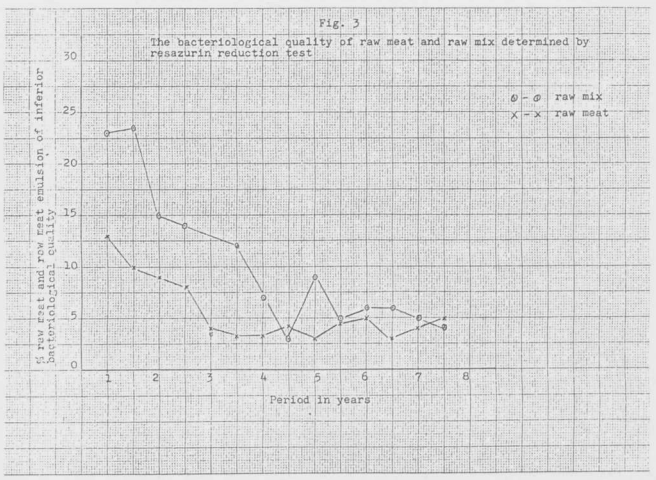

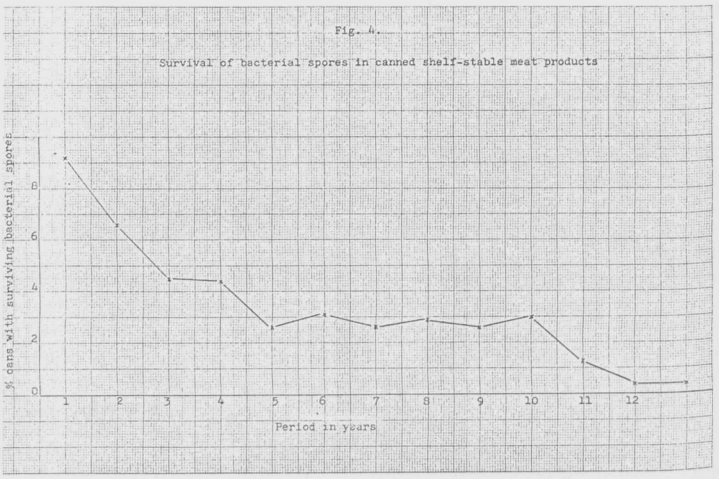

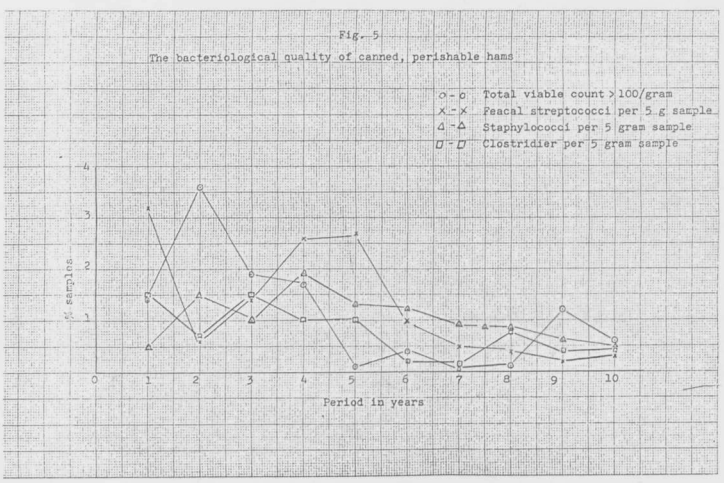

Table 1.

Sanitation control results for a period of 5 years conducted on 5 different production areas.

Period in years	Sausage and cooked meat production area		Ham manufacturing area		Cutting and deboning area		Slicing and packaging area		Slaughtering and adjacent area	
	No.of sites examined	% sites inadequately cleaned	No.of sites examined	% sites inadequately cleaned	No.of sites examined	% sites inadequately cleaned	No.of sites examined	% sites inadequately cleaned	No.of sites examined	% sites inadequately cleaned
1	10.648	24	5472	14	4592	16	2328	15	2754	26
2	12.364	20	5311	17	5798	12	2412	10	4674	21
3	12.651	20	5125	14	6419	15	2855	14	6126	22
4	17.297	17	6531	12	8561	13	3655	8	9897	17
5	6.947	10	3307	9	4104	10	1381	5	4080	14

Table 2.

Distribution of bacterial spores in non-meat ingredients.

Non-meat ingredients	No. of samples	No. of spores per gram			
		<16	16-100	101-300	>300
Soy products	29	10	10	4	5
Caseinate	27	17	4	4	2
Potato starch	22	8	9	2	3
Wheat flour	23	7	7	2	7
Milk powder	16	2	4	6	4
Dehydrated bouillon	21	6	7	2	6
Maize starch	6	3	2	0	1
Sugar	16	13	3	0	0
Salt	9	8	1	0	0

Table 3.

Distribution of bacterial spores in spices and herbs.

Spices and herbs	No.of samples	No. of spores per gram						
		<16	16-100	100-1000	1000-10.000	10.000-100.000	100.000-1 mill	>1 mill
Spice mixtures	54	11	9	10	15	4	4	1
Dried onion (rings)	22	0	0	6	7	3	2	4
White pepper	17	12	4	1	0	0	0	0
Paprika	16	0	3	6	4	1	0	2
Allspice	15	0	2	5	2	4	2	0
Nutmeg	15	10	1	4	0	0	0	0
Cardemom	12	2	1	6	1	1	0	1
Garlic (ground)	12	0	0	1	5	1	5	0
Black pepper	11	0	0	4	3	3	0	1
Ginger	10	5	3	2	0	0	0	0
Coriander	9	3	3	2	1	0	0	0
Curry	8	0	1	2	2	2	0	1
Spice extracts	8	6	2	0	0	0	0	0

Table 4.

Occurence of sour or putrid taste and flavour in shelf-stable comminuted meat products

Organoleptical evaluation	1/1-1959-1/7-1961	1/8-1964-31/7-1965	1/6-1966-31/5-1967	1/6-1967-30/9-1968
% shelf-stable cans with sour taste and flavour	11,2	5,8	5,9	5,5
% shelf-stable cans with putrid taste and flavour	6,4	1,8	2,0	1,7