



**HAL**  
open science

## **Shockwave processing and sous vide cooking improve sensorial and nutritional qualities of beef**

Feng Ming Chian, Lovedeep Kaur, Thierry Astruc, Annie Venien, Olivier Loison, Anna-Sophie Stubler, Kemal Aganovic, Suzanne Hodgkinson, Mike Boland

► **To cite this version:**

Feng Ming Chian, Lovedeep Kaur, Thierry Astruc, Annie Venien, Olivier Loison, et al.. Shockwave processing and sous vide cooking improve sensorial and nutritional qualities of beef. Food Structure Digestion and Health congress, Sep 2019, Rotorua, New Zealand. 2019. hal-02289521

**HAL Id: hal-02289521**

**<https://hal.science/hal-02289521v1>**

Submitted on 16 Sep 2019

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# Shockwave processing and sous vide cooking improve sensorial and nutritional qualities of beef

Food Structures, Digestion and Health 2019  
Rotorua, New Zealand

www.riddet.ac.nz

CENTRE OF RESEARCH EXCELLENCE

## Introduction

In recent years, novel technologies have received extensive attention in the meat industry to effectively improve the organoleptic and nutritional properties of meat. Technologies such as shockwave processing and sous vide cooking have been investigated and are found to be effective in tenderisation of meat [1, 2]. These processing methods have been reported to cause structural modification of muscle physical structure [1] which may potentially influence the bioaccessibility of digestive enzymes and in turn affects the digestive properties of meat [3].

