DTU

Danish Agency for Higher Education and Science

Food & Bio Cluster Denmark

Conference on

Healthy, Safe and Sustainable Foods of the Future

13 October

Green technologies-based approaches for the food processing

Main drivers for development and employing innovative or novel process technologies

Some Examples:

Industrial needs

- Higher energy conservation
- Reduce production costs
- Development of new foods for specific groups of consumers
- Improve shelf life
- Reducing carbon emission
- Reducing water consumption

Non-thermal:
- High hydrostatic pressure(HHP)
- Ultrasound (US)
- Ultraviolet light (UV)
- Pulsed Electrical Field (PEF)
- Cold plasma
- Co_2 injection

Thermal:
- Ohmic heating(OH)
- Microwave
- Radio frequency(RF)
- Infra Red

Consumer demands for:

Enegy efficiency

Less water consumption

Less organic water pllutants

Fresh, nutritious, healthy and Safe products

Efficient reduction of microorganisms

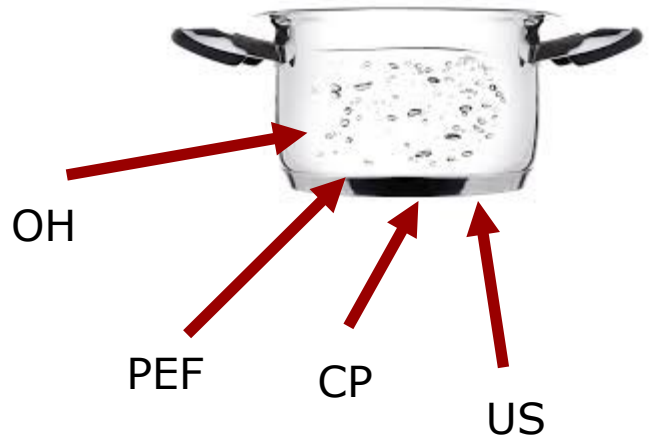
Preserving the structure and function of food ingredients

