

INTRODUCTION

Early processing of beef carcasses seems to be a technology for the future. On a technological and bacteriological basis, the feasibility of this method was well established (Sornay, 1984). It has recently been reported (Houlbert, 1985) that the working process was made easier when the beef carcass side was submitted to "intermediate-temperature" boning (5 to 6h. post-mortem) than to "hot" boning (2h. post-mortem). If one considers the economic point of view, this technology sensitively decreases the processing costs of carcasses in comparison with traditional chilled-carcass processing (Eynard and Dupit, 1985). In order to design a work-line for on-the-rail early processing of beef, aimed to be used in the meat-packing industry, the various work-stations have been studied (Dupit and Mounin, 1985). We defined and we characterized each work-station, so we kept the time of each operation. From these unit elementary times we could compare the productivities in the case of early processing with that of conventional chilled processing.

MATERIALS AND METHODS

Twenty cull cows with carcass weight ranging from 270 to 300 kg were used for this experiment. These beef carcasses (conformation class R or O, a fat cover grading 2 or 3) were boned and the primals were trimmed. For each carcass :
- one side was submitted to early processing : first boning operations took place 3 to 4 hours after slaughter. For practical reasons no beef carcass side was electrostimulated.
- the other side was processed (side boned and primal cuts trimmed) after being chilled 24 hours at 5°C (very moderate air velocity).
The sides were fully boned (including the shanks and the whole brisket). For comparison purposes a deboning procedure by disassembling of the skeleton, bone after bone, with simultaneous separation of meat primal cuts, was carried out. Afterwards, the primals were immediately trimmed, and the "ready to slice" type of trimming (in french butchery P.A.T.) or retail-type trimming was chosen. We thus obtained joints corresponding to those one normally gets with the french conventional cutting procedure.
Each unit operation time was kept (separation of a bone or a muscle). The monitored times were consolidated into the main anatomic parts :
- the shoulder : the whole of the fore limbs
- the back : spinal column (excepted the sacral vertebrae) with the ribs, the sternum and the corresponding muscles
- the thigh : back limb and pelvic belt.

These three main anatomic parts are illustrated on figure 1 which represents the two faces of a beef carcass side.

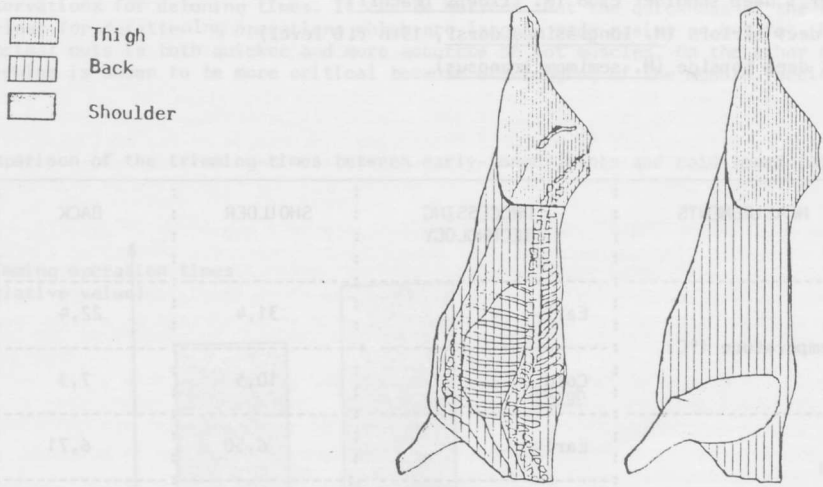


Figure 1. Main anatomic parts for which the processing (boning and trimming) times are classified

Early boning : The sides were boned hanging on-the-rail. This carcass side position has been chosen for hygienic reasons and also because it seems to be the most adequate one for a future mechanization of some deboning operations.