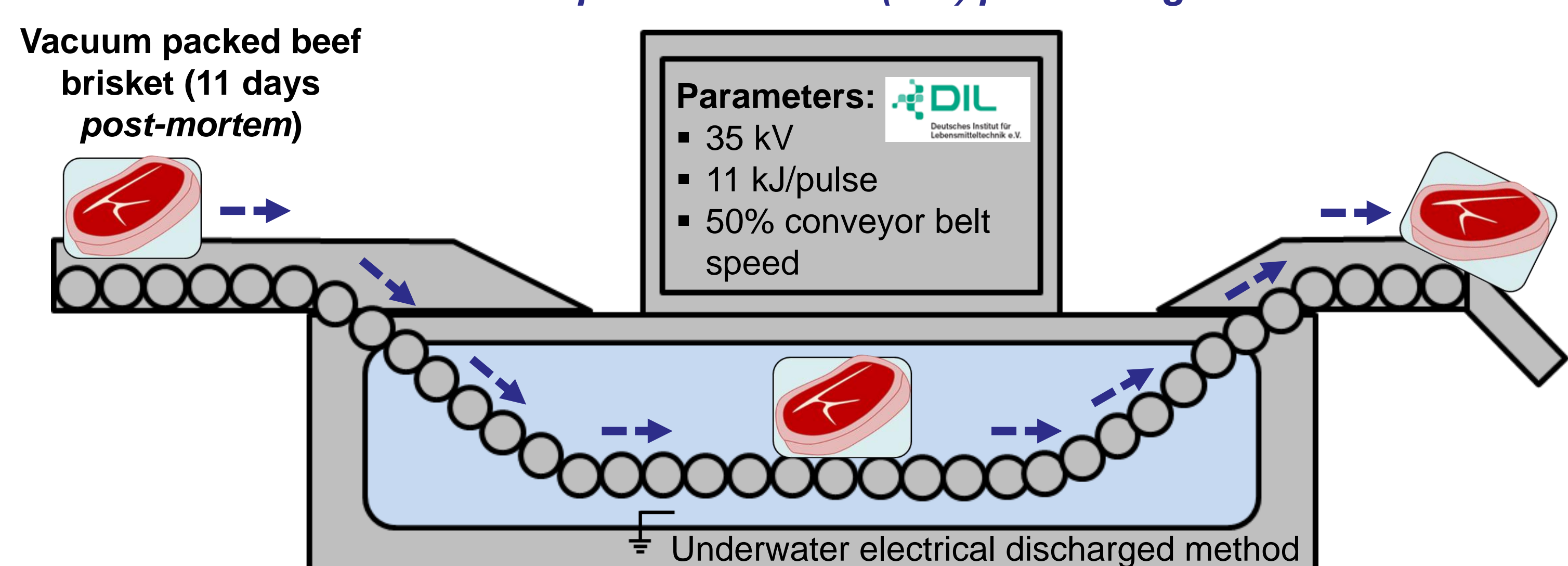
## Objective

The objective of this experiment was to study the effect of shockwave processing and subsequent sous vide cooking on meat tenderness, muscle structure and oral-gastro-small intestinal protein digestibility *in vitro*.