Lower loss of thermolabile compounds

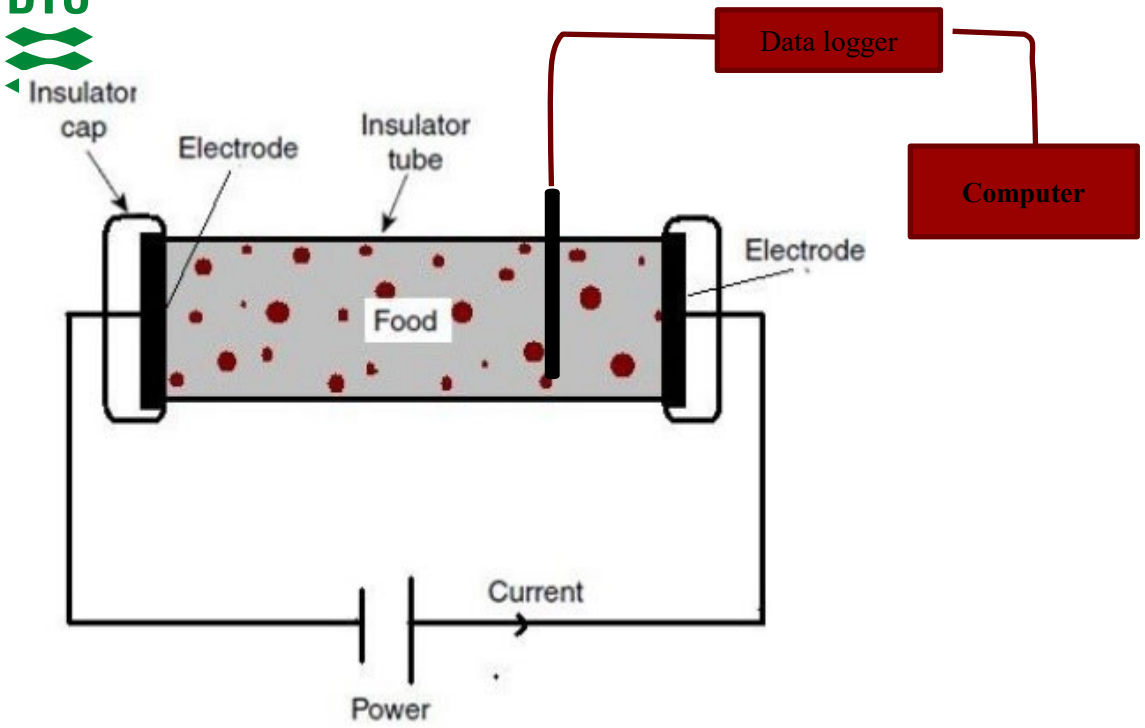
Clean label products

Better sensory

Better nutritional properties



Novel functional properties and food structure engineering



Ohmic Heating

- Preservation
- Evaporation
- Blanching
- Extraction
- .....

$P = R.I^2$ (power)

$q=(\frac{U}{L})^2 V\sigma$ (generated heat)

U is the voltage(volts)
I is the amperage (ampers)
R is resistance (ohms)
L is Food length
V is food volume
σ is electric conductivity

- ✓ Green process
- ✓ Uniform heating
- ✓ Heating product containing large particles
- ✓ Fast heating
- ✓ Higher energy efficiency
- ✓ Low capital ivestment

The need for a reliable feedback control to Adjust supply power to the conductivity change

Effect of MEF on the Structure and Functionality of Proteins

The non-thermal effect of MEF treatments could be prop
physical method to change the

Structural changes: Unfolding or partial de

Reduction in random c

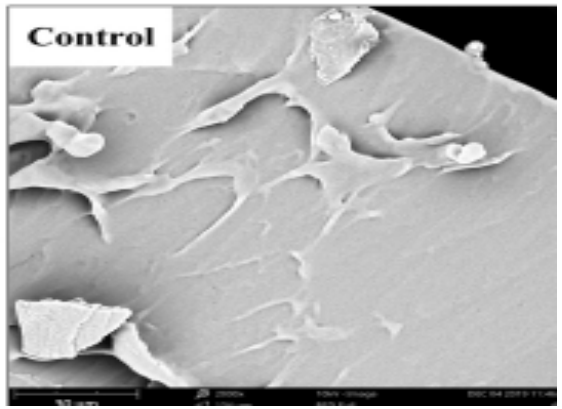
Higher β-structures

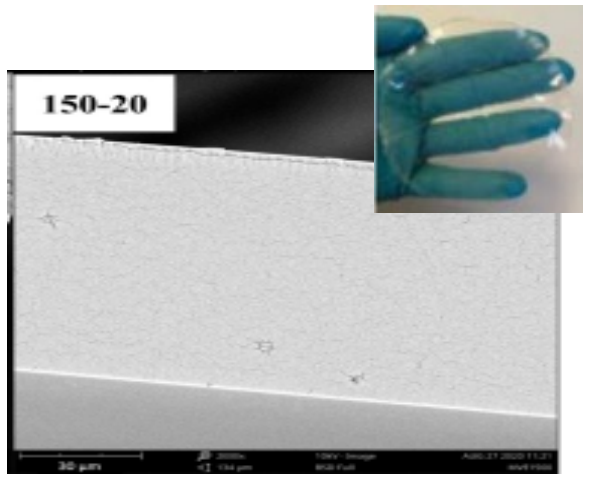
Interfacial and surface tension: lowering surface tensi

Thermal properties: Increase glass transitic

Particle size of dispersion: Smaller particle size

Emulsion stability: Higher stability





SEM images (cross-section) of control and MEF-treated caseinate films

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Effect of moderate electric field on structural and thermo-physical properties of sunflower protein and sodium caseinate

Büşra Gültekin Subaşı [a,b,c], Mastaneh Jahromi [b,d], Federico Casanova [b], Esra Capanoglu [c,*], Fatemeh Ajalloueian [d,e], Mohammad Amin Mohammadifar [b]

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Influence of moderate electric field on sodium caseinate structure and its techno-functionality

Mastaneh Jahromi [a], Mehrdad Niakousari [a,*], Mohammad Taghi Golmakani [a], Büşra Gültekin Subaşı [b,c,d], Mohammad Amin Mohammadifar [b]

