

## Omega-3 enriched insect (*Acheta domesticus*) as a novel and eco-sustainable food in Europe

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### Introduction

*Acheta domesticus* (house cricket, AD), recently authorised by the EU as novel food (EU 2022/188), is one of the most consumed insect species worldwide, due to its good taste and its high nutritional profile, rich in protein, lipids and other essential nutrients [1]. However, crickets are poor in unsaturated fatty acids, especially the health promoting omega-3 long-chain polyunsaturated fatty acids including the docosahexaenoic (DHA, 22:6n-3) and eicosapentaenoic acid (EPA, 20:5n-3), known for health-promoting properties [2]. In cricket farming, maintaining a balanced male-to-female ratio (typically 1:1) is essential for maximizing production efficiency. Adjusting this ratio can optimize yields based on specific requirements, such as increasing the number of females for higher egg production. Unfortunately, current methods for determining the gender of crickets on farms are inefficient, relying heavily on manual visual inspections.

### Aim of the PhD project

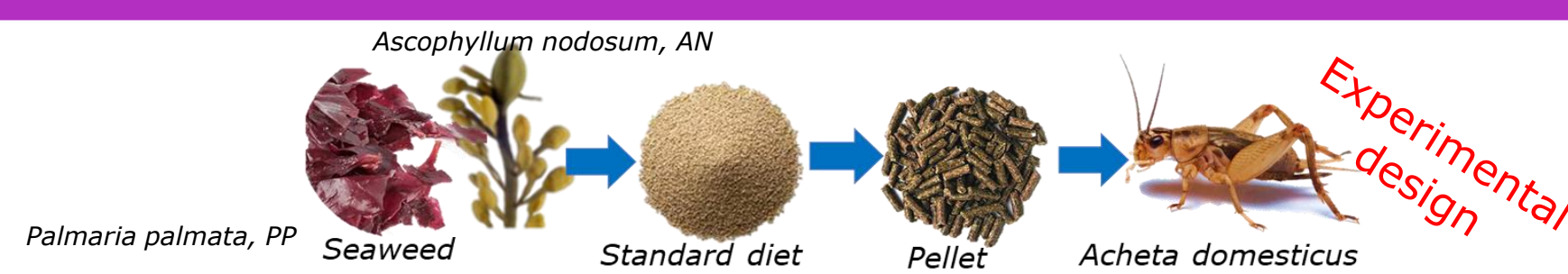
- Studying new cost-effective, eco-sustainable rearing substrates for the production of *Acheta domesticus* powder enriched in unsaturated fatty acids (UFAs), that could be integrated among the so-called "functional food".
- Improving crickets' production through a counting gender automatic system.

Sustainability (nutritional, life quality, sustainable, circular economy)

1st  
2nd  
3rd

- Evaluation of the use of seaweed as food supplement for *Acheta domesticus*.
- First experiment with the inclusion of *Palmaria palmata* (PP) (5, 10 and 20% of the diet) in cricket's diet.
- Determination of the proximate composition and fatty acids profile of *A. domesticus* fed PP-enriched diets.
- Second experiment with the inclusion of *Ascophyllum nodosum* (AN) (20 and 40% of the diet) in cricket's diet.
- Determination of the proximate composition and fatty acids profile of AD fed AN-enriched diets.
- Investigation of the presence of Potentially Toxic Elements (PTEs) Cd, Pb, Ni, As, Al, Cr and Hg in test diets and in *A. domesticus* fed diets included different percentages of PP and AN.
- Third experiment with the inclusion of microalgae (*Chlorella vulgaris*) into the water of crickets, cultivated using by-products from crickets rearing, as part of a circular economy approach.
- Developing a system for crickets' detection and gender classification, to study new rearing substrates to enhance the fertility of crickets themselves.

### 1st and 2nd year (synthesis)



**Food Chemistry**  
Optimizing the nutritional composition of *Acheta domesticus* (house cricket) with *Ascophyllum nodosum* dietary supplementation: promoting low-fat and healthy crickets as food

Optimizing the nutritional composition of *Acheta domesticus* (house cricket) with *Ascophyllum nodosum* dietary supplementation: promoting low-fat and healthy crickets as food

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Submitted

Adding *Ascophyllum nodosum* to the diets led to crickets with a significant reduction of the lipid content, accompanied by a decrease of SFAs and an increase of UFAs, compared to crickets fed the control diet.