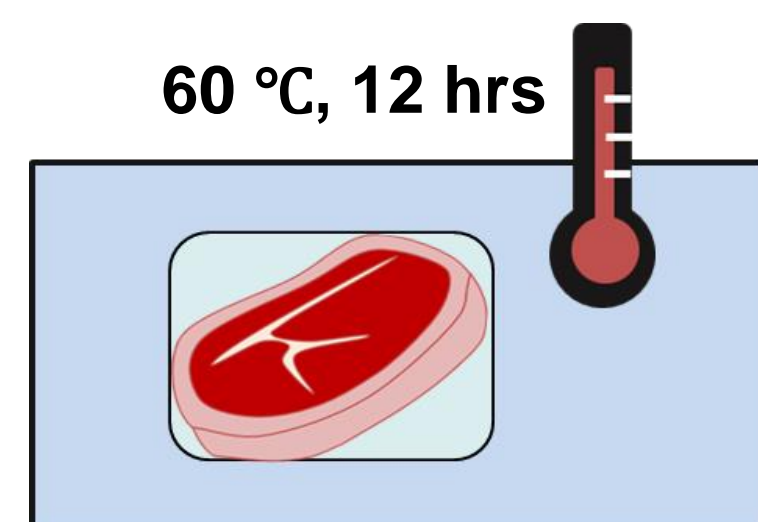
## Materials and methods

### Sample treatments

#### Step 1: Shockwave (SW) processing



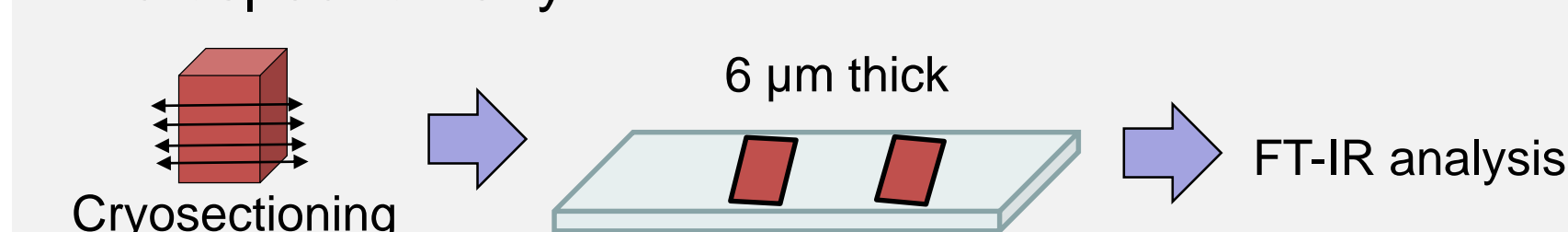
#### Step 2: Sous vide (SV) cooking



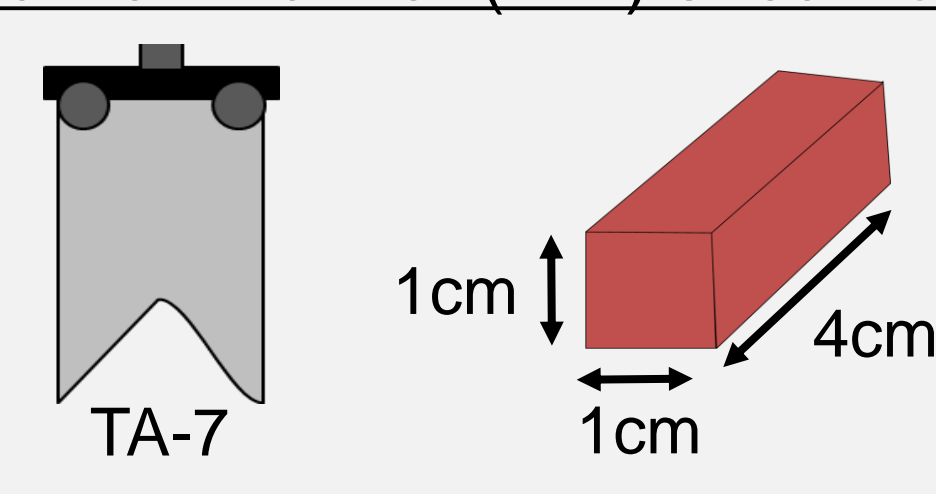
### Post-treatment analyses

#### Muscle structure

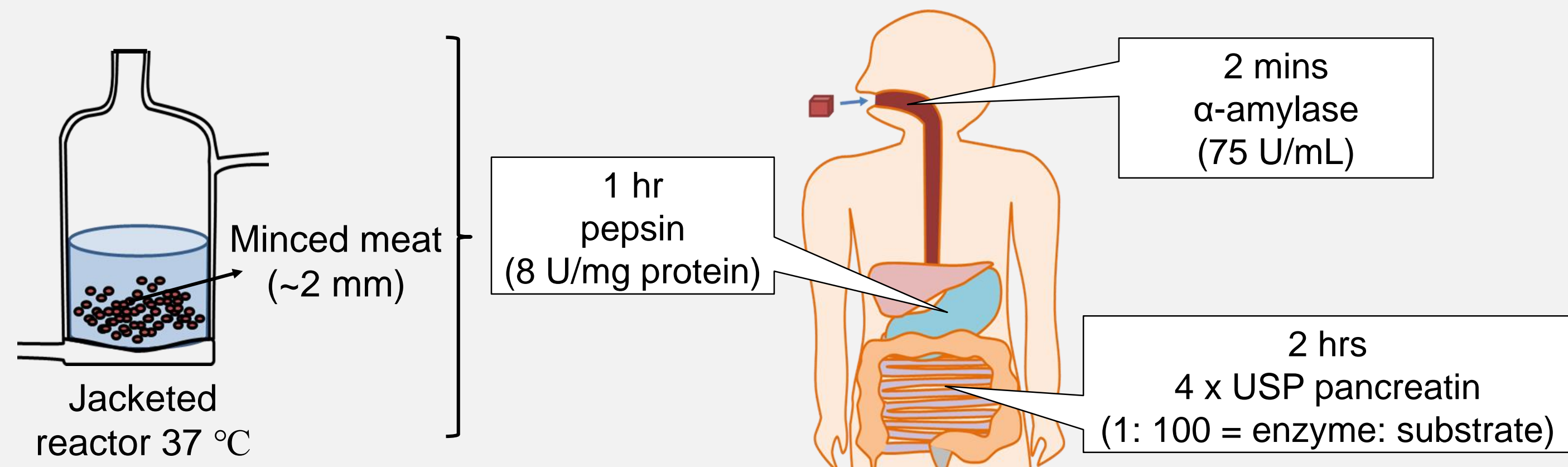
- Transmission electron microscopy (TEM)
- Fourier-transform infrared spectroscopy (FT-IR) microspectrometry



