



# Bioressource insects and biodiversity - opportunities and challenges





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The four Research Programs of the ATB.



- 300 Employees
- Budget: 20 Mio €
- Incl. third party funding
- Approx. 160 external research partners





## Leibniz Research Alliance "Sustainable Food Production and Healthy Nutrition"





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- 14 Leibniz Institutes
- Interdisciplinary network
- focus on the two societal challenges sustainability and health



#### Content

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- 5. Summary and outlook





#### 1. Introduction



#### Class Insecta

- Lat.: "insectum" = cut into sections
- Sody parts: head, thorax, abdomen
- Phylum: Arthropoda/ Subphylum: Hexapoda
- 🗕 6 legs
- More than 1 million described species
- Chitinous exoskeleton
- Metamorphosis (holo- or hemimetabolism)



#### Role of insects

- Plant pollination
- Natural pest control
- Degradation of organic material
- (e.g. dead plants)
- Feed
- Food









#### Edible insects - facts

- Consumed by more than 2 billion people worldwide
- 1.900 edible species known



Ento: http://www.core77.com/blog/case\_study/ case\_study\_ento\_the\_art\_of\_eating\_insects\_21841.asp







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Number of edible insects per country in the world. The total number of insects species in the world amounts to 1909. The data (updated March 2012) has been compiled by Yde Jongema from literature (see http://www.ent.wur.nl/UK/Edible+insects/Worldwide+species+list/). Realization: GRS group Wageningen University. Remark: countries not showing recorded edible insects species only indicates that it is not mentioned in literature.

## Relevant food species (consumption [%])

- Coleoptera beetles (31%)
- Lepidoptera caterpillars (18%)
- Hymenoptera bees and ants (14%)
- Orthoptera crickets, locusts, grashoppers (13%)
- Hemiptera true bugs (10%)
- Isoptera termites (3%)
- Odonata dragonflies (3%)
- Diptera true flies (2%)





2. Insects as food









## Average nutrient composition of edible insects



#### 2. Insects as food



## Edible insects - facts

- Consumed by more than 2 billion people worldwide
- 1.900 edible species known
- Rich in protein, fat, micronutr.
- High feed conversion efficiency
- Multivoltinism
- Low space requirements
- Low GHG emissions
- organic waste valorisation



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#### Liabilities of edible insects

- Toxic potential (production of toxins as defense mechanisms, sequestering of toxins via feed uptake)
- Potential heavy metal and pesticide content (via feed uptake)
- Allergenic potential (contains e.g. tropomyosin)
- Anti-nutrients
- Zoonotic risks (insects function as vectors)
- Microbiological risk (pathogens, spores, spoilage bacteria such as enterobacteriaceae)
  - Safe and controlled rearing conditions including substrate and personnel are mandatory



#### Legislation and food insects

#### REGULATION (EC) No 258/97 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 27 January 1997

concerning novel foods and novel food ingredients

 This Regulation concerns the placing on the market within the Community of novel foods or novel food ingredients.

2. This Regulation shall apply to the placing on the market within the Community of foods and food ingredients which have not hitherto been used for human consumption to a significant degree within the Community and which fall under the following categories:

- foods and food ingredients with a new or intentionally modified primary molecular structure;
- (d) foods and food ingredients consisting of or isolated from microorganisms, fungi or algae;
- (e) foods and food ingredients consisting of or isolated from plants and food ingredients isolated from animals, except for foods and food ingredients obtained by traditional propagating or breeding practices and having a history of safe food use;
- (f) foods and food ingredients to which has been applied a production process not currently used, where that process gives rise to significant changes in the composition or structure of the foods or food ingredients which affect their nutritional value, metabolism or level of undesirable substances.

 no history of "significant" consumption in the European Union prior to 15 May 1997.

 Obtained by traditional breeding practices and having a history of safe use.





#### Insects as feed

- Insects represent a natural feed source e.g. for birds and fish, reptiles
- Potential replacement of soy bean and fish meal
- Due to feed ban not allowed in Europe







#### Average amino acid spectra of edible insects



(data derived from literature, Human amino acid requirement: WHO; Soy meal 48: <u>www.feed-alp.admin.ch/fmkatalog</u>; n = Data amount)

3. Insects as feed



#### Quality of insect proteins as feed

(rats, t=28 days)	FI	WG	TD [%]	NPU	PER
Apis mellifera (bee;dried)	284.35	45.9	79.8	42.5	1.50
Honey bee protein	406.45	104.03	94.3	62.0	2.47
Casein	352.80	96.67	96.8	70.0	2.50
(rats, t=4 weeks)					
Defatted spent silkworm pupae ( <i>B. mori</i> )	233	47	67	45	1.39
Casein	301		84	72	2.50
(rats, t=7 days)					
Rynchophorus phoenicis	75.40	8.59	91.79		1.31
<i>Imbrasia belina</i> larvae	59.40	4.30	86.03		0.87
Casein	80.60	8.60	92.57		1.22

#### Removal of chitin improves protein quality

FI – feed intake [g/t/rat], WG – weight gain [g/t/rat], TD – true digesibility, NPU – net protein utilisation, PER – protein efficiency ratio; Ozimek et al (1985); Rao (1994); Ekpo (2011)



#### Legislation and feed insects

COMMISSION REGULATION (EU) No 56/2013

of 16 January 2013

amending Annexes I and IV to Regulation (EC) No 999/2001 of the European Parliament and of the Council laying down rules for the prevention, control and eradication of certain transmissible spongiform encephalopathies

- Lifting of feed ban (EU 999/2001) regarding feeding processed non-ruminant animal protein in aquaculture (June 1st, 2013)
- In aquaculture the lift of the feed ban only valid for proteins from "slaughtered" non-ruminants
- Feeding of insect proteins to poultry, pigs and cattle to date prohibited.



#### Other applications

- "Yellow biotechnology" = Insect biotechnology:
- Production of e.g. novel enzymes, microorganisms, antibiotics (antimicrobial peptides), chemicals
- Degradation/valorisation of organic residues
- E.g. food waste, manure, lignocellulose
- Fertilizer
- Frass and rearing residues



#### **Opportunities**

- Bioconversion and valorization of organic residues to food, feed, chemicals, enzymes, and bioactive substances
- Direct contribution to food and feed as well as protein and nutrient security
- Alternative to meat
- Replacement of soy bean and fish meal in feed
- $\rightarrow$  Contribution to forest and aquatic biodiversity
- Immense potential in insect biodiversity
- $\rightarrow$  Application of to date unexploited species



### Challenges

- Ecological services provided by insects are vital for food and feed security
- $\rightarrow$  Insect preservation
- The majority of insects used as food is to date collected in the wild
- $\rightarrow$  controlled mass rearing to prevent overexploitation
- Potential hazard of foreign insect species on the indigenous ecosystem
- Consumer acceptance of insects as food
- Legal barriers on the use of insects as food and feed



#### Future research

- Identification and investigation of known and unknown insect species and their potential applications
- Investigation of microbial/ enzymic/genetic potential of insects
- Development of safe mass rearing and processing methods for insects as food and feed





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### **Thank You!**