

Progetto di ricerca sostenuto da Fondazione Cariplo:  
Integrated research on industrial biotechnologies 2015

**“BIOCONVERSION OF FRUIT AND VEGETABLE WASTE TO  
EARTHWORM MEAL AS NOVEL FOOD SOURCE”  
U.O. CREA-ZA Lodi**

# Lombrichi: una futuribile proposta alimentare

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# Aim of the project



## Protein scarcity

- Humankind currently consumes more resources than the planet can regenerate.
- The protein sources are typically the most limiting and expensive ingredients.



## Food waste

- Roughly 1/3 of the food produced in the world for human consumption every year gets lost or wasted (FAO, 2011).
- Annually in Italy total food waste is about 150 kg per capita, with associated costs estimated (for total EU) more than 140 billion euros (FUSIONS, 2016).

## Sustainable solutions



Earthworms grown on fruit and vegetable waste and are suitable candidate to supplement other animal-based proteins.

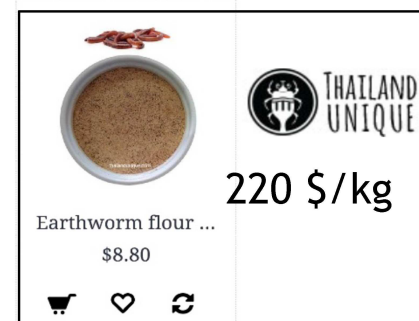
# *Eisenia foetida*

Earthworm are used as medicine in China.

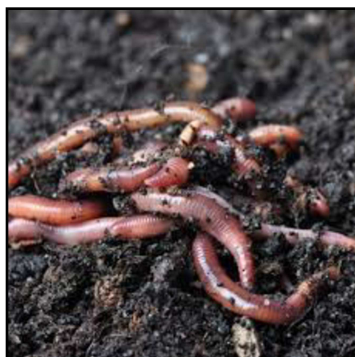
Earthworms are eaten in some areas of the world (e.g. China, Philippines; Thailand...)



Earthworm Fried Rice



Earthworm flour



Earthworms grown on fruit and vegetable waste contribute to waste disposal efficiency

Vermicompost

Earthworms

Earthworms (*E. foetida*) meal has high protein content in the range of 55-70% dry matter (Edwards, 1985; Zhenjun et al., 1997; Medina et al., 2003; Zhenjun, 2005; Cayot et al., 2009) and are rich in essential amino acids (Zhenjun and Jiang, 2017).



# Sample preparation



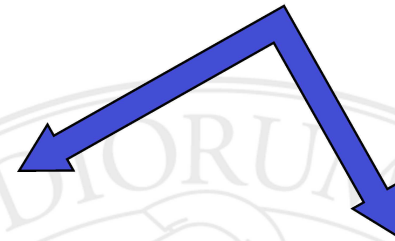
Earthworms grown on fruit and vegetable waste



Earthworm  
cleaning  
procedure

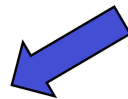


Earthworms  
stored at  
-30°C



Freeze-dried  
earthworm  
meals

Oven-dried  
earthworm  
meals



Defatted  
meals using  
ethanol



**Food**



**Feed**





# Biochemical composition of earthworms

Freeze-dried, defatted freeze-dried and oven-dried earthworms were analyzed to evaluate the following parameters:

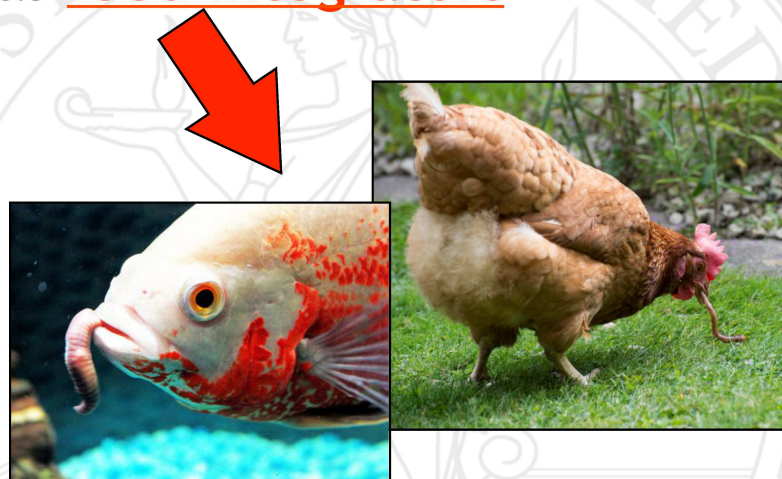
- Dry Matter
- Ash
- Crude proteins
- Total lipids
- Free amino acids
- Soluble sugars
- Total phenols
- Total sterols
- Amino acid composition
- Fatty acid composition
- Mineral composition
- Vitamin composition

# Conclusions

Earthworm meal has:

- high protein content with a good essential amino acid composition
- a good level of polyunsaturated fatty acids, in particular  $\omega$ -3 e  $\omega$ -6
- a good level of macronutrient and iron and the absence of toxic heavy metals
- a good vitamin composition

Due to these nutritive properties, earthworms can be employed as food integrators and as feed integrators



# GRAZIE PER L'ATTENZIONE

## GRUPPO DI LAVORO

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