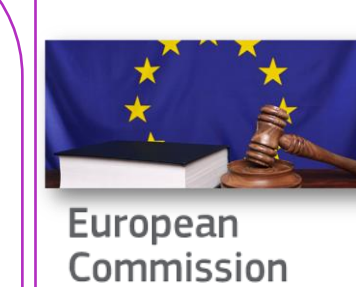
Based on this study, the inclusion of 20% of AN to the diet is considered optimal for AD, leading to crickets with a low-fat content, and with a good quality FAs profile, that may offer health-promoting properties and could be considered a nutritious alternative food source in human diets, particularly those focused on low calorie intake and cardiovascular health promotion.

### Potentially toxic elements

Cd, Pb, Ni, As, Al, Cr, Hg

Test diets

*Acheta domesticus*



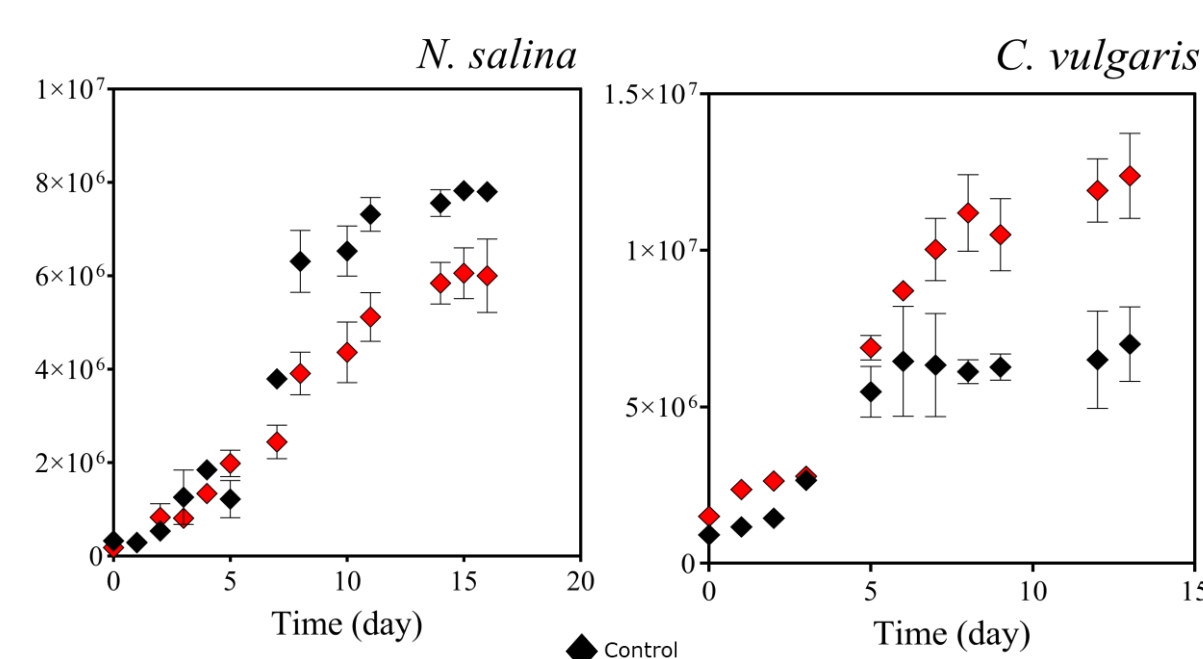
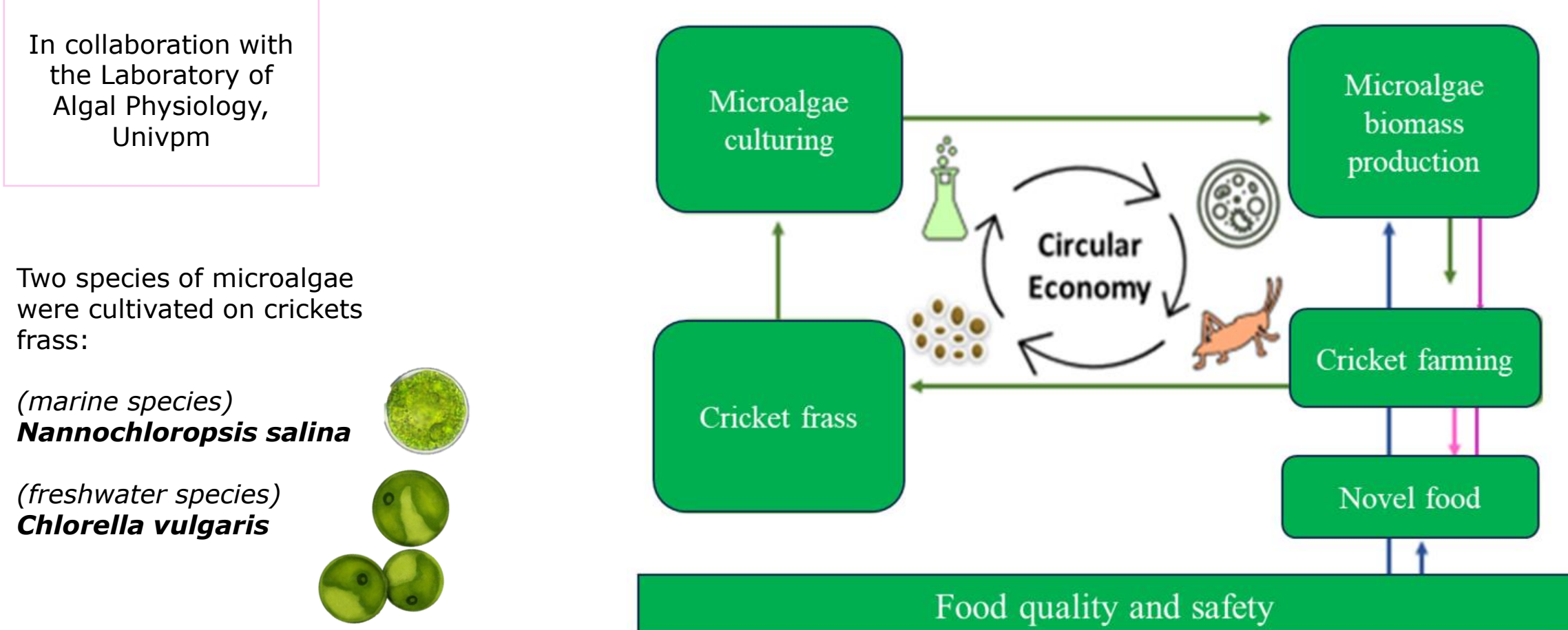
The obtained concentrations were well below the legal limits in foodstuff established from EU 1881/2006, EU 420/2011 and EU 1006/2015 (no law limit for Ni, Al and Cr), and 32/2002 and amendments in animal feed.

