MICROBIOLOGICAL CONTROL OF CRITICAL POINTS IN COOKED HAM PRODUCTION

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Background

Meats and many meat products are perishable foods, subject to microbiological risks during trasformation, handling and storage. It is also well known that no sampling system which provides for analysis exclusively of the finished product can a posteriori guarantee such an objective. For the application of HACCP to define critical control points, it is necessary to identify the hazards and evaluate the microbiological risks in various production processes, analysing each phase of the process. In fact recent regulations also involve this different approach on the part of the producer, obliging him to carry out his own measures of control for each production line on the basis of the principles of HACCP. With this aim in mind it is of fundamental importance that companies are able to have access to data relating to the progress of microbial contamination in the course of each production process.

Objectives

In the field of the production of Italian pork cured meats we proposed to follow, from a microbiological point of view, the processing line of cooked ham in seven companies in the sector, each one differing in dimensions and production technology.

Material and Methods

Sampling

Microbiological tests were carried out at different stages in the processing line of cooked ham. Monitoring was performed at seven companies in the sector, distinguishable by the letters A, B, C, D, E, F, and G, each one differing in dimension and production technology. In each company, a random selection was made of 5 distinctively marked fresh hams, from which subsequently samples were taken for microbiological analysis corresponding to the different phases of production down to the finished product. In particular our research was concentrated on the control of the product during the following stages: delivery of raw material, after tumbling, demoulding and after pasteurization.

Microbiological analysis

At each stage, one quantity of 30 grammes and 2 of 25 grammes for each of the five samples for examination were taken from the surface. The quantity of 30 grammes was supplemented by peptone physiological solution in the ratio 1:3 and homogenized with Stomacher 400 (PBI). The culture conditions used for the counting of the bacteria, temperatures and incubation times are displayed in Table 1. One of the 25 grammes quantities was used to identify the presence of *Listeria monocytogenes* employing the method described by Barbuti et al (1995), while the second quantity was used to identify the presence of *Salmonella* using the method ISO 6379.

TAB. 1 - Microbiological tests

Microorganisms	Culture media	Incubation temp.(°C)	Incubation time (h)
Total aerobic count	Tryptocasein-soya agar, TSA (Biogenetics)	30	72
Lactic acid bacteria	MRS agar, MRSA (Biogenetics)	30	72
Micrococcaceae	Mannitol salt agar, MSA (Difco)	30	72
Staphylococcus aureus	Baird-Parker medium, BP (Oxoid)	37	24 - 48
Gram negative bacteria	Violet red bile glucose agar, VRBGA (Biogenetics)	30	24 - 72
Yeasts and moulds	Malt extract agar, MEA (Oxoid)	30	72
Sulfite-reducing clostridia	M5 (Casolari, 1974)	30	72 - 96
Enterococci	Bile esculin agar, BEA (Biogenetics)	37	24

Analysis of results

For each company the arithmetical averages and the fiducial intervals of the averages (p=0.95) were calculated from the logarithms of the concentrations of the most prevalent micro-organisms.

Results and Discussion

Salmonella was absent al all times throughout the production process, whereas *Listeria monocytogenes* was present only in one fresh ham in one company. *Staphylococcus aureus* was also absent (< 100 cfu/g) in almost all the hams examinated; only in the demoulding phase in one sample of two companies was low level of contamination discovered (150 e 360 cfu/g). Data relating to microbial contamination in the stages preceding cooking are shown in Figures 1 and 2. The values for total aerobic count present in fresh hams (Figure 1) were distributed over a wide range reaching, in many companies, even contamination levels near or above 10^7 cfu/g. Even within the same company a wide variation in values was confirmed, moreover, in the high values of standard deviation that were calculated. The presence consisted prevalently in Gram negative bacteria, which is characteristic of fresh meat, and in *Micrococcaceae*. The concentration of lactic bacteria and Enterococci varied considerably with the company; in particular, Enterococci were absent (< 30 cfu/g) in hams from some companies (C, D and F), whereas they were present at very high levels, for example in the hams of G company.

At the tumbling stage, as was to be expected, a levelling in the values was observed, with microbial content lower than those of fresh hams (Fig. 2). An exception was the hams of company C, where at the tumbling stage a considerable increase in the total presence of Gram negative bacteria, lactic bacteria and Enterococci was observed. In company D also, the tumbling stage was accompanied by a relevant increase in the concentration of lactic bacteria and Enterococci. Such anomalous tendencies can probably be attributed to particular enviromental conditions in tumbling (company C) and/or inadeguate hygiene during the processing line (company D).

