Bulgarian Journal of Veterinary Medicine (2004), 7, No 3,167−172

CRITICAL CONTROL POINTS IN ASSESSMENT OF MICROBIOLOGICAL RISK IN A SMALL MEAT-PROCESSING ENTERPRISE

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Summary

Pavlov, A. and P. Chukanski, 2004. Critical control points in assessment of microbiological risk in a small meat-processing enterprise. *Bulg. J. Vet. Med.*, **7**, No 3, 167−172.

The studies were performed in a small meat-processing unit whose production is intended for the regional market. Raw ready-to-cook meat products that did not undergo a thermal processing and thus being at a higher risk for consumers were studied. The critical control points (CCP) were determined and corrective actions were realized. The analysis was performed according to the international requirements for this type of industry. The most important critical points were filleting and trimming of meat, the machine processing and packaging. Microbiological tests of production specimens, of machines and units prior to and following the accomplishment of the corrective actions were done.

Key words: HACCP, GMP, ground meat

INTRODUCTION

The safety of animal foodstuffs is a primary requirement according to several normative documents and thus, obliges producers to implement systems for decreasing the risk for consumers that originates from the process of production itself (Anonymous, 1993; Anonymous, 1993a, Anonymous, 2002). Several investigators (Mortlock *et al.*, 1999; Hoornstra and Notermans, 2001; Rose *et al.*, 2002) outline microbiological hazards as the most important ones. The contemporary approach towards limitation of the risks mentioned is implementation of its analysis and using the Hazard Analysis and Critical Control Points (HACCP) system. It differentiates three types of hazards: biological, chemical and physical (Anonymous, 1993). By now, both European and national regulations do not require the obligatory implementation of the system in animal foodstuff production and therefore, the interest of producers is still limited. This is due to the lack of personnel and experience in this field (Stevenson, 1990) as well as to the insufficient financial funds in smaller enterprises (Jouve, 1994).

Our legislation has made a step towards increasing the responsability of producers (Anonymous, 2002) introducing mandatory self-control of the production. Furthermore, Berends and van Knapen (1999) offered a replacement of meat inspection, performed currently by state veterinarians, by a risk assessment-based system of meat safety and pointed out the possible risks related to it.

According to Bryan (1990), particular risks during the processing of meat products are the cool storage, the improper thermal processing anf the cross contamination during processing. The biological risks are outlined as most important in the works of Brown *et al.*, (2000), Hoornstra and Notermans (2001), Dormedy *et al.* (2000) etc.

Taking into account the significance of the problem, we aimed to assess the microbiological risk and to determine the critical control points in a small meat processing enterprise producing ready-to-cook meat products.

MATERIALS AND METHODS

The studies were performed in 1998-2000 in a small enterprise, manufacturing raw ready-to-cook ground meat products (ground meat, oblong rissoles, meat balls, sausages etc.) with a daily capacity up to 1000 kg. Our choice fell on ground meat as an assortment representative for the whole production range because its technology covered to a certain extent that of other products. The chosen product did not undergo a thermal processing and therefore the hazards related to its storage and realization for consumers were more likely to occur.

The technology of the production was studied and the risk points were detected. Microbiological studies on the supposed critical places were performed. On the basis of our results, the potential critical control points were determined. Corrective actions were made and one month later, the microbiological analyses were repeated.

The technological schedule and the process steps were recognized via observations. The critical control points (CCP) were identified via a decision tree (Anonymous, 1993).

The microbiological studies were performed via swabing the surface by means of sterile sampling swabs. The used swabs were placed in numbered tubes containing 10 mL sterile physiological saline. Surface swabbings were performed from the following units and materials:

- No 1: 1st table for deboning.
- No 2: 2nd table for deboning.
- No 3: knives and sharpening steels.
- No 4: plastic cassette – prior to cleaning.
- No 5: plastic cassette – clean.
- No 6: grinding machine.
- No 7: blending machine.
- No 8: table for stuffing.
- No 9: foam meat tray.
- No 10: plastic wraps.

The samples were obtained for 6 working days during the same time of the day – prior to the lunch break and were processed as followed:

- inoculation on meat peptone agar with cultivation for 72 h at 30 ^{o}C for determination of the total microbial cell counts per 1 cm^2;
- inoculation on Endo agar with cultivation for 48 h at 37 ^{o}C for determination of total coliforms per 1 cm^2;
- inoculation on tetrathionate enrichment broth according to Muller-Kauffmann with cultivation for 24 h at 37 ^{o}C and then re-inoculation on brilliant green phenol red agar by hours 24 and 48 respectively, for detection of salmonellae;
- enrichment in a broth with cultivation for 24 h at 37 ^{o}C and re-inoculation on Chapman's agar for 48 h at 37 ^{o}C for detection of staphylococci.

On the basis of our results, a hazard analysis was made, corrective actions were performed and the ultimate critical control points were specified with regard to restricting the hazard in those points to acceptable limits ensuring the safety of the foodstuff.