The risk of exposure to PTEs from AD consumption is relatively low and is not harmful for consumers.



### 3rd year

#### Sustainable crickets production: circular economy approach



Two type of samples of *Ch. vulgaris*

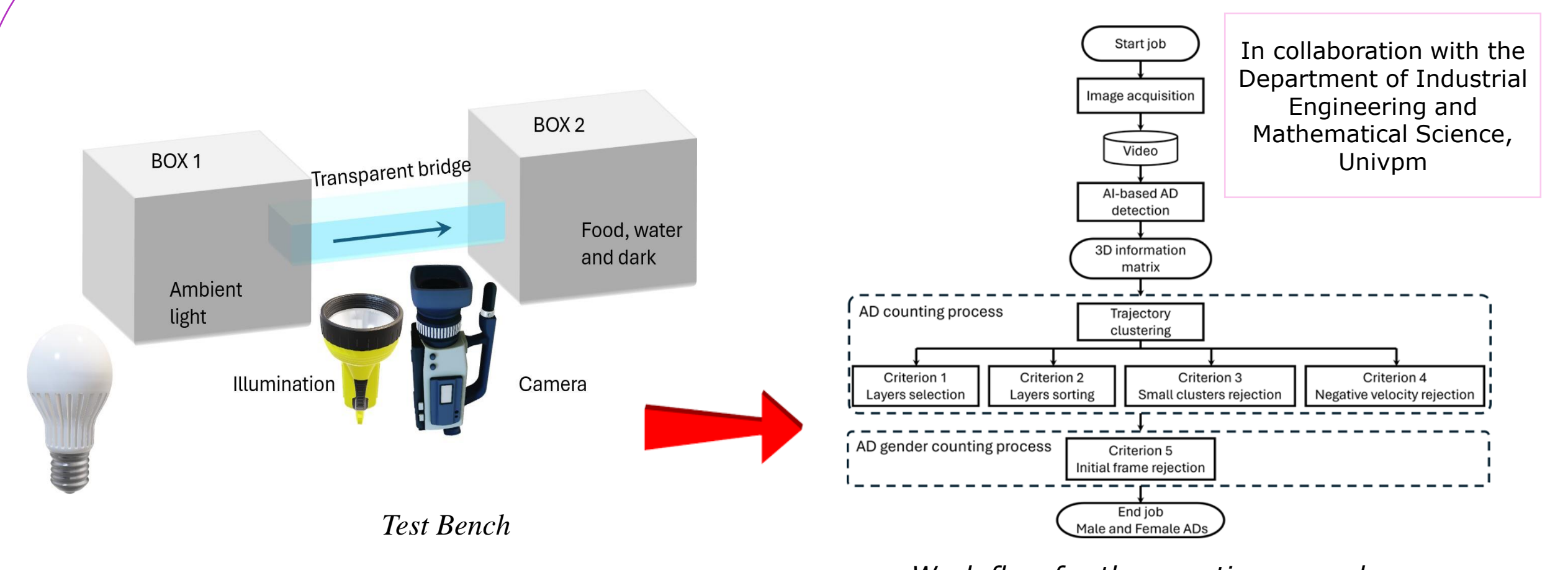
Control *Ch. vulgaris*  
Autoclaved BG11 medium

