Ultrasonics

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 EU, US or Australia.
Effectiveness	Not yet clearly identified
Likely Cost	High capital outlay
Value for money	Currently poor
Plant or process changes	A 5-min treatment 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 meat colour/texture changes on raw meat products Product must be packaged, eg. Vacuum Packed, as it must be immersed in water to transmit the ultrasonic wave to the product

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Ultrasound has various applications in the food industry, including killing or inhibiting bacteria. Historically, the effectiveness of low intensity ultrasound in inactivating bacterial cells has been limited by the protection afforded to the organisms by the food environment. Recently, however, systems with high output of ultrasonic energy at low frequency have greatly increased the lethal effect on bacteria.

High power ultrasound – within the frequency range 20-100 kHz and of energy intensity 10-1000 Wcm^{-2} – generates intense pressure, shear and temperature gradients within food that can disrupt the structure of bacteria in the food. The efficacy of the treatment depends more on the intensity of the wave than on the frequency, and as frequency increases, the effect reduces (Sykes 1965). The effect of ultrasound on microorganisms is complex, but the disruption of cell membranes and DNA chains is thought to be mainly responsible for the lethal effect.

Vacuum-packaged meat has been experimentally treated with ultrasound by USA researchers. Whilst the treatment caused an immediate reduction in the numbers of viable bacteria, after five days there was no longer evidence of a significant benefit of the treatment, the microorganisms having recovered and grown back to the same level as in the untreated meat (Pohlman *et al.* 1997). The energy intensity of the system used was low (just 1.55 Wcm^{-2}), and application of much higher intensity – up to 500 Wcm^{-2} – will very likely have a much more dramatic effect on meat bacteria in vacuum packs. Ultrasound could be potentially applied to premium quality, vacuum-packaged meat if an immersion system was used, for example during heat shrinking of the bag in a waterbath.

Ultrasound used in conjunction with chemical treatments can give a synergistic effect (Ahmed and Russell 1975), and ultrasound in combination with mild heat treatment has been investigated for its potential application on vacuum-packed primals. Manothermosonication is the term given to a combination of ultrasonication, increased temperature and increased pressure. Researchers found that as temperature increased, the antibacterial effect of ultrasound decreased. However, if the pressure is increased by only a small amount, this loss of efficacy disappears. It has the overall effect of reducing the bacterial resistance to temperature by 5-20°C, so they are inactivated at lower temperatures (Gould 2001). The process has not yet been commercialised, and little information is available for its efficacy in meats as yet.

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References

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