RESULTS AND DISCUSSION

The investigations revealed that the enterprise accomplished the general requirements of the Good Manufacturing Practice (GMP):

- the health status of the personnel was approved (by means of health certificates);
- a good personal and production hygiene was observed;
- the requirement for adequate working clothes was observed;
- the feeding, drinking and smoking in the production premises was forbidden; it was allowed only at intended places;
- all jewellery was took off prior to work;
- the mechanical cleaning and the disinfection of every working place and the premise as a whole were carefully performed.

The results of microbiological analyses of the samples obtained during the process of production are presented in Table 1. They showed that the hazard process steps could be:

- meat deboning, removal of fascia and sorting;
- the grinding of raw materials;
- the blending.

Those processes were assessed as potential CCP and the respective corrective actions were undertaken.

The results from the second microbiological study, performed after the completion of the corrective actions in order to improve the conditions of the technology (Table 2) showed that the total microbial cell counts per 1 cm^2 and the total coliforms were decreased compared to the first determination, probably consequently to the performed corrective actions.

On the basis of potential hazards of the process, we identified critical control points, shown in Table 3. They allowed us to point out the following prerequisites for minimizing the risk for consumers to an acceptable level:

Table 1. First analysis of samples – microbial cell counts (thousands/cm^2). Data are presented as mean ± SD

Point	Total counts	Coliforms	Staphylococci	Salmonellae
1. 1st table for deboning	11.15±3.37	6.73±2.20	0	0
2. 2nd table for deboning	4.11±1.59	2.30±0.80	0	0
3. Knives and sharpening steels	5.10±1.08	3.25±0.97	0	0
4. Plastic cassette – prior to cleaning	3.37±1.14	1.61±0.86	0	0
5. Plastic cassette – clean	2.99±1.06	0	0	0
6. Grinding machine	1.77±0.81	0	0	0
7. Blending machine	1.49±0.69	0	0	0
8. Table for stuffing	0	0	0	0
9. Foam meat tray	0	0	0	0
10. Plastic wraps	0	0	0	0

Table 2. Second analysis of samples – microbial cell counts (thousands/cm^2). Data are presented as mean±SD

Point	Total counts	Coliforms	Staphylococci	Salmonellae
1. 1st table for deboning	3.58±2.39*	1.93±1.22*	0	0
2. 2nd table for deboning	3.10±2.11	1.65±1.44	0	0
3. Knives and sharpening steels	1.89±0.81*	0	0	0
4. Plastic cassette – prior to cleaning	3.03±0.99	0.31±0.26*	0	0
5. Plastic cassette – clean	2.13±0.69	0	0	0
6. Grinding machine	0.87±0.45	0	0	0
7. Blending machine	0.33±0.37*	0	0	0
8. Table for stuffing	0	0	0	0
9. Foam meat tray	0	0	0	0
10. Plastic wraps	0	0	0	0

* statistically significant vs the first analysis at $p<0.05$.

Table 3. Critical control points (CCP) of technology

Process step	Food safety hazards – biological (B), chemical (C), physical (P)	Critical control points
Meat supply. Storage	B – microbial contamination C – none P – foreign objects, contamination	CCP – CCP
Additives supply. Storage	B – none C – not acceptable chemicals P – foreign objects, damaged wraps	– CCP CCP
Meat deboning, fascia removal and sorting	B – microbial growth C – none P – foreign objects	CCP – CCP
Grinding	B – microbial contamination C – none P – foreign objects	CCP – CCP
Weighing and preparing of additives	B – none C – performed not according to the formulation P – foreign materials	– CCP CCP
Blending	B – microbial contamination C – contaminated water P – none	CCP CCP –
Weighing and packaging	B – none C – none P – lack of final check for foreign objects	– – CCP
Cooling. Freezing of product	B – microbial growth C – none P – none	CCP – –

- maintenance of premise air temperature under 12 °C;
- instead of using wooden tables for deboning, plastic surfaces have to be used in order to facilitate effective washing and disinfection;
- the knives and the sharpening steels should be sterilized prior to each trimming operation at water temperature not less than 82 °C;
- the plastic cassettes should be washed in specially detached respective premises with detergent and hot water with a temperature of 35–40 °C;
- the grinder blades and the blending equipment should be maintained in a manner allowing the proper disinfection.

CONCLUSION

The introduction of HACCP resulted in decrease in microbiological hazards to an acceptable level. The monitoring system from the part of the manufacturer should be tied down with the state veterinary control with regard to the achievement of a greater efficacy. This implies the implementation of the HACCP principles together with those of the GMP and therefore, increased responsability of manufacturers. In this respect, efforts should be directed toward attaining an adequate competence of enterprises' management team.

Moreover, the existing legislation should be improved in order to specify the acceptable and the inadequate risk during the production of various animal foodstuffs, especially in connection to the microbial contamination.

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Paper received 15.05.2003; accepted for publication 07.07.2004

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