ECT OF A VARIATION OF *PRE RIGOR* TEMPERATURE ON MEAT AGEING.

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gissimus Dorsi and *Semimembranosus* muscles from five old cows were removed 1h30 min. after slaughter and divided into seven parts. of the parts were maintained respectively at 15° C (sample T15) and 30° C (sample T30) for 24h. The five other parts were stored at C except for a period of 3h where they were maintained at 30° C. The time at which they were transfered at 30° C was changed between t 0.1*tr and 1*tr where tr is the duration of *rigor* onset determined by low deformation measurements. This time had no effect on ageing measured at one day (D1) and nine days (D9) *post mortem*. The ageing amplitude has been defined as the difference between the ance of myofibrillar structure measured at D1 and the resistance measured at D9. Keeping a sample for 3h at 30° C in the *pre rigor* d decreased the resistance of the myofibrillar structure compared to that of the T15 at D1. This decrease represents about 30 % of the g amplitude of T15 for LD muscles and only 10-20% of that of SM muscle at D1. At D9 no difference remained between these ents and the T15 . The effect of 24h at 30° C (T30) was dependent on the muscle. At D1, T30 samples were usualy more aged than amples but the ageing amplitude of *longissimus dorsi* T30 samples was reduced.

RODUCTION :

cle temperature during the *pre rigor* period is known to have an influence on ageing kinetic. LOCHNER *et al* 1980, MARSH *et al.*, 1) have shown that early *post mortem* temperatures have great effect. In contrast DRANSFIELD *et al.*, 1992, found that *pre rigor* erature (from 0°C to 30°C) maintained until the pH has fallen to 6.4 had no effect on toughness nor on the rate of tenderisation after r. The purpose of the present study was to produce short variations of *pre rigor* temperature at different times during *rigor* onset and to yse the effect on ageing of the time at which this variation has been applied.

TERIALS AND METHODS :

mals : five cows (5-8 years old) were used. About 1h - 1h30 after slaugther the *Semimenbranosus* and *Longissimus dorsi* muscles were oved. Muscles from one side were used for measurements the day after slaughter (D1),and those from the other side were for surements after nine days of ageing (D9) at 2°C. In each muscles 7 slices, 4 cm thick, were cut vacuum packed and submitted to one of following treatments.

Let t_o be the *post mortem* time at the end of the preparation of slices. Time t_o was between 1h30 and 2h.

The 7 treatments were :

Control at 15°C (T15) : storage in water bath at 15°C for 24h from t_o

Control at 30°C (T30) : storage in water bath at 30°C for 24h from t_o

he five following treatments meat was stored at 15°C for 24h except for a period of 3h during which they were put in a water bath at C. This period happens between :

t_o and t_o + 3h in treatment C1

t_o + 3h and t_o + 6h in treatment C2

t_o + 6h and t_o + 9h in treatment C3

t_o + 9h and t_o + 12h in treatment C4

t_o + 12h and t_o + 15h in treatment C5

For each muscle and each treatment a separate sample was cut and used for pH determination during the first 18h *post mortem*. At 24h all the samples were stored at 2°C.

1 - Mechanical measurements :

The two following methods were used to mesure the mechanical properties of muscle fibres during *rigor* onset and ageing.

- a) Sinusoidal compression

Raw meat samples (L = 1.5cm, w = 1cm, h = 1 cm) were submitted to a 20% compression at a 10 Hz frequency with the S.A.T.A sinusoidal compressive device (SALÉ *et al.*., 1984). During compression the samples were maintained in a cell fitted with two lateral walls. Measurements were made in the longitudinal configuration of the test which is the configuration required for the determination of myofibrillar resistance (LEPETIT and SALÉ, 1984 ; LEPETIT, 1989). Means of the maximum stress were obtained from 10 determinations. This measure have been made at D1 and D9.

- b : Low deformation measurements.

This method (LEPETIT, 1992) was used here to give a mechanical determination of the time of *rigor*. The procedure used was to apply a vibration (Frequence 100 Hz, 2 % amplitude) every 20 min. to a sample prestrained at a 10% compression ratio and maintained at 15°C in a chamber at saturated humidity. Measurements were made in the longitudinal configuration. From the stress-strain diagrams, maximum stress, phase lag, hysteresis and linearity were measured. The time of *rigor* was determined as the time at which there was a transition in the evolution of these parameters. Although the transition is simultaneous for all parameters, the determination is improved using the four curves as it reduce the effect of noise in measurements.

2 - pH measurements :

One gram of meat was ground in 10 ml of iodoacetate 5mM. The pH was determined with an electrod Ingold attached to a pHmeter SCHOTT CG837. Measurements of pH were made from 3h *post mortem* until about 18h. Ultimate pH was measured the day after slaughter. All ultimate pH were normal.

