The desirability of pork products processed prior to chilling

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Fabrication of the warm pork carcass into primal and consumer size portions seems commercially feasible and economical. In-line-processing of market weight pork carcasses directly from the slaughter floor was suggested by Henrickson *et al.* 1965. This work led to numerous investigations relative to the quality of the products produced by this method. Mandigo *et al.* 1966 reported little difference in product yield. Moore *et al.* 1966 found no significant difference between the conventional and accelerated processed pork loin for thaw loss, moisture loss during cooking or residual moisture. Barbe *et al.* 1966 and Barbe and Henrickson 1967 clearly stated that the shorter processing time would be more desirable from the standpoint of precluding potential food poisoning and/or spoilage problems in meat products. Many of the basic chemical and physical changes (Wismer-Pederson, 1959; Bendall, 1960; Briskey, 1961; Lawrie, 1962; Sayre, *et al.* 1963) in pork muscle following death have been reported.

The purpose of this manuscript is to provide further detailed studies which will substantiate the improved quality of pork products processed before being chilled.

MATERIALS AND METHODS

One hundred twenty barrows of similar breeding, age, and weight (91 Kg) when slaughtered were used in these studies. The animals were slaughtered according to the methods and practices currently used in the industry. Following bleeding, scalding, dehairing and eviscerating, the carcasses were split and washed prior to assignment to the alternate processing treatments. Pre-chill processing involved removal of the wholesale parts and processing the cuts within 30 minutes after slaughter. The warm cuts were trimmed free of excess fat and chilled in a air blast freezer at −62° C until the center temperature reached 10° C, then tempered in a room at 1.7° C. Postchill

processing involved a 24 hour chill period at 1.7° C prior to any cutting or processing. Processing the post-chilled cuts was the same as for the pre-chill pieces.

The hams were removed from the hot carcass (internal temperature 35° C), defatted, injected with brine to 110 % of green weight, boned, and inserted into fibrous casing, placed directly into forming molds, heated, and smoked. Individual muscles were treated in the same manner as the hams. Muscles used were longissimus dorsi, biceps femoris, semimembranosus, and semitendinosus. Chilling the »hot» ham or muscle was accomplished at —62° C, until the internal temperature reached 10° C, followed by tempering to a temperature of 1.7° C. Samples for detailed physical, chemical, histological, and microbiological studies were taken at appropriate points in the processing.

RESULTS AND DISCUSSION

Cutting pork carcasses when at a temperature in access of 35° C and finishing the processing of fresh, cured and smoked products before an initial chill appears commercially feasible. The total pigment and myoglobin content of the »hot» tissue was slightly greater than in tissue chilled 24 hours (Table 1).

Table 1. *The effect of pre- and post-chill treatment on the total pigment, myoglobin, nitroso-pigments and cure diffusion distance in porcine muscles*[a]

Variables	*Treatment*		*S.E.*
	Pre-chilled	*Post-chilled*	
Total pigment, mg/g wet tissue	1.40	1.34	0.04
Myoglobin, mg/g wet tissue	0.76	0.73	0.02
Cure diffusion distance, mm	21.69**	20.32	0.30
Nitrosopigments, p.p.m.			
Lower	46.00**	40.24	1.60
Upper	0.93**	0.52	0.10

[a]Means calculated using 15 animals
*Significant at P .05
**Significant at P .01

Muscle type significantly influenced the amount of total pigment and myoglobin. This difference was expected since the muscle vary as to function, tone, workload, and chemical composition. The myoglobin content was generally high in the biceps femoris and semitendinosus but low in the longissimus dorsi muscle.

Cure diffusion through the tissue was examined using a muscle core 2.2 cm in diameter. The curing solution moved through the tissue by osmotic action. A significant ($P<.01$) treatment effect on the diffusion distance was noted. Thus, cure diffused faster in the pre-chilled than in the post-chilled muscles. A wide variation in cure diffusion was noted among the muscles studied (Table II). This great variation supported the work of Hornsey (1964) who stated that the conversion of natural pigments into cured meat pigments depended greatly upon the inherent myoglobin and total pigment in the fresh tissue.