Our work was practised on a side hanging on-the-rail, a hook into the Achilles tendon suspended on the overhead network. In order to help us keep the side in position, we designed a vertical resting device consisting of horizontal painted metal rungs. These horizontal bars were adjustable in height according to the various concerned anatomic regions.

Boning was practised according to the following procedure :

- . Boning of the shoulder with separation of primals : chuck roll, blade clod, shoulder clod, chuck cove. After trying on-the-rail on a few sides, it was found easier to bone the shin on table.
- . Boning of the back : this operation was executed after quite a long preparation stage : collection of the fillet top loin, the tops of the sirloin, separation of the ribs from the apophysis and sawing in the medullary sheath. Boning was then performed vertebra after vertebra going from the bottom (chuck) to the top. The separated cuts were : chuck primals, brisket and short plate, ribs, sirloin.
- . Boning of the thigh with separation of the joints : rump, knuckle, topside and silverside. The back shank was boned on table.

Early trimming : As we proceeded to their separation, the joints were put on a table and immediately trimmed. The joints for fabrication (or grinding) were submitted to a succinct trimming and to elimination of fat. The joints aimed to be roasted or broiled, were mechanically trimmed (trimming-machine) after a manual cutting and defatting. They were vacuum-packed immediately after a possible manual finishing operation.

Cold boning : Two different methods were carried out :

- Fourteen beef sides were conventionally boned on a table after being divided into forequarter and hindquarter and roughly cut : cutting the shoulder off, separation chuck and cube roll from brisket and plate for the fore quarter. The loin was separated from the thigh on the hind quarter. All these primal joints were conventionally deboned on table. The preparation times were included in the processing of the back.
- Six beef sides were deboned hanging on-the-rail in a similar way as those which were early-boned. It seemed worthy indeed to compare the work-times monitored in early boning with those in cold-boning, with an identical cutting procedure.

Cold trimming : All the beef side joints were trimmed on table, using a trimming-machine, in exactly the same conditions as those for early trimming. Vacuum-packing immediately followed trimming of the joints.

Temperature and pH : They were monitored before the beginning of the boning operations, e.g. 4 hours post-mortem for the early-boned sides, and after 24 hours chilling for the cold-boned sides.

Each anatomic part already defined was probed for pH and temperature measurements (table 1).

- . shoulder : deep shoulder clod (*M. triceps brachii*)
- . back : deep sirloin (*M. longissimus dorsi*, 13th rib level)
- . thigh : deep topside (*M. semimembranosus*)

MEASUREMENTS	PROCESSING TECHNOLOGY	SHOULDER	BACK	THIGH
Temperature (°C)	Early	31,4	22,4	36,8
	Cold	10,5	7,3	14,9
pH	Early	6,50	6,71	6,31
	Cold	5,60	5,67	5,52

Table 1 : Temperature and pH of beef sides before early boning and before cold (conventional) boning. Mean values from 20 carcass sides are shown in each case.

The temperature was measured by means of a digital numerical thermometer equipped with a thermocouple probe; the pH was directly measured on a portable digital pH-meter equipped with a penetration electrode (SCHOTT-GERATE).

Results and discussions

The work-times, integrated by anatomic part, were compared for boning, trimming operations and the overall. Figures 2, 3 and 4 show the dispatching of these work-times.

