

Industrial significance

- Ultrasound as an alternative method for tenderising meat.
- Ultrasound can assist in extraction, gelation and restructuring of meat proteins. Ultrasound treatment can replace/reduce salt in restructured beef roll manufacture and results in superior colour (Vimini *et al.*, 1983)
- Ultrasound assisted cooking. ultrasound can increase the water holding properties of meat and the binding strength which are responsible for increased cooking yield (Reynolds *et al.*, 1978)

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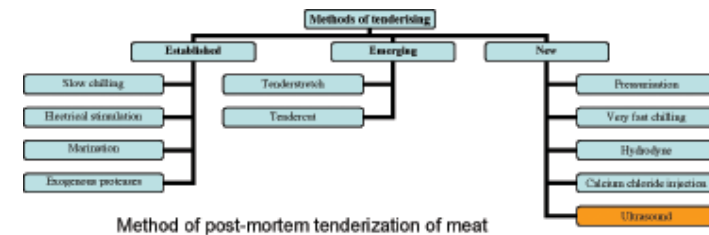
Ultrasound in Meat Processing

Ultrasound, when used at low frequencies and high intensities has the potential of improving tenderness of meat. This process is currently under the scrutiny of meat scientists.



Meat Tenderness

Despite continuous research in achieving consistent eating quality of meat, it still remains as an elusive goal in meat research. There is no other attribute in meat more highly rated than *tenderness* and has received more attention in literature of meat science. Tenderness is influenced by composition, structural organisation and the integrity of the skeletal muscle. Tenderness enhancing method can be categorised according to their recognition as illustrated below.



Ultrasound as a potential technique of tenderisation

Conventional applications of ultrasound such as medical imaging, cleaning and measuring fat depth of carcasses are well established. The sonochemical and sonomechanical effects of sound waves (20 kHz -100 kHz) at a sufficiently high power range (100 W-10 kW) radiated through food (aqueous or semisolids) can alter the intrinsic property of the foods. High power ultrasound has the potential to be used efficiently in food processing in place of chemicals, high temperatures and pressures and longer processing times under normal processing conditions.



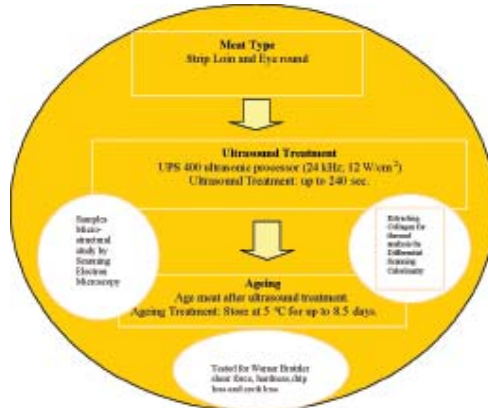
A sample being treated

Application of ultrasound at high intensities to provoke changes in physical and chemical properties of meat and meat products has attracted the interest of research workers for the past few decades because it is a pure physical technique.

A study at the University of Queensland is designed to investigate the effects of high power ultrasound treatment on the tenderness, colour, water loss, cook loss, thermal and ultra-structural properties of eye round and strip loin obtained from mature steers.

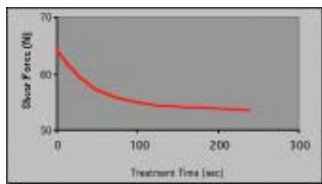
Research outline

The ultrasound radiation has inherent qualities of heat production and pressurisation. The results discussed are brief summary of the effect of those properties on mechanical, thermal and microstructural aspects, which are responsible for overall eating quality of beef.



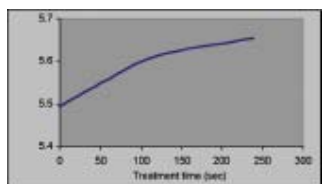
Ultrasound and physicochemical properties of meat

Effect of ultrasound treatment on Warner Bratzler Shear force of post-rigor beef



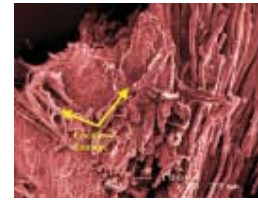
The tenderness was found to be increased due to the ultrasound treatment as measured by the Warner Bratzler shear force device (objective tenderness) and the hardness of the muscles was also significantly reduced after the treatments. Other quality parameters tested were not compromised by the ultrasound treatment (e.g. drip loss, cook loss and colour).

Effect of ultrasound treatment on pH of post-rigor beef



The pH increased significantly after ultrasound treatment. This increase in pH could be due to a release of ions from the cell structure into the cytoplasm, or to a change in the protein structure, which would lead to the modification in the position of some ionic groups, enabling them to support in buffering the muscle (Got et. al., 1999)

Ultrasound and ultrastructural properties bovine muscle

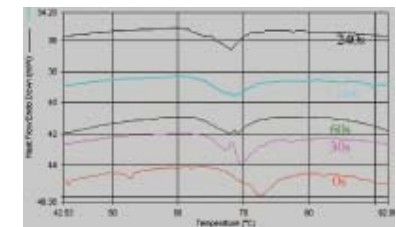


Ultrasound treated meat tissue illustrating the aspects of localized high pressure resulting in tearing apart the tissues

Ultrasound and thermal properties of extracted collagen

Ultrasound treatment reduces the denaturation temperature of collagen of both muscles. This effect can be attributed to the fragmentation of collagen macromolecules upon ultrasonication, reducing the denaturation temperature of extracted collagen (Nishihara & Dotty, 1958).

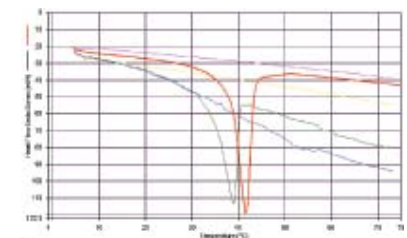
The figure below illustrates the capability of ultrasound in solubilising the collagen. The sharp endothermic peaks represent the denaturation of soluble collagen.



Effect of ultrasound treatment on the thermal transition temperature of extracted collagen from Strip loin

Remarks

- The results suggest that the use of high power ultrasound is capable of tenderizing meat at a sufficient magnitude to be detectable by objective texture measurements.
- Muscle ultrastructural damages as illustrated might have contributed to the observed tenderness improvement
- High power Ultrasound waves are also capable of fragmenting collagen fraction.
- Further study is being pursued to detect the effect of ultrasound treatment on the aspects of solubility of collagen.



Effect of ultrasound treatment on solubilisation and the thermal transition temperature of soluble collagen from eye round