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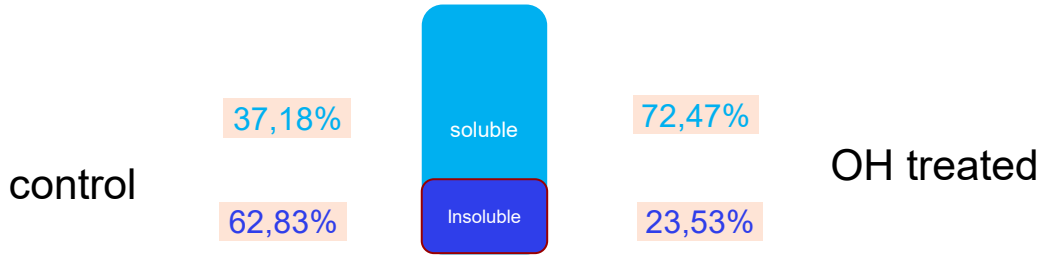
Effect of OH on Mineral balance in Cheese powder dispersions

More Sustainable Alternative: Manipulation of Ca balance in cheese emulsion to increase the soluble Ca amount.

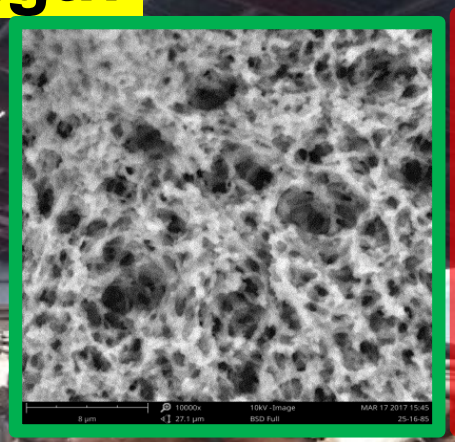
Application of different process methods (e.g., ohmic heating, PEF)

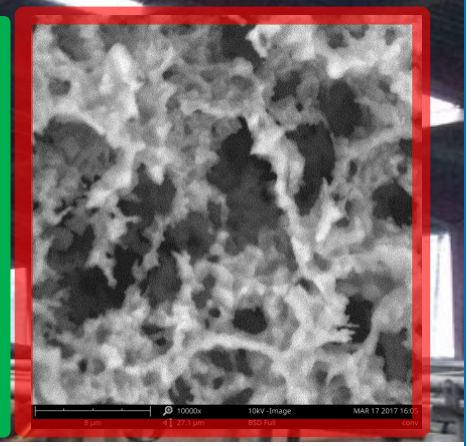
Solubilization of CaP → Disintegration of casein micelles → increased protein mobility and emulsification of oil droplets

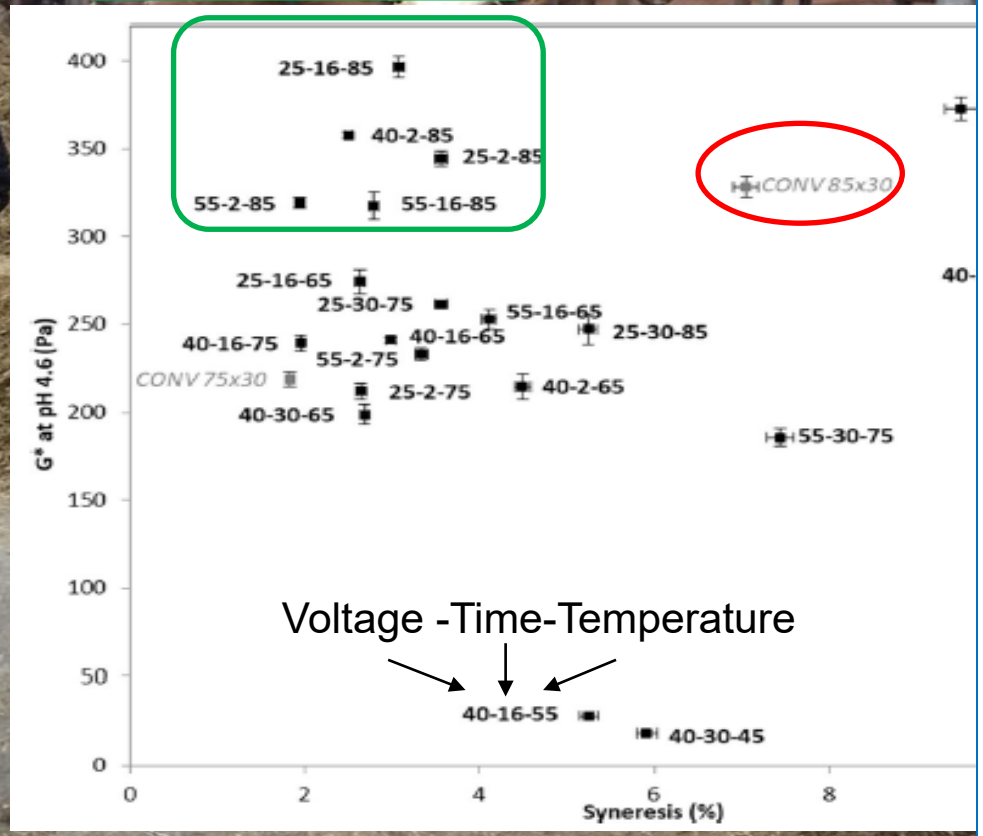
Ca distribution in Cheese powder dispersions