#### Warner Bratzler (WB) shear force



#### *In vitro* oral-gastro-small intestinal digestion (static model) [4]



## Results and discussion

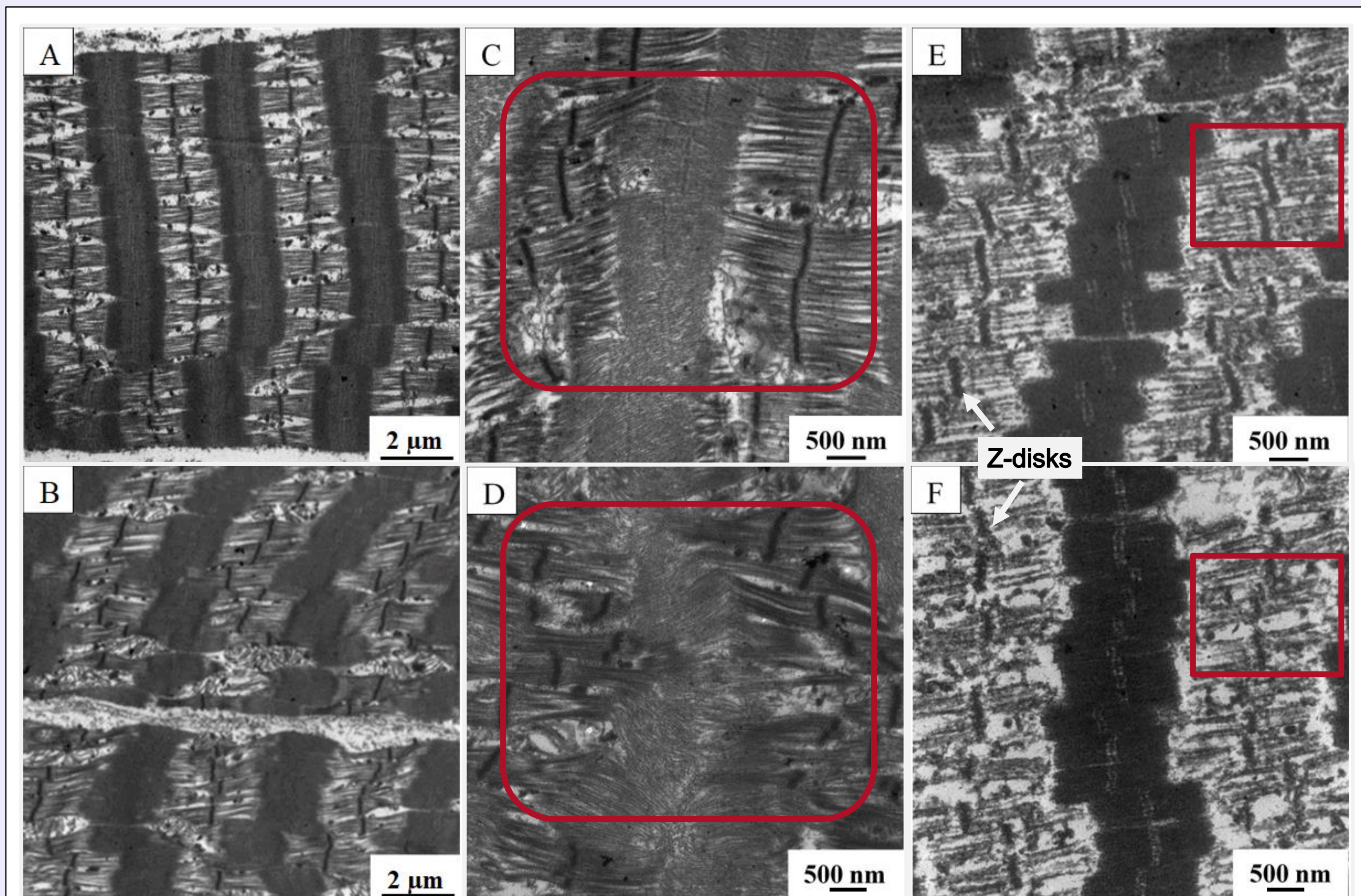


Figure 1. TEM micrographs showing the ultrastructure of beef brisket with and without processing. A and C: control untreated raw muscle; B and D: SW treated raw muscle; E: control untreated SV cooked muscle; F: SW treated SV cooked muscle. SW treatment has caused the formation of wavy and disordered sarcomeres. Subsequent SV cooking led to the disintegration of z-disks structure