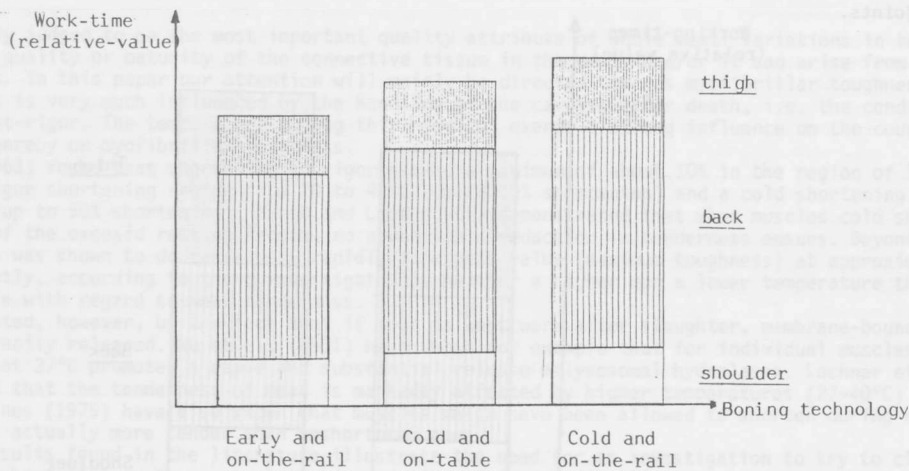


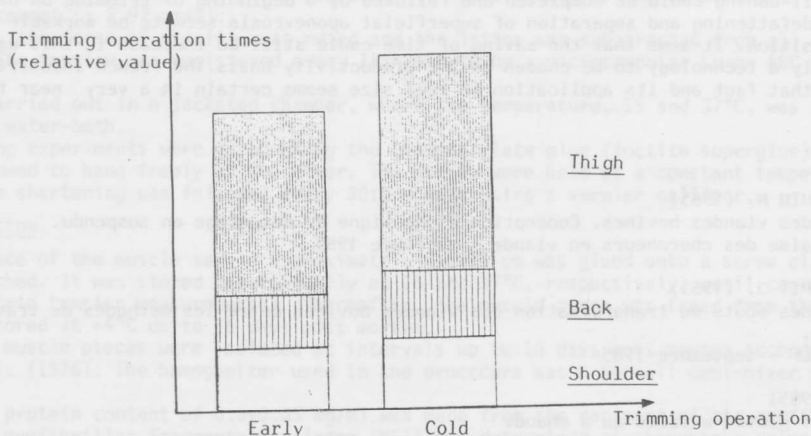
Figure 2 : Comparison of boning-times

Early boning is the quickest of the three studied methods for this operation. The reduction of work-time is 12 % compared to conventional cold deboning on-table and 19 % compared to cold on-the-rail deboning. A decrease of these work-times could be observed on the three main anatomic parts, but it was more important for the thigh. For the back, the reduction of boning-times is actually more important because the beginning of trimming is made on-the-rail (particular for the flanks). It is to be noticed that on-the-rail cold-boning is not worth while if we compare it to on-table cold-boning at least during this experimentation where all the deboning operations were manually carried out.

Trimming times

Early trimming takes a much shorter time than cold-trimming; saving in time is 19 % (figure 3). All the anatomic parts are concerned, however the most important time-saving took place on back-primal trimming, which confirms our observations for deboning times. It can be noticed that the quickness of the early trimming operations is mostly clear for defatting operations which are largely made easier on hot fat. Moreover, the disassembling of primal cuts is both quicker and more accurate on hot muscles. On the other hand, the use of the trimming-machine is shown to be more critical because of clogging of the muscle feeding rolls.

Figure 3 : Comparison of the trimming-times between early-boned joints and cold-boned joints



Overall comparison

If one considers the overall processing of beef joints (deboning and trimming), the labour power needed to work on one side can then be evaluated. Early processing of beef appears to be a much faster method than cold processing : the observed saving can be evaluated at 15 % for the overall deboning operations (choosing table-deboning in case of cold-processing) and elaborate-type trimming (P.A.T. type) (figure 4). This saving concerns the three studied anatomic parts and it is much more evident for deboning and trimming of the thigh joints.

