HOT BONING AND ACID SPRAY: A TECHNOLOGY FOR DEVELOPING COUNTRIES ?

ANDRE-MARIE MATHIEU and NOBINZO KAPAY
University of Lubumbashi, Faculty of Veterinary Medicine, Department of Food Hygiene and Technology, BP 3283, Lubumbashi, Zaire.

SUMMARY: The microbiological contamination of deboned meat resulting from the cold boning (CB) commonly used in these regions has been compared to the hot boning procedure with (HBW) or without (HBO) acid spray of the carcasses.

Aerobic colony counts *Enterobacteriaceae*, *Pseudomonaceae*, *Enterococcus* spp. and yeasts & moulds were enumerated. Corresponding values (log N/cm^2) were:
CB≠HB: 6.33-5.55; 4.37-2.55; 4.73-3.54; 3.73-3.12; 3.49-2.93.
HBO≠HBW: 5.72-4.95; 2.77-2.21; 3.55-2.88; 3.09-2.41; 2.87-2.37.

A high significant decrease of the contamination ($P<0.01$) was observed on hot packaged meat cuts. High significant differences ($P<0.01$) from 0.5 to 1.0 log N/cm^2 were also observed between meat cuts coming from hot forequarters, sprayed or not. Results suggest that there might be an hygienic advantage in the utilization of hot boning and acid decontamination in the Tropics.

INTRODUCTION: The purpose of this study is to ascertain microbiological populations of hot-boned beef using conventionally chilled meat as a comparison.

The low efficiency of the chilling rooms and the ambient temperature during boning induce always high levels of microbiological contamination on deboned meat in Lubumbashi. In recent surveys (1985 to 1988) total aerobic counts were 7.19±0.47, 6.61±0.72 and 6.78±0.66 (Mathieu **et al.**, 1989).

An accelerated procedure (3 to 4 hours) between slaughter and meat freezing (before boxing) would reduce the bacterial increase currently observed on beef carcasses during the slow chilling (20 h).

MATERIALS AND METHODS: In 7 experiments 2 left forequarters were hot boned 3 to 4 hours *post mortem*; the other forequarters were chilled overnight (20 h; chilling rooms of 2.2 m high; 0.72 to 1.44 m^3/quarter, initial air T° 16-20°C, RH 90-100 %; air speed null).

An identical procedure (6 experiments) was followed for early processed forequarters with (300 ml acid spray 3 to 4 hours *post mortem* after transport - 10 kms - from the abattoir to the deboning plant: 4% lactic acid, 1 % citric acid, 1 % ascorbic acid, 4 % dextrose, 1 % NaCl made up to 100% with water as solvent) or without an acid spray. For each experiment meat cuts of 1 kg packaged in polyethylene film were sampled (25 cm^2; n=5).

The following procedures were followed for specific parameters:
- Aerobic colony count: in poured plates of Plate Count Agar (PCA, Oxoid CM 325) incubated 2 days at 30°C.

- *Enterobacteriaceae*: in poured plates of Violet Red Bile Glucose Agar (VRBG, Oxoid CM 485) with overlayer incubated 1 day at 37°C.
- *Pseudomonaceae*: on spread plates of Pseudomonas Agar Base (Oxoid CM 559) with cetrimide-fucidin-cephaloridine supplement (Oxoid SR 103) incubated 2 days at 30°C.
- *Enterococcus* spp.: in poured plates of Kanamycin Aesculin Azide Agar (Oxoid CM 591) + Kanamycin supplement (Oxoid SR 92) incubated 1 day at 37°C.
- Yeasts and Moulds: on spread plates of Sabouraud Glucose 2% Agar (Merck Art 7315) + Penicillin 1000 IU/ml + Streptomycin 1 mg/ml incubated 3 days at 25-30°C.

The statistical analysis of the data was performed with the Student t-test (Rafferty **et al.**, 1985).

RESULTS AND DISCUSSION:

High significant differences existed in the microbiological numbers on samples from cold-boned and hot-boned beef. Total aerobic count, *Enterococcus* spp. and yeasts/moulds were 0.5 to 1.0 log units lower on hot-boned beef; the magnitude of the difference for *Enterobacteriaceae* and *Pseudomonaceae* was greater than one logarithm (Table 1).

Table 1 Microbiological counts (log N/cm^2) on conventionally (CB) or hot-boned beef (HB)

Counts:	CB	HB
Aerobic colony count:	6.33 ± 0.48	5.55 ± 0.56**
Enterobacteriaceae:	4.37 ± 0.86	2.55 ± 0.89**
Pseudomonaceae:	4.73 ± 1.03	3.54 ± 0.65**
Enterococcus spp.:	3.73 ± 0.54	3.12 ± 0.71**
Yeasts and Moulds:	3.49 ± 0.93	2.93 ± 0.47**

** Differences significant ($P<.01$)

In many studies concerning the undesirable effect of hot boning on initial microbial counts, researchers showed that differences, when they did occur, were less than 1.0 log (Corte **et al.**, 1980; Fung **et al.**, 1980; Taylor **et al.**, 1980; Kotula and Emswiler-Rose, 1981; Kennedy **et al.**, 1982; Sheridan and Sherington, 1982; Smulders and Woolthuis, 1985; Kotula **et al.**, 1987). For accurate assessment of the effect of hot boning, it is necessary to compare the microbial counts at every step after the carcass receives the final wash (Kotula, 1981).

