URATION OF HIGH TEMPERATURE *PRE RIGOR* PERIODS : EFFECT ON AGEING

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ongissimus dorsi, *Semimembranosus* and *Triceps brachii* muscles from old cows were removed 1h - 1h30 after slaughter. For each uscle, one sample was immediately stored at 15°C. Six other samples were first maintained at 30°C for periods from 90 min to 24h d thereafter at 15°C. The day after slaughter, there was a decrease in muscle fibre strength when the duration of the period at 30°C crease until a certain limit.This limit varied between muscles and animals. Increasing the period at 30°C from that limit to 24 hours d no effect whereas meat continue to age when it was stored several days at 2°C. The inability, for longer periods at 30°C, to give a eater reduction of sample resistance the day after slaughter, reveals the rapid inactivation of one of the systems responsible for derization . This inactivation was not closely linked to pH.

NTRODUCTION

igor onset is a sensitive period to influence ageing as meat is at high temperature and the amounts of enzymes involved in derization are still high (DRANSFIELD *et al.*, 1992b, GEESINK *et al.*, 1992). Early post mortem temperatures are known to ffect ageing (LOCHNER *et al* 1980, MARSH *et al.*, 1981) Also short periods at 30°C applied at different times during rigor veloppement produce great reduction of muscle fibre strength the day after slaughter (VERNAZ and LEPETIT, 1992). The rpose of that study was to establish the dependance between the time during which *pre rigor* meat is maintained at 30°C and the ging state of meat *post rigor*.

ATERIAL AND METHODS

ongissimus dorsi (LD) and *Semimembranosus* (SM) muscles from six old cows and *Triceps brachii Caput Longum* (TB) muscles om two old cows were used. Muscles were removed 1h-1h30 post mortem. In each muscle from half carcass seven parts (≈ 400 g) ere cut and vacuum packed. They were used for measurements the days after slaughter (D1) and after ageing at 2°C during 9 days D9, four animals) or 15 days (D15, two animals). One part of the muscles was immediately put in a water bath at 15°C (sample 15). The six other parts were first maintained at 30°C for periods from 90 min. to 24 hours and thereafter at 15°C.

parate samples (≈ 100 g) of each muscle underwent the same treatment in open bags and were used for pH determinations on the y of slaughter.

echanical Measurements :

e ageing state of raw meat was determined in compression. Meat samples (L = 1.5 cm, w = 1 cm, h = 1 cm) were submitted to a 20 compression at a 10 Hz frequency with the S.A.T.A. sinusoidal compressive device (SALE *et al.*, 1984). The samples were tested the longitudinal configuration of the test (strain applied perpendicular to muscle fibres, free strain in the direction of muscle fibres) hich is the configuration needed for the determination of myofibrillar resistance (LEPETIT and SALE, 1984, 1985). Mean values f the maximum stress were obtained from 10-12 determinations. Measurements were made the day after slaughter and after 9 days after 15 days of ageing at 2°C

pH measurements :

The pH was determined with one gram of meat ground in 10 ml of iodoacetate 5mM. Measurements were made with an electrod Ingold attached to a pHmeter Schott CG837. The pH determinations were made since 3h *post mortem* until about 18 hours about every 1h30.

Protein denaturation :

The denaturation of proteins was determined by the test of HART (1962) which measure the denaturation of sarcoplasmic proteins. The DO value is related to protein denaturation: the lower the DO value, the higher the denaturation of proteins.

