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MEAT QUALITY OF RABBIT
II. EFFECTS OF CHILLING AND STORAGE CONDITIONS ON CARCASS SHRINKAGE AND MUSCULAR pH

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INTRODUCTION

In France, 30 slaughter-houses handle more than 5000 rabbits per week. They represent 2.8 % of slaughtering places and give half (20.000 tons) of the carcass supervised tonnage. Even in slaughter-houses of this size, the implemented technologies are very different (OUHAYOUN, 1985). Nevertheless, chilling conditions control heat and matter transfers, flora development and the physicochemical development of muscle in meat. Therefore they decide upon meat quality.

This study was undertaken to assess the effects of various chilling methods on the evolution of muscular pH and on carcass weight losses during chilling and further storage.

MATERIAL AND METHODS

The study deals with 190 INRA 9077 male rabbits, 11 weeks old. The rabbits are stunned by electroanesthesia (90 V, 50 Hz, 2 s), then bleeded by cutting of jugular vein and carotid. Carcass preparation is ended 30 mn after stunning. The inner temperature evaluated at the level of Semimembranosus proprius muscle is then of 30°C. Carcasses are then submitted to three successive treatments :

- Pre-chilling in a room at 14°C, for 13, 26, 40 or 54 mn ;
- Chilling in a room ventilated at 3°C for 5 h or 21 h ;
- Storage in a room at 2°C for 23 h or 46 h. Carcasses are put into perforated card-board boxes (0.75 x 0.40 x 0.15 m) in 3 rows of 4 carcasses each divided by a greaseproof sheet of paper.

Commercial carcasses are weighed as soon as they are obtained (30 mn after stunning) and again after chilling and storage.

The Longissimus dorsi muscle pH is measured at the level of first lumbar vertebra, at the completion of chilling and storage. The accurate indexing of measurement point is important because the fibre composition of this muscle differs according to anatomical location (VIGNERON et al., 1976 ; OUHAYOUN and DELMAS, 1988). Measurement is carried out, in situ, with a Knick apparatus (Portamess 654) fitted with an Ingold 406-M3 glass-calomel electrode (accuracy 1/100 pH unit).

The mean values of pH measurement data and carcass weight loss during the various experimental stages, calculated by mode of "pre-chilling", "chilling" and "storage" factors are compared by variance analysis at fixed effects with first order interaction. Measurements are done using softwares from the Amance Library, on the Mini 6 computer of the Toulouse Research Center.

RESULTS - DISCUSSION

Carcass temperature

On an average, the muscular temperature measured close to Semimembranosus proprius muscle (thigh deep-seated muscle) reaches 5°C after a chilling of 5 h ; it reaches 3°C after a chilling of 21 h and once storage is completed (23 h or 46 h).

L. dorsi muscle pH

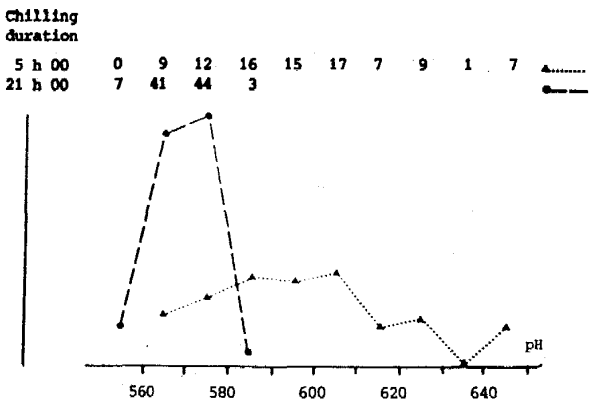
Muscular pH mean and variability lessen during chilling (figure 1). The pH mean value measured at the end of chilling, all effects mingled, and the estimates of variation factors are given in table 1.

TABLE 1
L. dorsi pH (x 100).
Overall mean and estimates of prechilling (P), chilling (C) and (P x C) interaction

Overall mean	Prechilling (mn)					Chilling (h)			Interaction
	13	26	40	54	F	5	21	F	
584	7	3	- 1	- 9	**	14	- 14	**	**

** : highly significant (P < 0.01)

FIGURE 1
Distribution of L. dorsi pH at the end of chilling (all prechilling durations mingled).