OH treatment of Milk:Stuctureal strength and syneresis of yougurt







ORIGINAL ARTICLE

Effect of Ohmic Heating on the Formation and Texture of Acid Milk Gels

Ademi Caruggi[1] · Mara Lucisano[1] · Aberham Hailu Feyissa[2] · Saeed Rahimi Yazdi[3] · Mohammad Amin Mohammadifar[2]

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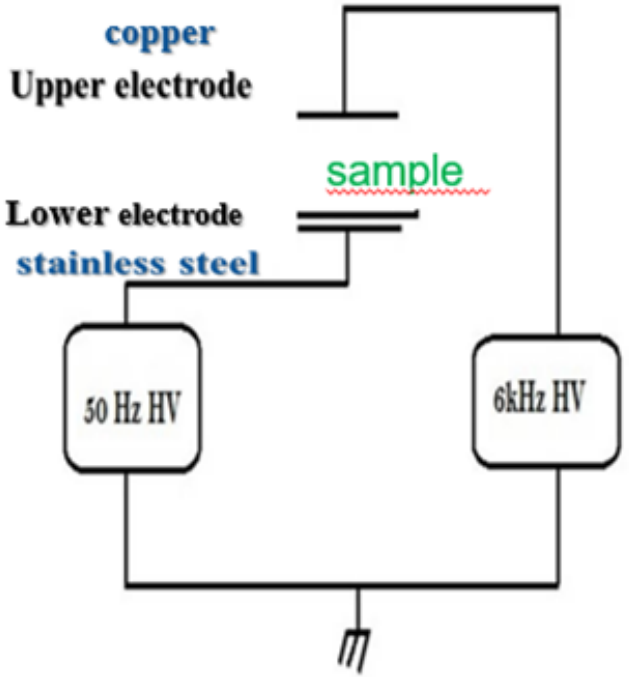
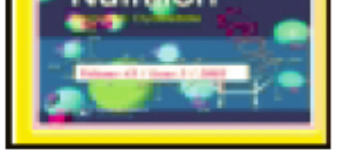
Food Biophysics
https://doi.org/10.1007/s11483-019-09578-y

The impact of atmospheric cold plasma (ACP) treatment on inactivation of lipase and lipoxygenase of wheat germs

The Sun
is an example of a star in its
plasma state



- Plasma has been described as the fourth state of matter
  - There are ionized gases that consist of positive and negative ions and electrons as well as neutral species.



