Ultrasound

INTERVENTION SUMMARY	
Status	An emerging technology
Location	Packaging/retail
Intervention type	Surface treatment of packaged product
Treatment time	0.5-5 minutes
Regulations	No specific restrictions in the EU, US and Australia
Effectiveness	Approximately 1 log
Likely cost	High capital outlay
Value for money	Currently poor
Plant or process changes	A 5-minute treatment of tank will take up a lot of space in a boning room
Environmental impact	Requires energy
OH&S	Major OH&S issues, particularly with noise
Advantages	Less use of preservatives required such as lactates, salt for processed meat products Potential for manufacture of new, minimally processed ready-to-eat meat products Shelf-life extension Can be used for treatment of vacuum packs
Disadvantages or limitations	Possible changes in colour and/or texture of raw meat products Product must be packaged, e.g., vacuum packed, as it must be immersed in water to transmit the ultrasonic wave to the product

Ultrasound

Ultrasound is a non-thermal, non-chemical, physical processing technology with various applications in food processing. Historically, the efficacy of ultrasound in inactivating bacterial cells has been limited by the protection afforded to the cells by the food environment. However, recent developments in ultrasound have greatly improved its efficacy. Ultrasound with higher output of energy (10-1000 W/cm^2) and at lower frequency (20-100 kHz) potentially generates intense pressure, shear and temperature gradients within food that can cause cell death in the food. The efficacy of the ultrasound treatment appears to depend more on the intensity of the wave rather than on the frequency, and as frequency increases, the effect reduces (Sykes, 1965).

Ultrasound treatment is suitable for small products (e.g., vacuum-packaged meat), and small carcasses (e.g., chicken and pork). This is because the products are typically required to be immersed in an ultrasound bath for treatment. However, the ultrasound treatment has not yet been commercialised, and little information is available for its efficacy in meats.

Pohlman *et al.* (1997) have evaluated the efficacy of ultrasound (at 1.55 W/cm^2) in reducing bacteria on vacuum-packed meat. The results revealed that the treatment caused an immediate reduction in the numbers of viable bacteria. After five days of storage, bacteria appeared to recover and grow back to the same level as in the untreated meat. This indicates ineffectiveness of the treatment. However, it has been suggested that application of ultrasound with higher intensity of energy (up to 500 W/cm^2) should produce a much more dramatic effect on bacteria in vacuum-packed meat.

Several studies have reported that ultrasound used in conjunction with other treatments could give a synergistic effect (Eustace, 2004; Gould, 200; Kordowska-Wiater and Stasiak, 2011). Kordowska-Wiater and Stasiak (2011) demonstrated that ultrasound alone caused a 1-log reduction of Gram-negative bacteria (e.g., *Salmonella* spp., *E. coli* and *Psudomonas fluorescens*) on the surface of chicken wings, whereas ultrasound with lactic acid reduced bacterial numbers by at least 1.5 log cfu/cm^2. Ultrasound has also been used in combination with mild heat treatment and showed to enhance the bactericidal effect on meat (Eustace, 2004). This combination of treatments was found to reduce the heat resistance of bacteria by 5-20°C when the pressure is increased slightly (i.e., by only the order of megapascals) (Gould, 2001).

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