Treated *Ch. vulgaris*  
Autoclaved Milli-Q + crickets' frass

*Ch. vulgaris* cultivated on crickets' frass was added in different concentrations to the crickets' drinking water.

The inclusion of *Ch. vulgaris* into AD water did not negatively affect the performance parameters of AD (weight, yield, FCR and survival).

#### Detection and gender identification



The YOLOv8 architecture was chosen for its accuracy and low computational requirements, detecting small objects and managing complex backgrounds

Gender recognition is performed using the AI model's classification data. Female ADs are recognized by detecting the ovipositor.

The acquisition process yielded 457,000 images, with crickets detected in 42,944 frames.

### Conclusions

- Chlorella vulgaris* exhibited the optimal growth when cultivated on crickets' compost, compared to *Nannochloropsis salina*.
- Crickets reared from *Chlorella vulgaris* biomass cultivated on crickets' compost demonstrated a good performance similar to control AD.
- The test bench, system for detecting and AI models for the automatic counting of male and female specimens used has impacts farming sustainability by balancing the male-female ratio, which affects the quality and quantity of insects produced, and benefits the food industry due to gender-related nutritional differences.

### Work in progress...

- Determination of the fatty acid composition of house crickets through incorporating the microalgae (*Chlorella vulgaris*) into their water, grown on by-products of crickets rearing, for novel eco-sustainable functional foods formulations.
- Investigation of the presence of Potentially Toxic Elements (PTEs) Cd, Pb, Ni, As, Al, Cr and Hg in *A. domesticus*.
- Microbiological analysis of crickets' samples.

### Publications

- B. Ajdini et al., 2024. The use of seaweed as sustainable feed ingredient for the house cricket (*Acheta domesticus*): investigating cricket performance and nutritional composition. *Journal of Insects as Food and Feed*, 1, 1-18.
- Nicola Giulietti et al., 2024. Gender-based counting of *Acheta domesticus* and uncertainty assessment. *Measurement Science and Technology*, submitted 12/04/24.
- B. Ajdini et al., 2024. Optimizing the nutritional composition of *Acheta domesticus* (house cricket) with *Ascophyllum nodosum* dietary supplementation: promoting low-fat and healthy crickets as food. *Food Chemistry*, submitted 24/05/24.
- B. Ajdini et al., 2024. Potentially toxic elements in the novel food *Acheta domesticus* grown on seaweed-enriched diets: risk assessment for human health. (In preparation)

### References

[1] Payne, C.L.R et al., 2016. Insects as food and feed: European perspectives on recent research and future priorities. *Journal of Insects as Food and Feed*, 2(4), 269-276.  
[2] Udamsil, N., et al., 2019. Nutritional Values and Functional Properties of House Cricket (*Acheta domesticus*) and Field Cricket (*Gryllus bimaculatus*). *Food Science and Technology Research*, 25(4), 597-605.