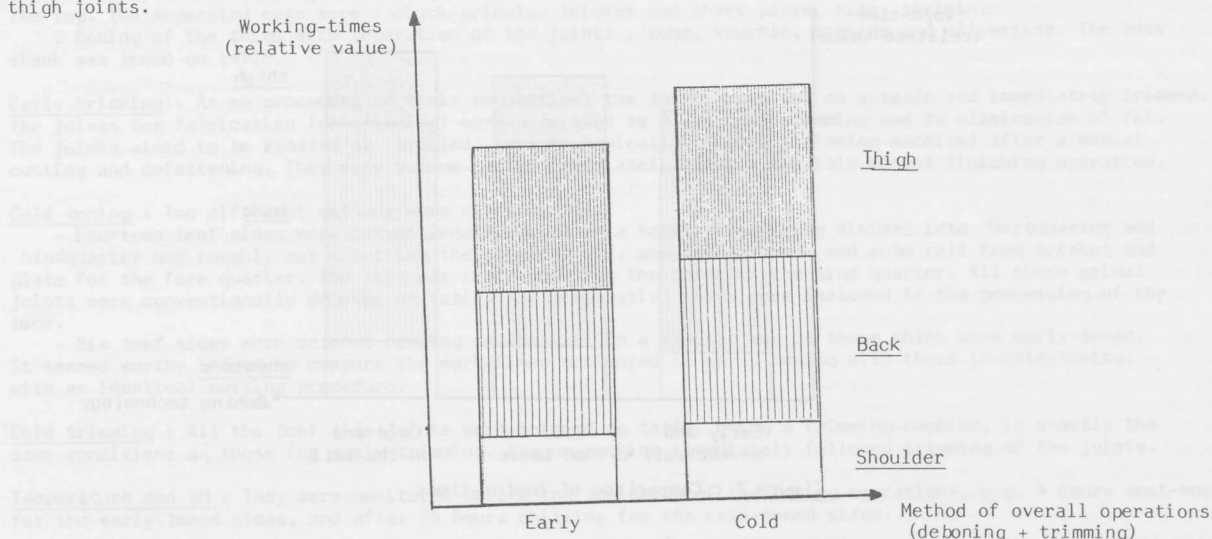


Figure 4 : Comparison of overall working times (deboning + trimming)

Although deboning operations are quicker when they are executed early post mortem, the saving in time mostly results from the quicker trimming operations.

Conclusions

Early processing of beef should result into an increase in productivity of boning and trimming plants. This increase, already very clearly showed in this experiment, should be even more important in future processing plants for the following reasons :

- on the one hand, the specialization of the work-stations will decrease the necessary times for each elementary operation. During our series of experiments, we observed a definite decreasing of work-times between the first and the last carcasses.
- on the other hand, the "hanged on-the-rail" position will allow the use of devices helping the manual work (supporting of joints, pulling of bones) even mechanization of some operations (pulling out of bones or muscles) which is not possible by on-table processing. The hanged on-the-rail processing will find all its interest, perhaps even if practised on chilled carcasses. The work-lines could then be used as well for hot carcasses as chilled ones and then be able to process all the categories of beef meat.

At last, on-the-rail-boning could be completed and followed by a beginning of trimming on hanged carcass sides. The operations of defatting and separation of superficial aponevroses seem to be workable indeed, at last partly, in this position. It seems that the saving of time could still be increase in this way. Early processing of beef is evidently a technology to be chosen on the productivity basis. The french industrial companies are very conscious of that fact and its application in real size seems certain in a very near future.

References

- . DUPIT J. and MOUNIN M. (1985)
Désossage précoce des viandes bovines. Conception d'une ligne de désossage en suspens.
3ème réunion française des chercheurs en viande - décembre 1985
- . EYNARD P. and DUPIT J. (1985)
Etude comparative des coûts de transformation des viandes bovines entre les méthodes de travail classique, à chaud et à tiède.
Bulletin du CEMAGREF - septembre 1985
- . HOULBERT J.M. (1985)
Désossage précoce : plutôt à tiède qu'à chaud.
3ème réunion française des chercheurs en viande - décembre 1985
- . SORNAY J. et al. (1984)
Stimulation électrique et désossage à chaud des carcasses de gros bovins.
Etude réalisée par l'ITEB sous contrat OFIVAL