RESULTS

Mechanical strength :

The day after slaughter the resistance of samples was greatest for treatments T15 or samples maintained 90 min at 30°C. There was a first rapid decrease of resistance when the length of the period at 30°C increased (Fig. 1). Then increasing the length of the period at 30°C until 24 h produced no more effect. A limit time after which the resistance does not decrease and a limit level which corresponds to the level of stress reached were determined graphically. The limit time varied largely from one animal to another but its mean value was lower for LD muscle (≈ 420 min.) than for SM muscle (≈ 480 min.) and for TB muscle (500-800 min.). The limit level also varied greatly between animals but its mean value was similar for LD (≈ 14 N/cm2) and for SM (≈ 15 N/cm2) but was much higher for TB (≈ 20 N/cm2). The resistance of muscle fibres continues to decrease after D1 whatever the treatment and the length of storage (9 days or 15 days). After ageing (9 or 15 days) there was a small increase of resistance with the duration of the period at 30°C.

pH measurements :

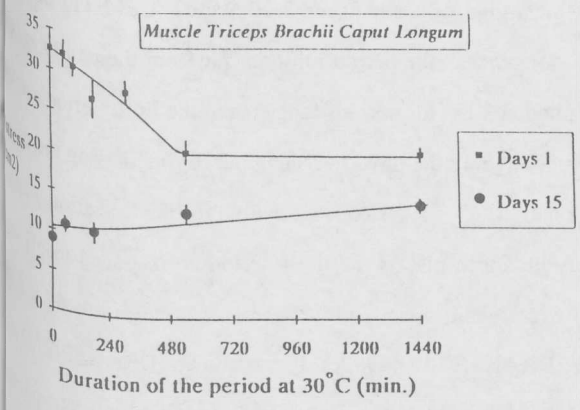
From the pH-time graphs (fig. 2) the pH values corresponding to the limit time defined above were determined graphically. Although inacuracy in the determination of the pH at limit time has to be taken into account, this pH varies largely as its values were between 5.3-6.5 for LD, 5.3-6.6 for SM and 5.2-5.6 for TB.

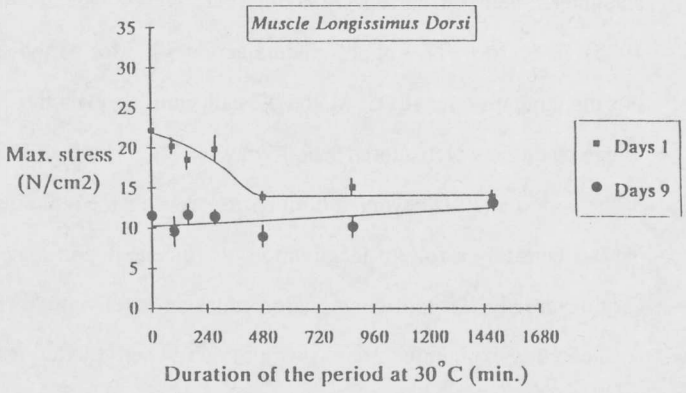
Proteins denaturation :

The increase in protein denaturation with the duration of the period at 30°C was more or less rapid depending on the muscle and animal (Fig. 3). Although after ageing the denaturation was higher than at D1 in both case the denaturation increases when the duration of the period at 30°C increases.

DISCUSSION - CONCLUSION

When *pre rigor* muscles were maintained at 30°C for periods shorter than a certain period limit, then the longer the period the lower the resistance of samples measured the day after slaughter. For periods at 30°C longer than a period limit there was no further decrease in sample resistance the day after slaughter. For LD and SM samples which were maintained at 30°C during periods equal or longer than the period limit the major part of the decrease in resistance during ageing had already largely taken place the day after





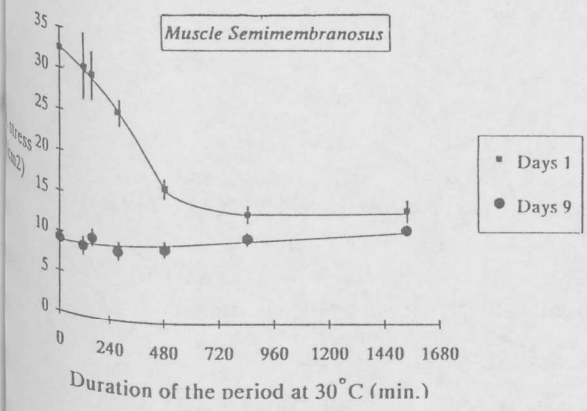


Figure 1: Raw meat strength measured at 20% compression the day after slaughter (D1) and after ageing (D9 or D15) :effect of a pre rigor period at 30°C before storage at 15°C.

