MODIFICATION OF A DRY CURING PROCESS FOR BEEF

J.E. Hayes* and T. Kenny

Ashtown Food Research Centre, Teagasc, Ashtown, Dublin 15, Ireland. Email: jenny.hayes@teagasc.ie

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Introduction
Vacuum tumbling is a mechanical method used in industry to improve brine distribution. The application of vacuum tumbling has been found to produce more extractable protein in beef than non-vacuum condition (Ghavimi *et al.*, 1986). Better binding ability and water absorption has been found in vacuum tumbled meat (Wiebe and Schmidt, 1982). Deumier *et al.* (2003) found that pulsed vacuum increased salt gain and decreased water loss. Products obtained by pulsed vacuum brining had more uniform water and salt distribution from the product surface to the core. Consumers are demanding convenience foods, but are increasingly concerned about issues of food safety, quality and health. This is reflected in growing niche markets for products perceived as healthier and of higher quality than mainstream products. Dry-cured meat products fit this description. This project aims to develop a modified dry-curing process using a number of novel accelerated curing techniques such as vacuuming, tumbling and vacuum pulsing which would increase the relatively slow through-put associated with traditional curing allowing for more uniform and consistent products. For this reason, beef *M. supraspinatus* was applied various different vacuum tumbling and pulsing treatments to further accelerate the curing process without having a detrimental effect on the product quality and safety.

Materials and Methods
The *M. supraspinatus* were obtained from a local meat plant at 72 hours post-mortem. The pH of the *M. supraspinatus* was checked to ensure pH was within the normal range of 5.4 to 5.6. Six replicate loins chosen at random were used for each dry curing treatment. The following treatments were applied: 1) Control (conventional static dry cure); 2) Vacuum pulsed tumble (6 hour tumble, 4 revolutions per minute, vacuum at 90% (900mBar) for 20 minutes followed by 0% for 3 minutes); 3) Vacuum pulse (no tumble, vacuum at 90% for 20 minutes followed by 0% for 3 minutes); 4) Vacuum tumble (6 hour tumble, 4 revolutions per minute, vacuum at 90% with no pulsing); 5) Tumble only (6 hour tumble, 4 revolutions per minute, no vacuum or pulsing). The treatments were compared to a control conventional (static) dry cure method. The dry cure mixture was prepared in bulk and contained 66.5% w/w fine sea salt 32.0% brown sugar, 0.5% sodium nitrite and 1.0% sodium nitrate. It was applied by rubbing uniformly over the surface of the pork at a rate of 6.0% by weight. For the conventional control method 6% by weight of dry cure mix was rubbed onto the loins which were then placed in the chill at 2°C. It had been observed in preliminary trials that conventional dry cured loins appeared to be cured at day 7 hence all other treatments were compared at day 7 of curing. At day 7 of curing, samples for each treatment were taken for chemical analysis. The sample section for chemical analysis was separated into core and outer regions. Salt content was determined by titration using the Mohr method (Kirk and Sawyer, 1991). Samples were analysed for moisture, fat and protein content (Bostian *et al.*, 1985; Sweeney and Rexford, 1987). The remainder of the muscles were then cooked in the oven at 85°C to an internal temperature of 72°C. When cooked, the beef muscles were refrigerated at 4°C. An 8 member trained panel was employed to evaluate sensory quality of sample treatments (AMSA, 1995). Colour was measured using the HunterLab system. One-way analysis of variance (ANOVA) was used to compare means and to identify significant differences ($p<0.05$) between treatments.

Results and Discussion
Comparing core regions only the salt content for vacuum tumble and tumble only treatments were found to be higher ($p<0.001$) then the control. This result indicated the potential of vacuum tumbling and tumbling only treatments in accelerating the curing processes i.e. rate of diffusion of curing ingredients to the core of the muscle. All of the dry cure treatments were found decrease ($p<0.001$) cook loss compared to the control, hence increasing cook yield (Table 1). The control and vacuum pulse treatments were rated 'slightly darker' in cured colour in comparison to the remaining three treatments which were 'slightly pale' in colour (Table 2). For colour uniformity the control and vacuum pulse treatments had only 'fair' colour uniformity with the presence of brown uncured areas in the centre of the slice, while the other three treatments had 'good' colour uniformity ($p<0.001$). Juiciness results found that both the control and vacuum pulse treatments were 'slightly dry', whereas the other three treatments were found to be 'slightly juicy' according to the panellists. It should be noted that both the control and vacuum pulse treatments also had lower moisture content. The control and vacuum pulse treatment were perceived by the panel to be 'slightly tough' compared to the other treatments, which were rated as 'slightly' to 'moderately' tender. Saltiness results showed that the control and vacuum pulse treatments were 'ideal' to 'slightly' salty whereas all other treatments were 'slightly' salty. It should be noted that control and vacuum pulse treatments had the lowest average of 2% core salt whereas the other treatments had an average of c. 3% core salt. Both the control and vacuum pulse treatment also had an average outer salt level of c. 3% compared to the other three treatments, which had an average 4% salt level. Vacuum pulse tumble and vacuum pulse treatments were observed as similar overall acceptability to the control while vacuum tumble and tumble only

treatments were found to be higher ($p<0.05$). Williams (2004) found that vacuum-tumbling had minimal a inconsistent effects on quality attributes in M. *Supraspinatus* steaks. No significant effect on colour was found betwe the outer and core samples of each of the treatments. However, visual differences were apparent between the differe treatments, with the control and vacuum pulse treatments showing visible colour differences between the core and ou regions of the beef sample. These different regions indicate that the beef was not fully cured hence uneven distributi of curing ingredients.