3 - . Proteins denaturation

The denaturation of protein was quantified by the test of HART (1962). It measures the denaturation of sarcoplasmic proteins. The measurements were made on D1 and D9 for 3 of the 5 animals.

RESULTS :

1 - Duration of *rigor*

The duration of *rigor* at a controlled temperature of 15°C varies by more than two fold among the five animals .The durations of *rigor* in minutes were, 925, 1000, 1010, 1410 and > 2010. For one animal, the measurements were stopped at 2010 min. and the maximum stress was still rising.

2 - Effect of treatments on ageing.

A variance analysis (table 1) applied on maximum stresses measured at 20% compression show that the 5 treatments (C_1, C_2, C_3, C_4, C_5) were indistinguishable from one another.

1 :Variance analysis on maximun stresses measured at 20% compression ratio

Treatments with the same letter are not significantly different.

nents	Means (N/cm2)	Homogens groups	
	19.5	A	
	18.5	A	B
	18	A	B
	18	A	B
	17.5		B
	17		B
	17		B

ariance analysis give the mean effect of the treatment C1, C2...C5. In fact as the duration of *rigor* onset varied from one animal to ter, a particular treatment , for exemple C1, does not corresponds to the same progress of *rigor* development for the five animals. In r to determine whether the state of *rigor* development is a determinant factor in the effect of a treatment, two parameters, representing rogress of *rigor* onset ,were calculated .

(1) reduce time $\tau = t/tr$ where t_r is the duration of *rigor* determined by low deformation measurements and t the time at the middle of atment C1 or C2 ...or C5.

(2) pH at the middle of the treatment. This value was interpolated by fitting pH-time curves with an exponential low.

elations between the maximum stress of a treatment and τ, and correlation between the maximum stress of a treatment and pH were non significant.

e five treatments (C1, C2, C3 ,C4 ,C5) gave similar values, their mean value for LD and SM at D1 and D9 were calculed (table2). In ollowing ,the mean value of treatments C1, C2 ,C3 ,C4 and C5 will be attributed to a TC treatment (Treatment C).Therefore, TC value esents the resistance of a sample maintained 3h at 30°C at any time during the onset of *rigor*.

ble 2 : **Values of the resistances (in N/cm2) at 20% compression for the different treatments at Days 1 and Days 9**

	LDT15	LDTC	LDT30	SMT15	SMTC	SMT30
ys 1	22	19	19	27	25	18
ys 9	13	13	15	15	14	15

TC, (respectively SMTC) are the mean values of treatments C1, C2, C3 , C4, C5 for LD (respectively SM) muscle.
ndard deviation is about 1 N/cm2.

01 the samples T15 (15°C during 24h) were harder than the TC ones. T30 samples (30°C, 24h) of LD muscle had similar values than the , whereas in SM muscle T30 was much lower than the TC. At D9 all treatments gave a similar value but the LDT30 was slighly harder n LDT15 and LDTC. The reduction of maximum stress of the TC compared to the T15 was expressed as percentage of the ageing plitude of the T15. Ageing amplitude was defined as the difference between the resistance at D1 and the resistance at D9. The day after ghter, the percentages of stress reduction compared to the ageing amplitude of T15 were for LDTC 33%, LDT30 33%, SMTC 16%, T30 75%.

HART test :

enaturation was determined by DO values. The lower the DO value, the higher the denaturation. Variance analysis of the DO values (Table llowed that in the first 3 treatments C1, C2 and C3, the denaturation was as low as in T15. Denaturation increased in samples (C4 and

C5), which were maintained at 30°C in the latter part of *rigor* onset. Denaturation was maximum in samples T30 which were maintained 24h at 30°C.

Table 3 : Variance analysis of Do values given by the test of Hart for proteins denaturation

Treatments with the same letter are not significantly different.

Treatments	Means	Homogens groups		
C1	0.70	A		
C2	0.68	A		
T15	0.64	A		
C3	0.63	A		
C5	0.56		B	
C4	0.54		B	
T30	0.17			C

CONCLUSION :

Data in this experiment show that for samples transferred during *rigor* onset from 15 to 30°C for 3h, the time of transfer was not determinant for ageing when this time range between about 2h *post mortem* and the end of *rigor* onset. According to the durations of *rigor* (tr) found in that experiment, except for one animal, the variation of temperature have been applied at time equal or greater than tr/10. That experiment,therefore, does not concern the temperatures of muscles at early stages of *rigor*. Nevertheless, this study shows that, even if it is not applied soon after slaughter, a short increase of *pre rigor* temperature can have a tremendous effect on the ageing state of meat the day after slaughter. When the increase in temperature happened in the latter part of *rigor* onset it goes with a significant proteins denaturation ,which is certainly due to the fact that pH had already dropped.

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