and coagulation of myofibrils in a greater extent when compared to the control untreated SV cooked meat.

### Raw connective tissue (CT)

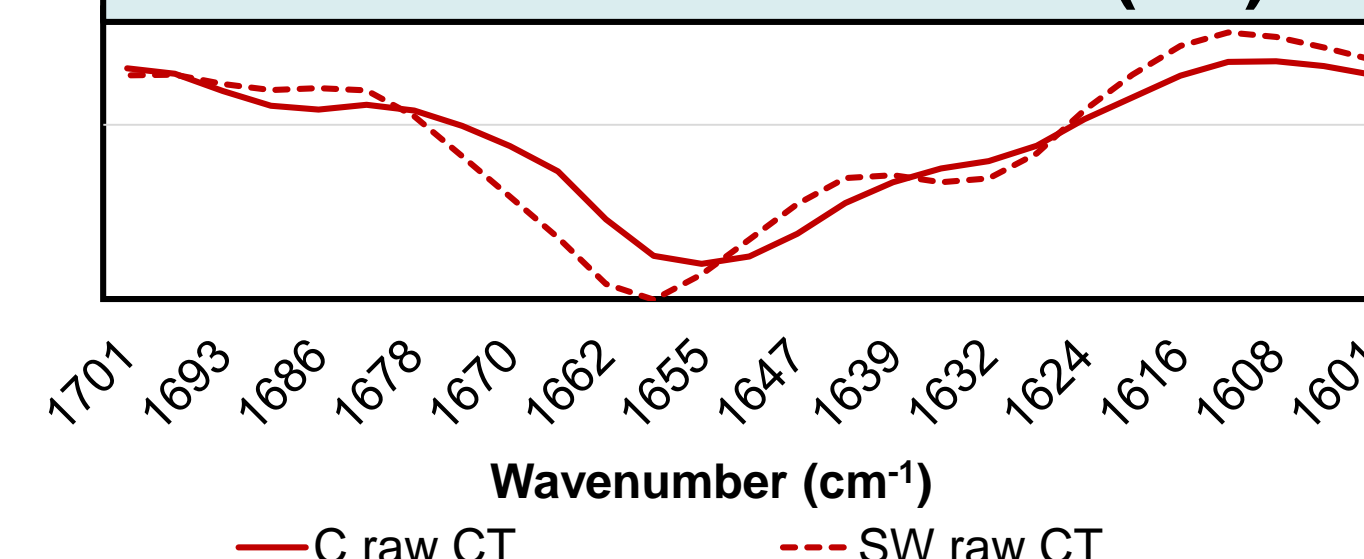


Figure 2. Amide I region second derivative spectra of connective tissue (CT) of raw control (C) and SW treated samples obtained from FT-IR microspectrometry analysis. The maximum peak absorption of SW treated meat at 1655  $\text{cm}^{-1}$  ( $\alpha$ -helices) was shifted to 1659  $\text{cm}^{-1}$ , indicating the weakening of hydrogen bonding in collagen triple helices [5].

