The significance of edible insects as food and feed for world nutrition (Berlin, 24-05-2016)

BfR-Symposium "Insects as food and feed - food of the future?"

Prof. dr ir Arnold van Huis
Contents

- Why insects?
- Insects in the food chain
- Private enterprise
- Crucial issues
Last five year increased interest

Book published (FAO, Rome)  
(Van Huis et al, 2013)  
7 million downloads

World Conference  
FAO & Wageningen UR  
14-17 May 2014
Urgent: how to remain below 2°C rise (Paris)?

**Goal**

Agriculture unchecked

Technical mitigation

Change dietary patterns

**Conclusion:**

Less beef and dairy products !!!!

Hedenus et al (2014)
Why alternative protein sources?

- **Land area not enough in 2050**
  - Increase demand meat: 76%
  - Area livestock now: 68%

- **Livestock globally emits**
  - Greenhouse gases: >14%
  - Ammonia: 59-71%

- **Water** for 1 kg beef: 20,000-40,000 liters

- **Others problems**: Deforestation, soil erosion, desertification, loss of plant biodiversity, public health, and water pollution

Dietary solutions needed: global challenge and opportunity
Impact on environment: edible insects versus livestock species

<table>
<thead>
<tr>
<th>ENVIRONMENTAL IMPACT</th>
<th>Number of times insects less than livestock spp.</th>
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<tbody>
<tr>
<td></td>
<td>Chicken</td>
</tr>
<tr>
<td>Greenhouse gases</td>
<td>1.3</td>
</tr>
<tr>
<td>Ammonia production</td>
<td>8</td>
</tr>
<tr>
<td>Land area</td>
<td>1.8</td>
</tr>
<tr>
<td>Water</td>
<td>1.5</td>
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<tr>
<td>Feed conversion ratio</td>
<td>2.1</td>
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</tbody>
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Insects can convert organic side streams
Globally: 1.3 billion tonnes - US$ 750 billion

Miglietta et al, 2015; Oonincx et al, 2010; Oonincx & de Boer, 2012
Nutrition edible insects

- **Large variation**
- **Protein** (DM): 40-60%
- **Essential amino acids** (~ beef, soy)
- **Fat** content (DM): 10-30% (PUFAs)
- **Iron and Zinc** content high
- **Nutrient value score** edible insect species similar to conventional meat
- **Processing** influences nutritional value
20,000 farms produce 7,500 tonnes a year

Mealworms for human food
Edible insects
Weaver ants
Mopane caterpillar

10 billion caterpillars US$ 85 million / year

From harvesting to rearing

Mealworms for human food
Black Soldier Fly as feed for animals
Crickets as food in Thailand

20,000 farms produce 7,500 tonnes a year
Food chain: weaver ant pupae in Laos

Ant nest in tree

Stabbing into nest, pupae fall in basket

Women harvesters with bamboo sticks with basket at the end

Basket with pupae

Pupae sold on ice on local market
Cricket food chain

Eggs

Larvae on egg cartons

Stacked crates

Cricket Flour

Chirps are chips made with cricket flour

Cricket pasta, bugsolutely

Wageningen University
Production units

- Reproduction (continuous process to produce eggs)

Production (eggs to larvae or pupae)

![Diagram of insect life cycle]

- Eggs harvested & sown on feeding substrate
- Last larval stage
- Pre(pupae)

Harvested by separating insects from substrate
Production of Black Soldier Fly

Reproducing (Mating) → Egg Hatchery → Rearing Insects

Eggs

Separating pre-pupae and substrate → Harvesting

Synchronization of larval development

Products
- Fertilizer
- Chitin
- Larvae

Processing of prepupae

Protein
Fat
Proti-Farm (Lesser mealworm)
Europe: International Platform for insects as food and feed (launched 13 April 2015)
Some companies selling cricket products

**France**
- Gryö—Gryö’s
- Kinjao

**UK**
- Gathr Foods
- Mophagy

**S. Korea**
- Edible Inc.

**Thailand**
- Bugsolutely
- Eco Insect Farming

**Canada**
- Aspire
- Entomofarms

**The Netherlands**
- Jumping Jack Snack
- Delibugs

**USA**
- All Things Bugs
- Big Cricket Farms
- Bitty Foods
- Next Millennium Farms
- Tiny Farms
List of insect companies in the world