The pH at the end of chilling varies according to pre-chilling and chilling durations. When pre-chilling lasts for a long time, energy reserves are more scattered ; pH is then significantly more acid at the end of chilling. A long chilling (21 h), all "pre-chilling" durations mingled, gives a muscular pH more acid than a short one.

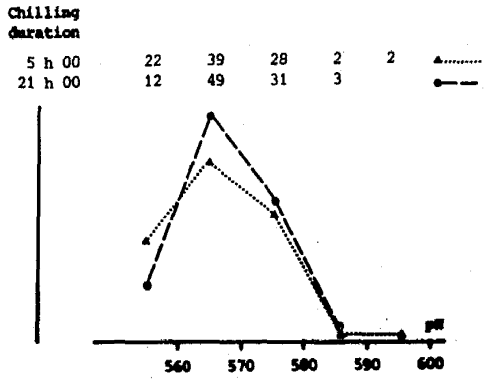
These two factors significantly interact. A short pre-chilling (13 mn) leads to a more acid pH (- 0.07 pH) than it could be deduced from the combination of marginal effects, if chilling is short (4 h) and to a pH less acid if chilling is long (21 h). An extended pre-chilling (54 mn) has the opposite effect (+ 0.04 pH).For intermediate pre-chilling durations (26 or 40 mn), deviation to additivity is equal to zero. Carcass early chilling (a pre-chilling of 13 mn only) seems thus to accelerate the acidification of L. dorsi muscle during first post-mortem hours, which means the implementation of biochemical mechanisms involved in cold shortening (JEACOCKE, 1977).

During storage, pH still changes, but differently according to the previous chilling duration.

In 22 % of cases, pH increases (Δ pH = + 0.05) ; it happens more often with carcasses chilled for a long time (21 h ; 34 cases out of 41) than for a short one (5 h). A pH stability is only observed (3 % of cases) when carcasses were chilled for 21 hours. Finally, in most cases (75 %), muscular pH shortens during storage, more frequently (86 cases out of 143) when carcasses were chilled for a short time (5 h ; Δ pH = -0.34) than a long one (21 h ; Δ pH = - 0.06).

When storage is completed, the influence of pre-chilling and chilling durations on L. dorsi muscle pH (mean and variability) is no more apparent (figure 2).

FIGURE 2
Distribution of L. dorsi pH at the end of storage (all chilling and storage durations mingled).



Matter transfers

Heat transfers outside of rabbit carcass happen very fast, approximately 95 Joules/mn/kg during the first chilling hour (OUHAYOUN and DELMAS, 1988). They go along with matter transfers, which induce a loss (draining, superficial dehydration) of approximately 2.1 % of carcass weight when this one is put at + 2°C for 24 hours (OUHAYOUN, 1984).

With a chilling of 5 h, it appears that weight loss is significantly weaker than in the case of 21 h (2.13 vs 2.62 %), all parameters being otherwise equal (table 2).

TABLE 2
Weight losses of carcass (%.).
Overall mean and estimates of prechilling (P), chilling (C), storage (S) and (P x C), (P x S) (C x S) interactions effects

	Overall mean	Prechilling (mn)					Chilling (h)			Storage (h)			1st order interactions
		F	13	26	40	54	F	5	21	F	23	46	
Chilling loss	238	*	- 2	6	10	-14	**	-25	25	-	-	-	NS
Storage loss	80	NS	2	1	-2	- 1	**	17	-17	**	-25	25	NS