Table 1: Effect of treatment on cook loss, salt and moisture content of core and outer regions at day 7.

Treatment	% Cook loss	Core region		Outer region	
		% Salt	% Moisture	% Salt	% Moisture
Control	26.5[a]	2.1[a]	72.3[a]	3.8[a]	68.5[a]
Vacuum pulse tumble	22.4[b]	2.4[a]	71.2[a]	3.6[a]	69.8[b]
Tumble only	20.8[b]	2.0[a]	71.9[a]	3.3[a]	69.8[b]
Vacuum tumble	21.5[b]	3.3[b]	69.5[b]	4.0[a]	70.1[b]
Vacuum pulse	20.1[b]	3.1[b]	71.0[a]	3.6[a]	70.1[b]

[a, b] Means in the same column with unlike superscripts are different ($p<0.001$).
SED: standard error of the difference of the means

Table 2: Sensory analysis results of cured beef.

Treatment Type	Cured Colour	Colour Uniformity	Juiciness	Tenderness	Saltiness	O/F	O/A
Control	3.4[ab]	2.8[a]	4.0[a]	4.5[a]	3.6[a]	3.2[a]	2.9[a]
Vacuum PT	3.6[ab]	4.3[b]	4.9[b]	5.3[bc]	4.5[b]	3.3[a]	3.4[ab]
Vacuum pulse	2.9[a]	3.8[b]	4.0[a]	4.5[ab]	3.5[a]	3.3[a]	3.2[ab]
Vacuum tumble	3.6[b]	4.2[b]	4.9[b]	5.6[c]	4.1[ab]	3.7[a]	3.7[b]
Tumble only	4.6[c]	4.3[b]	4.8[b]	5.8[c]	3.8[ab]	3.7[a]	3.7[b]

Vacuum PT = vacuum pulse tumble, O/F= Overall Flavour, O/A= Overall Acceptability,
[a, b] Means in the same column with unlike superscripts are different ($p<0.001$). SED: standard error of the difference of the means
Cured colour, colour uniformity, saltiness, O/F and O/A were evaluated by means of a six-point hedonic scale (6 very p excellent/100%uniformity, very salty, extremely good flavour, extremely acceptable respectively; 1= very dark, very poor, very m very poor, not acceptable respectively). Juiciness and tenderness were evaluated by means of a eight-point hedonic scale (Extremely juicy and extremely tender respectively; 1= Extremely dry and extremely tough respectively)

Conclusions

This research has shown the benefits of vacuum tumbling technique. Further research will include a detailed shelf- study, to be carried out on the vacuum tumble treatment, which was chosen as the optimum treatment for dry curing beef. This will be compared against the static conventional methods in the development of cured products w enhanced organoleptic quality.

References

AMSA (1995). Research guidelines for cooking, sensory evaluation and instrumental tenderness measurements fresh meat. American Meat Science Association, 10-11.

Bostian, M.L., Fish, D.L., Webb, N.B., and Arey, J.J. (1985). Automated methods for determination of fat a moisture in meat and poultry products: collaborative study. *Journal Association of Official Analytical Chemist 68, 876.*

Deumier, F., Bohuon, P., Tystram, G., Saber, N. and Collignan, A. (2003). Pulsed vacuum brining of poultry me experimental study on the impact of vacuum cycles on mass transfer. *Journal of Food Engineering*, 58, 75-83.

Ghavimi, B., Rogers, R.W., Althen, T.G. and Ammerman, G.R. (1986). Effects if non-vacuum, vacuum and nitrog back-flushed tumbling on various characteristics of restructured cured beef. *Journal of Food Science*, 51, 11 1168.

Kirk, R.S. and Sawyer, R. (1991). *In:* Pearson's Composition and Analysis of Foods. Longman Scientific Technical. 14-15.

Sweeny, R. A. and Rexroad, P. R. (1987). Comparison of LECO FP-228 "Nitrogen Determinator" with OAC copp catalyst Kjeldahl method for crude protein. *Journal of the Association of Official Analytical Chemists*, 70, 102 1030.

Wiebe Jr, W.R. and Schmidt, G.R. (1982). Effects of vacuum mixing and precooking on restructured steaks. *Journ of Food Science,* 47:386-387, 396.

Williams, T.A (2004). Effects of beef enhancement with non-meat ingredients, blade tenderization and vacuu tumbling on quality attributes of 4 beef cuts stored in high oxygen. MSc Thesis Texas A & M University p20-51