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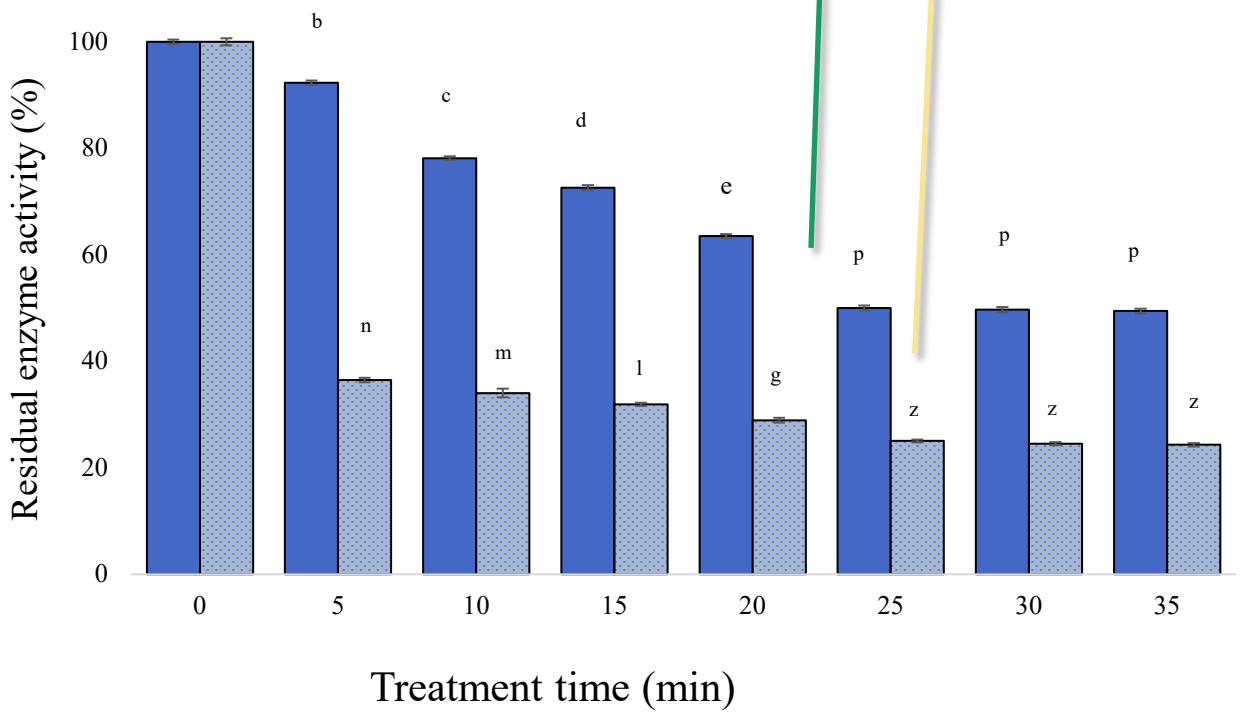
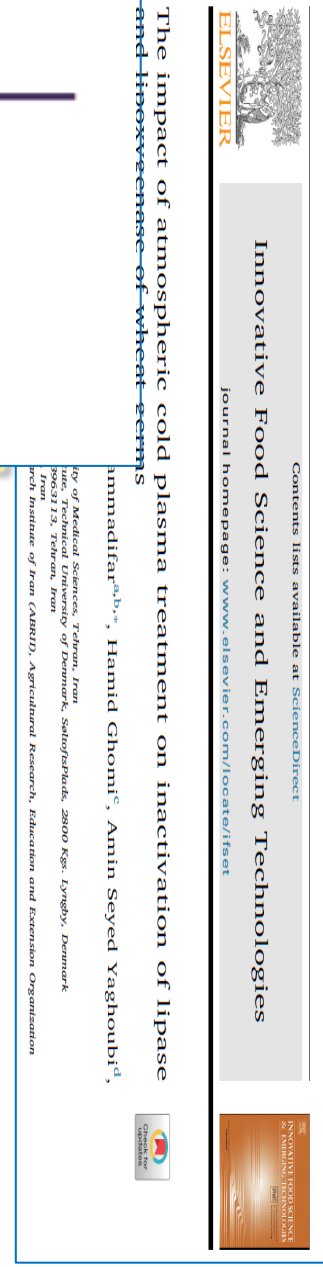
Cold Atmospheric Plasma Manipulation of Proteins in Food Systems

Haniye Tolouie, Maryam Hashemi , Mohammad Amin Mohammadifar & Hamid Ghomi

Modification of some amino acids side chains of the enzyme
(Pankaj et al., 2013)

Changing in the protein conformation and structure
(Surowsky et al., 2013)