Table 2. *Means and standard error of myoglobin, nitrosopigments and cure diffusion distance in relation to various porcine muscles*[a]

Variables	*Biceps femoris*	*Longissimus dorsi*	*Semimembranosus*	*Semitendinosus*	*S.E.*
Total pigment, mg/g wet tissue	1.51[a]	0.95[b]	1.47[a]	1.55[a]	0.05
Myoglobin, mg/g wet tissue	0.89[a]	0.53[c]	0.76[b]	0.81[a,b]	0.04
Cure diffusion distance, mm	22.01[a]	19.19[b]	22.16[a]	20.66[c]	0.43
Nitrosopigments, p.p.m.					
Lower	50.64[a]	21.61[b]	37.69[c]	62.53[d]	2.26
Upper	1.02[a]	0.56[b]	0.72[a,b]	0.60[b]	0.15

[a]Means with the same supercripts are not significantly different from each other.

Nitroso-pigments

A difference in the nitroso-pigment content of cured porcine muscle was observed among carcasses. The pre-chill cured muscles possessed high concentrations of nitroso-pigments than the post-chill cured muscle. A warm brine (30° C) proved to migrate through the tissue more rapidly and provide more cured pigment than a cold brine. The nitroso-pigment concentration was highest in the pre-chill cured quadriceps followed by the semitendinosus, biceps femoris, and semimembranosus muscle (Figure 1). The post-chill cured quadriceps possessed the highest pigment content followed by the biceps femoris and semitendinosus which reversed inorder at the 24 hour period (Figure 2). Loss of pigment occurred at both 10ft-c and 100 ft-c (foot candle) of display light. The greatest loss in nitroso-pigment occured during the first hour of exposure to light.

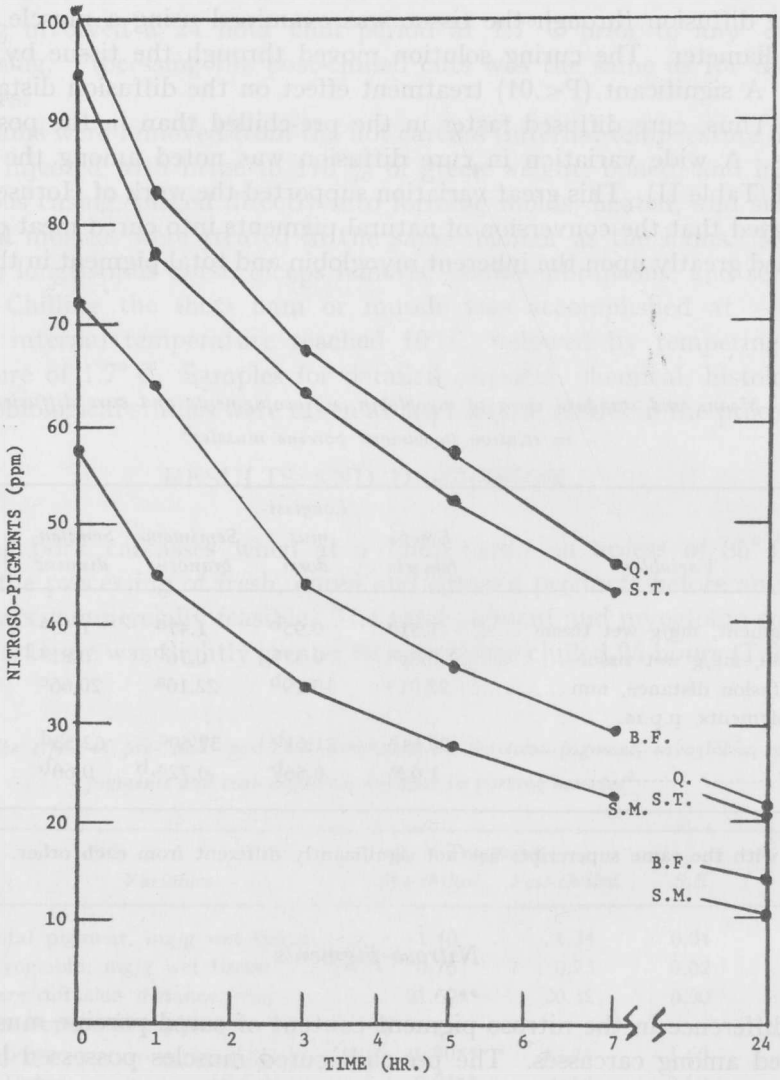

Figure 1. Remaining Nitroso-Pigments (100ft-c, Pre-Chilled)

Color-stability

The percent nitroso-pigment remaining after exposure to 100ft-c of light was different among carcasses. These data indicated that the nitroso-pigments of the pre-chill cured muscles were less susceptable to the rapid and severe loss of color immediately after exposure to light than pigments of the post-chill cured muscles. The greatest pigment retention after exposure to 100ft-c of light for 24 hours, occurred in the semitendinous (21.1 %) followed by the