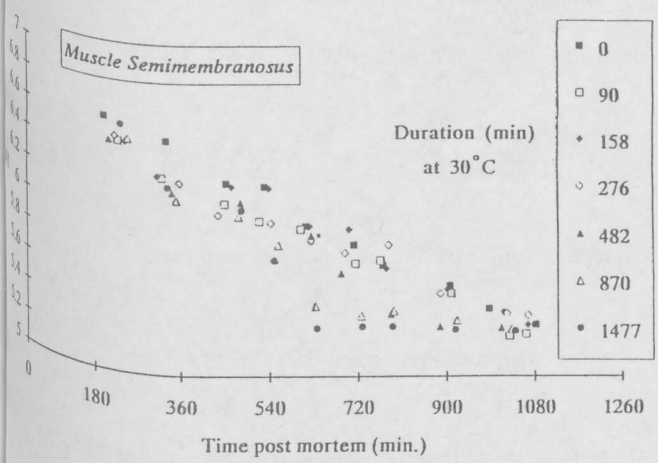


Figure 2: Evolution of pH with time for the different treatements.

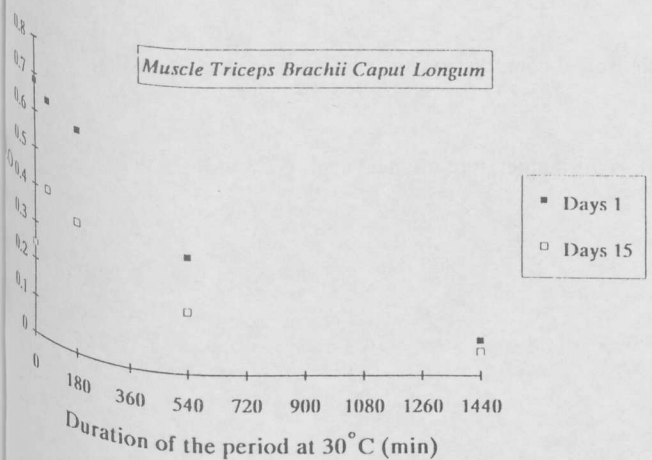


Figure 3: Protein denaturation : Test of Hart : DO values measured the day after slaughter (D1) and after ageing (D15): effect of a pre rigor period at 30°C before storage at 15°C.
The lower the DO the higher the denaturation.

slaughter. Their resistance were about 14-15 N/cm2 whereas fully age meat give values between 8-10 N/cm2 (LEPETIT and SALÉ, 1985). In contrast, TB samples maintained at 30°C for periods equal or longer than the period limit are far from their fully age state. For the three muscles (LD, SM and TB) all samples, even those maintained at 30°C for periods longer than the limit period,continued to age when they were stored 9 or 15 days at 2°C. The inability to increase ageing the day after slaughter, by increasing the duration of the period at 30°C beyond a limit period, reveals the rapid inactivation at 30°C of a system responsible for tenderization. Although pH has certainly a role in inactivation, this phenomenon is not closely linked to pH, as the limit period corresponds to pH values varying greatly. Protein denaturation must be taken into account to explain this inactivation . Also enzyme autolysis had been considered to explain the decrease of proteolitic activity during storage (DRANSFIELD 1992c). It was shown (DRANSFIELD *et al.*, 1992a) that the extend of ageing decreased when the temperature of storage increased. The results obtained in the present study show that this decrease depends on the duration of storage at a given temperature. Indeed the resistance after agieng (D9 or D15) increased sligtly and almost linearly with the duration of the *pre rigor* period at 30°C.

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