After cooking, during the demoulding stage, the hams were subjected to external re-contamination and the values of bacterial presence at this stage were variable both as entity and as the type of bacteria prevalently present (Table 2). Such variability was caused by the hygiene of the work conditions (type of surface, cleaning measures, etc), and on the disposition of premises and equipment. In all the companies examined, thermal treatment for pasteurization of the surface of the finished product was carried out. Pathogenic bacteria were not found in the finished product while as can be observed in Table 3, the cooking (sample taken from the core of the product) and pasteurization after packaging (sample from surface), were not always adeguate for the inactivation of non-pathogenic vegetative cells (especially lactic bacteria).

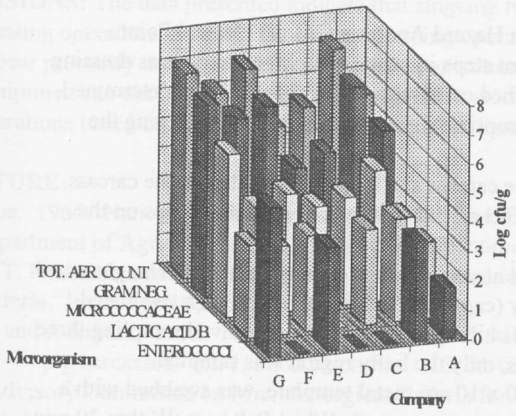

Fig.1. Microbial contamination of fresh hams.

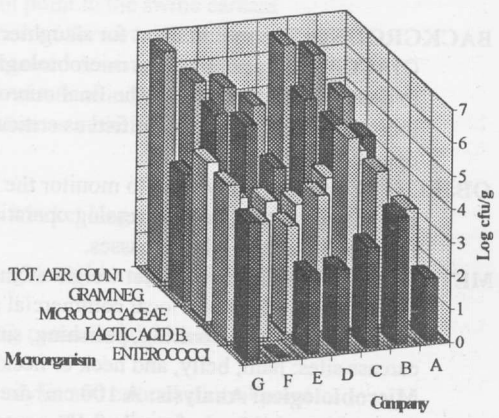

Fig.2. Microbial contamination of hams after tumbling.

Cooking and pasteurization were particularly inadeguate in company D, with the survival of lactic bacteria in all the samples examined. The finished product of company G was also contaminated, especially at the core; this result revealed insufficient cooking (T<67°C), in relation to a high quantity of Enterococci already present in the raw material.

TAB. 2 - Contamination of hams after cooking at the demoulding stage: average value ($\bar{x}$) and interval of variability of the total aerobic count.

Company	Log cfu / g $\bar{x}$ +/- 1.96σ	Microrganisms
A	2.80 +/- 1.56	Gram negative bacteria
B	3.11 +/- 1.14	*Micrococcaceae*
C	3.47 +/- 0.74	*Micrococcaceae*, Gram neg., lactic bacteria
D	4.03 +/- 0.42	Lactic bacteria, *Micrococcaceae*, Gram negative bact.,Enterococci
E	3.88 +/- 0.66	Gram negative bact.
F	3.95 +/- 0.89	*Micrococcaceae*, Gram neg. bact.
G	4.65 +/- 0.50	Lactic bacteria, Gram neg. bact.

TAB. 3 - Contamination of finished product after pasteurization.

Company	average value (cfu / g) (n° positive hams / n° tested hams) Surface sample	Core sample	Microrganisms
A	< 10	< 10	none
B	< 10	12 (5 / 5)	Lactic bacteria
C	< 10	< 10	none
D	$9.3.10^3$ (5 / 5)	91 (5 / 5)	Lactic bacteria
E	< 10	< 10	none
F	< 10	< 10	none
G	12 (1 / 3)	$1.5.10^3$ (2 / 3)	Enterococci

Conclusions

It was demonstrated that cooking was the critical control moment and was generally adeguate for inactivating any bacteria present. During packaging the product underwent variable recontamination both as entity and typology, but pasteurization of the packaged product, which was carried out by all the companies, was almost always enough to inactivate vegetative recontamination cells. In all the cases under examination the thermal treatment adopted made it possible to control health hazards: the absence of pathogens in the finished product. Only in two companies were the thermal treatments of cooking and pasteurization unsuitable for guaranteeing the commercial stability of the product.

Pertinent literature

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