The low efficiency of the chilling rooms in developing countries (chilling rooms of 2.2 m high; 0.72 to 1.44 m^3/quarter; initial air T° 16-20°C; RH 90-100 %; air speed null) enhances the microbial contamination on the surface to more than 6.5 log APC/cm^2 and doesn't always provide adequate protection against deep spoilage: deep bone temperature to about 15°C in 24 hours (Locker **et al.**, 1975).

It is the reason why in the developing countries better hygienic results could be expected when cutting carcasses while hot.

The Table 2 gives the microbiological counts from cuts in the second experimental procedure.

Table 2 Effect of the forequarters acid decontaminaion (HBW) on the microbiological counts (logN/cm^2) of hot-boned beef

Counts:	HBO	HBW
Aerobic colony count	5.72 ± 0.48	4.95 ± 0.64**
Enterobacteriaceae	2.77 ± 0.96	2.21 ± 1.20**
Pseudomonaceae	3.55 ± 0.58	2.88 ± 0.53**
Enterococcus spp.	3.09 ± 0.72	2.41 ± 0.54**
Yeasts and Moulds	2.87 ± 0.34	2.37 ± 0.41**

** Differences significant ($P < .01$)

The acid spray used on beef forequarters reduced the counts of 0.5 to 1.0 log N/cm^2 on the cuts.

The cumulative effect of acid spray and hot boning may considerably improve the bacteriological status of meat in tropical areas where the level of microorganisms on the meat (APC) generally exceeds 10^6 (Ahmad **et al.**, 1981; Kagiko, 1986; Mathieu **et al.**, 1989).

The cost of the acid decontamination of carcasses in the working conditions of Zaire should be approximately of 2 U.S. cents/kg meat.

CONCLUSIONS: Meat cuts prepared from hot-boned carcasses have microbiological counts that are better than those of cuts prepared from conventionally processed carcasses.

Hot boning of meat is an interesting processing method to remedy the low efficiency of the chilling rooms in the developing countries where high ambient temperatures in the deboning plants are also observed.

The use of an acid spray must be considered as an additional treatment of interest:
- in reducing the total contamination of the carcasses and the health hazards linked to potential pathogenic organisms (*Staphylococcus aureus*, *Salmonella* spp.);
- in improving the shelf-life of packed beef cuts and preventing the loss of meat, particularly frequent in these regions.

REFERENCES:

- Ahmad, H., Siddiqui, R.R., Shakoor, C., and Ehteshamuddin, A.F.Md (1981) Fleischwirtschaft 61:1554.
- Corte, O.O., CIA, G., Picchi, V., Procknor, M.L.S.C., and Delazari, I. (1980) Proc.26th Eur.Meet.Meat Res.Work., Colorado Springs. I5:53.

- Fung, D.Y.C., Kastner, C.L., Hunt, M.C., Dikeman, M.E., and Kropf, D.H. (1980) J.Food Protection 43:547.
- Kagiko, M.M. (1986) Proc.2nd World Congress Foodborne Infections and Intoxications, Berlin, II:996.
- Kennedy, J.E., Oblinger, J.L., and West, R.L. (1982) J.Food Protection 45:607.
- Kotula, A.W. (1981) J.Food Protection 44:545.
- Kotula, A.W., and Emswiler-Rose, B.S. (1981) J.Food Science 46: 471.
- Kotula, A.W., Emswiler-Rose, B.S., and Berry, B.W. (1987) J.Food Protection 50:915.
- Locker, R.H., Davey, C.L., Nottingham, P.M., Haughey, D.P., and Law, N.H. (1975) Advances in Food Research 21:157.
- Mathieu, A.-M., Mboyo, O. and Isigidi, B.K. (1989) Proc.Xth Symposium W.A.V.F.H., Stockholm, in press.
- Rafferty, J., Norling, R., Tamaru, R., McMath, C. and Morganstein, D. (1985) Statworks. Ed.Heyden and Son Ltd., London.
- Sheridan, J.J., and Sherington, J. (1982) Meat SCience 7:245.
- Smulders, F.J.M., and Woolthuis, C.H.J. (1985) J.Food Protection 48:838.
- Taylor, A.A., Shaw, B.G., McDougall, D.B. (1980) Proc.26th Eur. Meet.Meat Res.Work., Colorado Springs, I3:45.