The impact of atmospheric cold plasma treatment on inactivation of lipase and lipoxygenase of wheat germ
ammadifar[a,b,*], Hamid Ghomi[c], Amin Seyed Yaghoubi[d],
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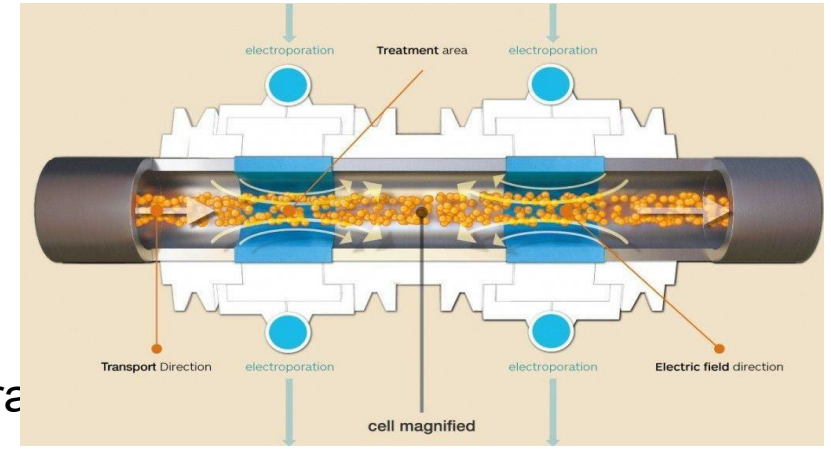
The lower rate of inactivation of lipoxygenase compared to lipase inactivation

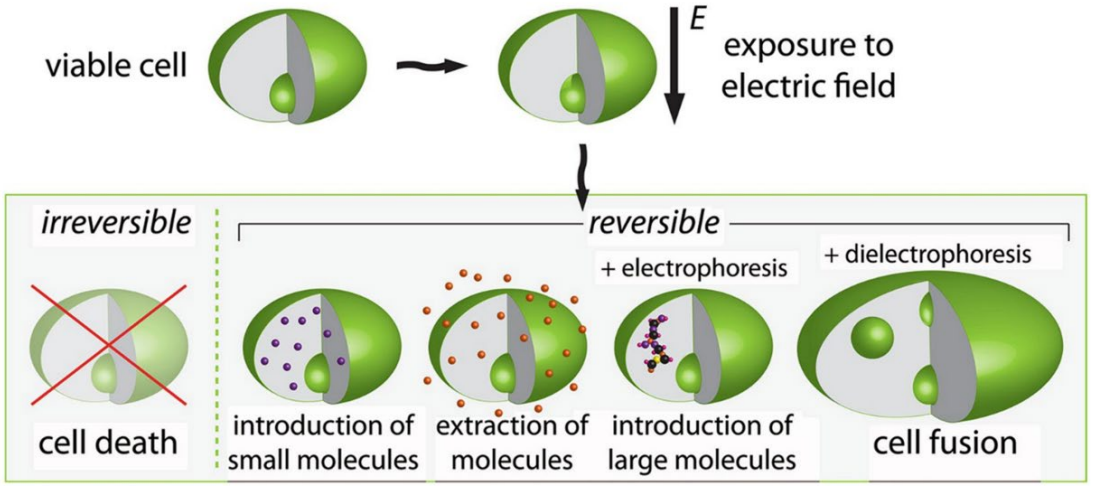
Pulsed electric field (PEF)



- Electric pulses of short duration (10^{-4} to 10^{-2} s)
- ***non-thermal*** food processing method
- high amplitude (0.1–80 kV/cm)
  - Critical electrical potential across cell membranes, enabling an easier extra

Advantages

- Increased mass transfer
- Reduced energy costs
- Decreased processing time
- Improved protein functionality



Pulsed electric field treatment-protein extraction

- PEF applied to insect *Tenebrio molitor* and *Hermetia illucens* (Black soldier fly larvae)

Sample	Mode	Pulse width (ns)	Pulses	E (kV/cm)	Frequency (Hz)	Flow
T. molitor	Batch	10,000	200	1.75	10	-
H. illucens	continuos	30,000	-	2.5	5	0.8L/min

Sample	Protein content (before)	Protein content (after)
T. molitor	42.47±0.02	58.87±1.01
H. illucens	60.58±0.12	83.25±1.46

Hermetia illucens

Tenebrio molitor

Lucas Sales Queiroz,2021

Thank you

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