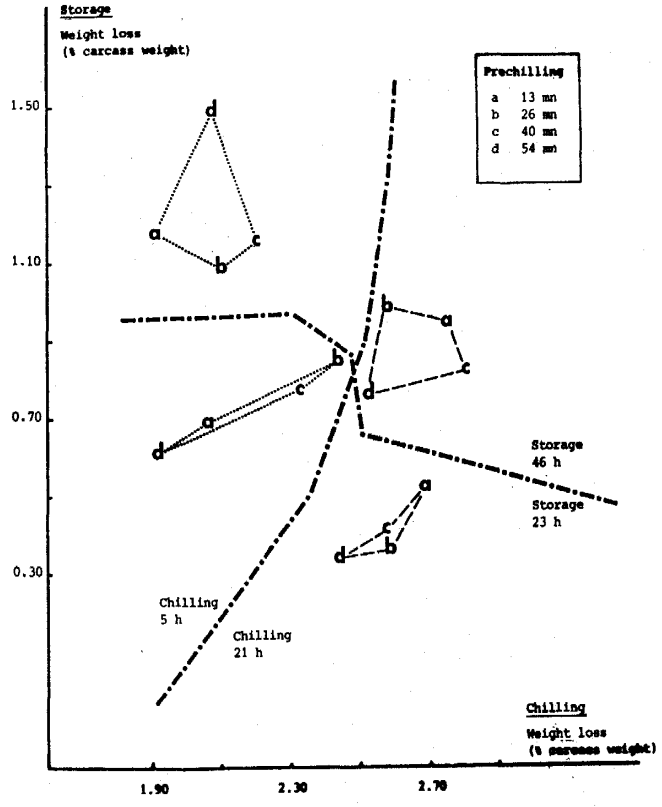
NS : non significant (P > 0.05)
* : significant (0.05 > P > 0.01)
** : highly significant (P < 0.01)

The influence of pre-chilling duration is erratic. Nevertheless, it seems that a long pre-chilling (54 mn at + 14°C), i.e. a slowing up of heat transfer, induces the limitation of matter transfers.

Carcass weight loss during storage represents, on an average, 0.80 %. It is all the more important when storage is longer and chilling shorter. On the whole, in the thermal conditions implemented in this study, the loss of fluid suffered by a carcass between preparation time (warm carcass) and commercialization (carcass kept for 46 h after 21 h of chilling) is, on an average, of 3.4 %. A short chilling duration reduces immediate weight losses and thus improves the first transformation output (+ 0.50 % on an average). Relationships between losses during chilling and losses during storage are reported on figure 3.

Nevertheless, this method transfers fluid exudations to storage period ; matter transfers outside of prepackaged product thus entail a strong surface humidity favourable to the development of contamination germs, restricting meat storage.

FIGURE 3
Weight losses of carcass (%)
Relations between prechilling, chilling and storage durations



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The influence of thermal conditions on carcasses (pre-chilling at 14°C, chilling at 3°C, storage at 2°C during variable durations) upon the acidification of L. dorsi muscle and matter transfers is studied. The experiment deals with 190 male rabbits of INRA 9077 strain, 11 weeks old. The depletion of energy reserves and thus the acidification of L. dorsi muscle is encouraged by carcass storage at 14°C before chilling at 3°C and by long chillings. After a chilling of 21 hours, L. dorsi pH muscle which is then of 5.70 on an average, does not change during storage when this one is limited to 46 hours. Three quarters approximately of matter transfers registered during chilling and storage stages (3.4 % of commercial carcass weight) happen during chilling. A short chilling (5 h) reduces carcass shrinkage but increases surface humidity of entirely prepackaged carcasses.

QUALITE DE LA VIANDE DE LAPIN
II. EFFETS DES CONDITIONS DE REFRIGERATION ET DE STOCKAGE SUR LES PERTES DE POIDS DES CARCASSES ET LE pH MUSCULAIRE

Ouhayoun J., Delmas Danielle

L'influence du régime thermique imposé aux carcasses (préréfrigération à 14°C, réfrigération à 3°C, conservation à 2°C pendant des durées variables) sur l'acidification du muscle L. dorsi et les transferts de matière est étudiée. L'expérimentation porte sur 190 lapins mâles de souche INRA 9077 âgés de 11 semaines. L'épuisement des réserves énergétiques et, par conséquent, l'acidification du muscle L. dorsi est favorisé par le maintien des carcasses à 14°C avant réfrigération à 3°C et par des réfrigérations longues. Après 21 heures de réfrigération, le pH du muscle L. dorsi, qui est alors en moyenne de 5,70, évolue peu au cours de la conservation lorsque celle-ci est limitée à 46 heures. Les trois quarts environ des transferts de matière observés au cours des phases de réfrigération et de conservation (3,4 % du poids de la carcasse commerciale) ont lieu pendant la réfrigération. Une réfrigération brève (5 h) réduit les pertes de poids au ressuage mais accroît l'humidité de surface des carcasses entières conditionnées.