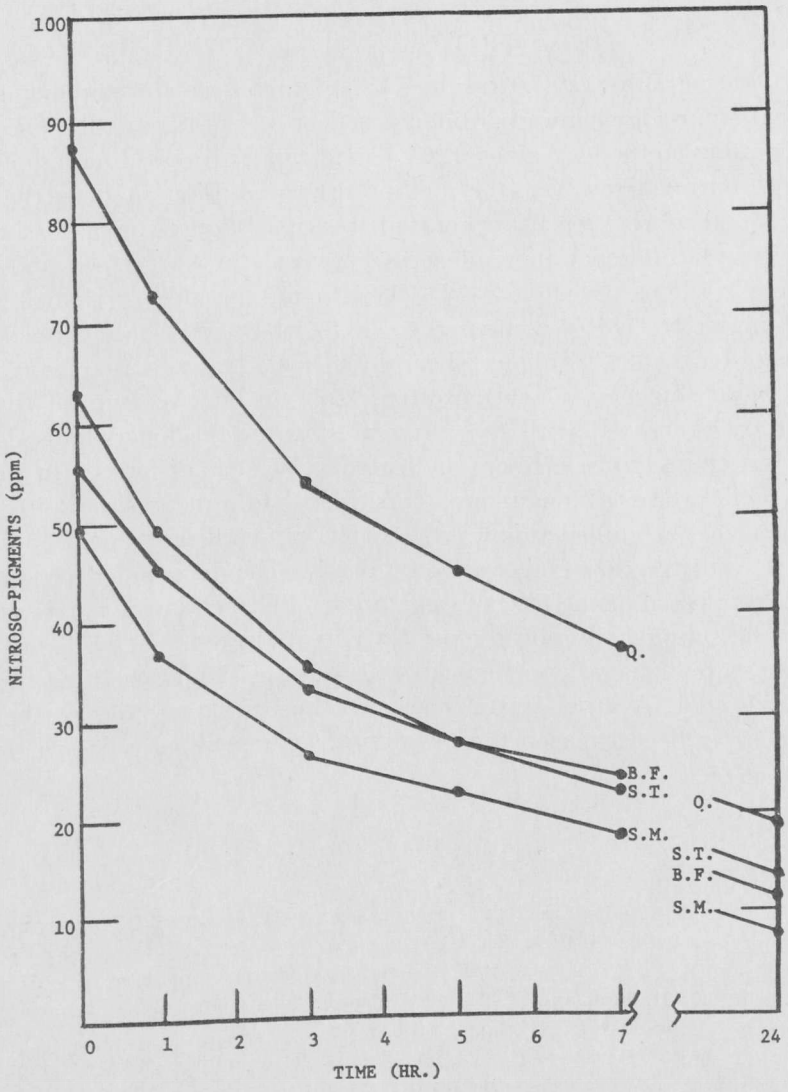

Figure 2. Remaining Nitroso-Pigments (100ft-c, Post-Chilled)

quadriceps (20.3 %), biceps femories (18.6 %), and the semimembranosus (16.9 %). The evidence indicated that actual color development and the retention of the pigments is more dependent upon the kind of muscle being cured than upon the curing method.

Tenderness

The Warner-Bratzler shear values using cores from the semimembranosus and longissimus dorsi muscles did not reflect a significant difference due to the processing method. Weiner, 1964, found rapid processed ham more tender than the control. However, the method used was different from that in this study. Moore *et al.* 1966 using roasted fresh pork longissimus dorsi reported no significant difference in tenderness between »hot» processed and conventional chilled loins. Reddy, *et al.* 1968, found the shear value of pre-chill canned muscle to be 10.6 compared to 7.6 lb for the post-chill canned muscle. The suggested that the higher shear force may be on actual advantage in canned muscle since over heating often results in poor texture.

A study concerned with the physical state of the longissimus dorsi and semimembranosus muscle fibers, indicated very little difference in their size. The pre-chill processed longissimus dorsi fiber had a mean size of 76.8 micron while those of the chilled side was 79.5 The pre-chill semimembranosus fiber was 70. 1 while the post-chill was 74.2 micron. The degree of rigor, as evident by visual apprasial of the fibers, was more readily seen in the longissmus dorsi than in the semimembranosus muscle. This indicated that each muscle will develop a state of rigor dependent upon its composition at the time the animal was slaughtered. Warner-Bratzler shear values nor the state of the muscle fiber did not reflect a reason to discriminate against rapid processing of pork.

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