# DEVELOPMENT OF A MODIFIED DRY CURING PROCESS FOR PORK

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**Introduction**
Bacon is one of the most widely produced traditional dry cured food items. Such products have a high variety of flavours and textures as compared to the corresponding wet-cured items. In keeping with the trend towards enriching our sensory perceptions, many consumers are getting more interested in dry-cured meat products (Toldrá, 2002). However, modifications to the traditional dry curing process are desirable in order to accelerate the process, improve the yield and increase the uniformity of the product. Tumbling causes disruption of the meat fibres (Lawlis *et al.*, 1992), which together with the curing additives allows the meat to bind more water (Chow *et al.*, 1986). Vacuum also increases cure absorption as well as extraction of the salt-soluble proteins (Sharma *et al.*, 2002). Tumbling without vacuum has been found to improve colour, sliceability, taste, aroma and yields of hams (Krause *et al.*, 1978). For this reason, various different vacuum tumbling and pulsing treatments were tested on pork M. *longissimus thoracis et lumborum* to further accelerate the curing process without having a detrimental effect on the product quality and safety.

**Materials and Methods**
Whole pork loins (*M. longissimus thoracis et lumborum)* were assigned to treatments at 72 hours post-mortem (pH 5.6-5.9). 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 over the surface of the pork at a rate of 6.0% by weight. The meat was then placed in the tumbler (Ruhle Ltd. Turbovac, Type SB 415, 200 liter) and the required programme selected. The test curing treatments were applied to the whole loins in order to simulate industry practice, but analysis of the products was confined to the eye muscle component. 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 form each treatment were taken for chemical analysis and 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). Colour was measured using the HunterLab system. An 8 member trained panel was employed to evaluate sensory quality of sample treatments (AMSA, 1995). Results were analysed using a two-way analysis of variance (ANOVA).

**Results and Discussion**
Salt content differed ($p<0.001$) between the core and outer regions for all treatments therefore results show that salt is not uniformly distributed. Comparing the cores only, moisture levels were similar for 4 of the treatments and lower ($p<0.01$) for the vacuum pulse treatment, corresponding also to the salt being highest for the latter. Results for Hunter L values showed that the vacuum pulse and vacuum tumble treatments were found to be lighter ($p<0.01$) than the control. The vacuum tumble treatment was paler ($p<0.001$) in cured colour in comparison to the control. All treatments had 'good' to 'very good' colour uniformity. The treatments had no effect on juiciness, tenderness overall flavour and overall acceptability. The cellular alteration caused by tumbling is also believed to influence juiciness (Dzudie *et al.*, 2000), but again sensory results vary between studies (Chow *et al.*, 1986). Cassidy *et al.*, (1978) reported differences in the ultra structure after tumbling and suggested that an increased disruption contributed to a superior tenderness; however, sensory results deviate from this theory (Lawlis *et al.*, 1992). The control and vacuum pulse tumble treatments were rated by the panel as having an 'ideal' salt level compared to the remaining three treatments which were found to be 'slightly' salty. It should be noted here that the control and vacuum pulse tumble treatments had 2% salt in the core compared to the other treatments which had a 3% salt level, and 3% and 4% respectively for the outer values. There was a difference ($p<0.001$) between the core and outer for all of the treatments, therefore results show that salt is not uniformly distributed.

**Conclusions**
The treatments had no effect on juiciness, tenderness overall flavour and overall acceptability. These findings indicated that the combinations of tumbling, pulsing and vacuuming did not significantly accelerate the diffusion of curing ingredients in the pork loins or improve the overall quality and acceptability in comparison to the static conventional dry cure method. Further research on these techniques is required which will also include a detailed shelf-life study.

**Table 1:** Sensory analysis results on cured bacon.

| Treatment Type | Cured Colour | Colour Uniformity | Juiciness | Tenderness | Saltiness | O/F | O/A |
|---|---|---|---|---|---|---|---|
| Control | $5.5^{ac}$ | $4.7^{ab}$ | $5.0^{a}$ | $5.6^{a}$ | $3.2^{a}$ | $4.2^{a}$ | $4.2^{a}$ |
| Vacuum PT | $5.7^{c}$ | $5.1^{a}$ | $4.7^{a}$ | $5,5^{a}$ | $3.3^{a}$ | $4.0^{a}$ | $4.2^{a}$ |
| Tumble | $4.9^{ab}$ | $4.9^{ab}$ | $5.0^{a}$ | $5.2^{a}$ | $4.1^{b}$ | $3.9^{a}$ | $4.0^{a}$ |
| Vacuum tumble | $4.6^{b}$ | $5.0^{a}$ | $4.7^{a}$ | $5.3^{a}$ | $4.0^{b}$ | $3.6^{a}$ | $3.9^{a}$ |
| Vacuum pulse | $5.0^{ab}$ | $4.3^{b}$ | $4.7^{a}$ | $5.5^{a}$ | $4.1^{b}$ | $4.0^{a}$ | $3.9^{a}$ |

[a, b] Means in the same column with unlike superscripts are different ($p<0.001$)
Vacuum PT = vacuum pulse tumble; O/F= Overall Flavour; O/A= Overall Acceptability
Cured colour, colour uniformity, saltiness, O/F and O/A were evaluated by means of a six-point hedonic scale (6 = very ... excellent/100% uniformity, very salty, extremely good flavour, extremely acceptable respectively; 1= very dark, very poor, very mild, ... poor, not acceptable respectively). Juiciness and tenderness were evaluated by means of a eight-point hedonic scale (8 = Extremely ... and extremely tender respectively; 1= Extremely dry and extremely tough respectively)

**Table 2:** Comparison of salt and moisture results on the core and outer samples of each treatment type of cured bacon.

| Treatment Type | | % Salt | % Moisture |
|---|---|---|---|
| Control | Core | $2.1^{a}$ | $71.9^{a}$ |
| Control | Outer | $4.3^{b}$ | $70.3^{b}$ |
| Vacuum pulse tumble | Core | $2.0^{a}$ | $71.9^{a}$ |
| Vacuum pulse tumble | Outer | $3.2^{b}$ | $71.1^{b}$ |
| Tumble only | Core | $2.9^{a}$ | $70.9^{a}$ |
| Tumble only | Outer | $3.8^{b}$ | $70.5^{a}$ |
| Vacuum tumble | Core | $2.7^{a}$ | $71.2^{a}$ |
| Vacuum tumble | Outer | $3.9^{b}$ | $70.7^{a}$ |
| Vacuum pulse | Core | $3.4^{a}$ | $71.2^{a}$ |
| Vacuum pulse | Outer | $4.2^{b}$ | $70.7^{b}$ |

[a, b] Means in the same column with unlike superscripts are different ($p<0.001$).

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