### WB shear force (N)\*

Control SV	45.46 ± 10.20
SW SV	40.33 ± 5.40

Table 1. A significant reduction in WB shear force was observed for the SV cooked SW treated meat compared with the control, which might be due to the disruption of muscle fibres and collagen structure from the SW processing. \* $p < 0.05$

### Ninhydrin Amino N %

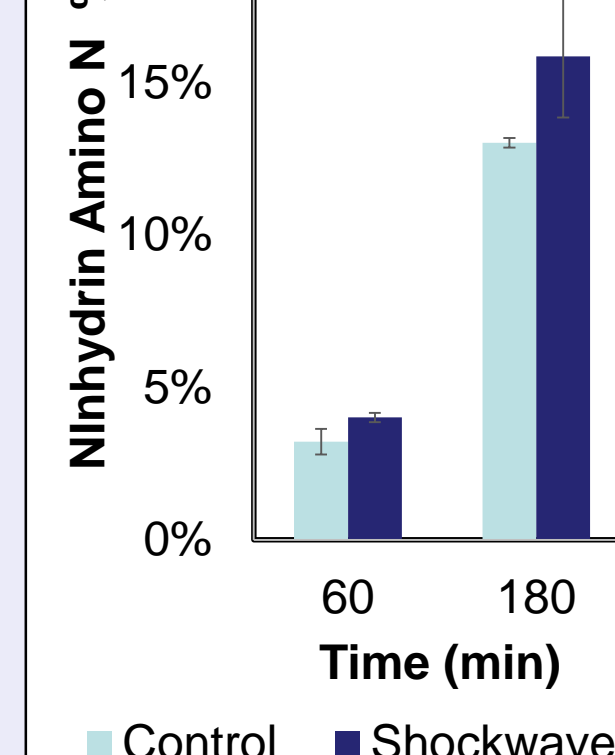


Figure 3. Ninhydrin Amino Nitrogen released from the control and SW treated SV cooked meat after 60 mins (an hour of gastric digestion) and 180 mins (an hour of gastric digestion followed by two hours of small intestinal digestion) of *in vitro* digestion. The ninhydrin amino nitrogen released from the SW treated SV cooked meat was significantly higher than control SV cooked meat after both 60 mins and 180 mins of digestion, showing improved protein digestibility *in vitro*.

## Conclusions

Shockwave processing followed by sous vide cooking improved meat texture and *in vitro* protein digestibility and thus could be a useful approach to enhance meat's organoleptic and nutritional properties.

## Acknowledgements

Funding from the Riddet Institute Centre of Research Excellence (CoRE) is gratefully acknowledged. The authors would also like to thank INRA and DIL for hosting Miss Chian as part of this study as well as Miss Claire Szczepaniak (Cellular Imaging Center of Health (CICS) laboratory, Clermont Ferrand University, France) for helping with the TEM sample embedding process.

## References

- Bolumar, T., Bindrich, U., Toepfl, S., Toldra, F., & Heinz, V. (2014). Effect of electrohydraulic shockwave treatment on tenderness, muscle cathepsin and peptidase activities and microstructure of beef loin steaks from Holstein young bulls. *Meat Sci*, 98(4), 759-765.
- Baldwin, D. E. (2012). Sous vide cooking: a review. *International Journal of Gastronomy and Food Science*, 1(1), 15-30. doi:10.1016/j.ijgfs.2011.11.002
- Astruc, T. (2014). Muscle structure and digestive enzyme bioaccessibility to intracellular compartments. In Boland, M., Golding, M., & Singh, H., Food structures, digestion and health (pp. 193-222). London: Academic Press.
- Chian, F. M., Kaur, L., Oey, I., Astruc, T., Hodgkinson, S., & Boland, M. (2019). Effect of Pulsed Electric Fields (PEF) on the ultrastructure and *in vitro* protein digestibility of bovine longissimus thoracis. *LWT*, 103, 253-259. doi:10.1016/j.lwt.2019.01.005.
- Payne, K. J., & Veis, A. (1988). Fourier transform infrared spectroscopy of collagen and gelatin solutions: Deconvolution of the amide I band for conformational studies. *Biopolymers*, 27(11), 1749-1760. doi:10.1002/bip.360271105