Effect of Mechanical Work on the Meat Used for Making Reformed Meat Products

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Abstract

Tumbling, a process commonly used during production of reformed meat, applies mechanical work against the meat pieces to break down the meat structure, enhance brine absorption and extract solubilized myosin to the meat surface. The myosin acts as glue to bind meat pieces together when heated. The work done in the tumbler is currently unquantifiable and its relationships with total protein and myosin extraction and binding strength (Tensile Adhesive Strength, TAS) of two meat pieces are unknown.

Much of this project was allocated to developing and evaluating an instrument called the Impact and Friction Mechanical Robot (IFMR), which is able to repeatedly apply a desired impact and to vary the rate of repeated impacts and the time gap between each impact. The degree of sample compression could also be varied. The work done as a consequence of the hitting process can be calculated for each individual hit and summed to give the total work impacted on the meat.

Four groups of 20 mm^3 meat cubes were prepared for the hitting treatments. One group was used as the control while the other three were pre-soaked in 0.396, 0.713 or 1.146 mol/L of brine consisting of NaCl and salts of phosphate. The meat cubes were hit so maximum impact force was 10 N with an average 0.665 s between each hit for 0, 400, 800, 1200, 1600 or 2000 hits. The exudate on the hit meat surface was scraped off and examined for total protein and myosin.

The total protein extracted was not influenced by the work ($p=0.764$) applied on meat cubes pre-soaked in different concentrations of brine ($p=0.123$). Myosin extracted increased with total work done ($p=0.006$) on the meat and concentration of brine ($p<0.001$) used for soaking.

Two meat cubes were attached together at the hit surfaces, cooked at 70 °C with a 250 g weight applied, and tested for tensile adhesive strength (TAS). The TAS between meat pieces increased with increased total work ($p=0.0001$) done on the meat and increased brine concentration ($p<0.001$) for pre-soaking. The TAS also increased as myosin concentration increased ($p=0.001$). A good TAS of the meat pieces could be achieved by adequately solubilising the myosin using brine and applying sufficient total work to the meat pieces.

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List of Abbreviations

IFMR	Impact and Friction Mechanical Robot
TAS	Tensile Adhesive Strength
NaCl	Sodium chloride
STPP	Sodium tripolyphosphate
TSPP	Tetrasodium pyrophosphate
SHMP	Sodium hexametaphosphate
SDS PAGE	Sodium dodecyl sulphate polyacrylamide gel electrophoresis
HH	Hitting head
VB	Visual Basic
DOS	Disk Operating System
GUI	Graphical User Image
BCD	Binary-Coded Decimal
AU	Arbitrary Unit

Nomenclature

S_R	Scanning rate
S_T	Total data to be scanned
n	Number of hits
H_G	average gap time between hits
H_T	average time per step
F_T	force target
D_T	distance target
S_N	initial step number
k	hit number
F_P	Peak force
F_T	Target force