Eating insects startups: list of Entopreneurs
http://www.bugburger.se/foretag/the-eating-insects-startups-here-is-the-list-of-entopreneurs-around-the-world/ (168 companies)

Entomology company database: https://ilkkataponen.com/entomology-company-database/ (254 companies)
Insects for human consumption declared novel food (25 Nov. 2015) – before 1 Jan. 2018 food safety proven

National and EU assessments


European Food Safety Authority (EFSA, 2015)

Belgian Federal Agency for the Safety of the Food Chain:
• Hazards can largely be controlled by good hygiene
• Contamination should be avoided
• Heating step indispensable

Biological hazards
Chemical hazards
Allergens
Challenges legislation insects as feed

- Insects as feed for livestock (Reg. EC 999/2001)
- Rearing insects on manure or catering waste (Reg. EC 1069/2009).
- Allowed in aquaculture (Reg. EC 56/2013), but killing only allowed in official registered slaughterhouse (Reg. EC 999/2001 Annex IV)

- Feed market for pigs and poultry: US$ 300 billion
- Worldwide 1.3 billion tons of waste; value US$ 750 billion
- Worldwide US$ 50 billion market (growing 5-7% a year)

(EFSA’s ‘Risk profile related to production and consumption of insects as food and feed’ published in October 2015)
The worm has turned. How British insect farms could spawn a food revolution:

With meat prices expected to soar, agricultural entrepreneurs believe invertebrate livestock can provide the protein we need. But will the mainstream ever be ready?

theguardian.com

10 April 2016

The Swedish government is showing their commitment to green principles and fighting climate change by spending tax payer money on developing ‘meat’ made out of crickets and mealworms.

28 April 2016
Insect burgers and meatballs

In supermarkets in Belgium and the Netherlands

- 15% mealworms
- Nutritionally equal to similar products
World: 1 million species

- Beetles: 40%
- Flies: 15%
- Ants, wasps: 13%
- Butterflies: 12%
- Others: 20%

Edible insect species (%): 2037

Jongema (2015)
Statistics on edible insects

- Not considered in national or international databases
- Neglected because considered "a peculiar habit by primitive people"
- Hardly any knowledge on
  - Extent of practice
  - Importance of insects in diets
  - Contribution to livelihoods
Nutrition – many articles

Nutritional values similar or better than meat products

However:

- Many insect species
- No standard analytic methods used
- Value depends on issues like gender, life stage, diet, and environmental conditions (temp., hum., light, etc.)
- Bio-availability often unknown
Environmental impact compared to livestock products

- **Life Cycle Analysis studies:**
  - Mealworms (Oonincx & De Boer, 2012)
  - Water footprint mealworm (Miglietta et al, 2015)
  - Housefly (van Zanten et al, 2015)
  - More needed !!!!!!!!

- How do insects perform on organic waste products (development, food safety)?
Food safety

- Most information about harvested insects from the wild
- Little information when reared under controlled conditions, but few problems expected
- However, for the sector to develop: urgently more information needed

In particular when insects are reared on organic by-products: how do insects deal with chemical and biological contaminants?

- Largest problem: feed (needs to be certified)
- Allergy: cross contamination occurs (seafood, HDM)
Farming

- Developing countries: from harvesting to farming
- Western world – companies are investing to produce tonnes a week (automation)
- Little known about diseases in insect rearing
- In a very preliminary phase of even not yet started:
  - Genetically improving insect species (breeding)
  - Using different strains
  - Inbreeding, outbreeding
Consumer studies

‘How to market the impossible’

- How to convince the western consumer?
- Strategies proposed: experimental tasting, providing info, processing (burgers), sky shrimps, role models, cookbooks, children

- Gastronomy
Enabling environment

- National cooperation between
  - Companies (e.g. VENIK in The Netherlands)
  - Government, private enterprise, academia (projects like RiskInsect in Belgium)
  - All stakeholders (e.g. UK - WOVEN)

- International
  - European Union (ProteInsect)
  - Between companies
  - FAO

International Platform of Insects for Food and Feed
Emerging issues: Insect welfare

- Can insects experience pain?
  - Not adaptive
  - Perception pain in brain absent
  - No pain behaviour
- Benefit of the doubt (freezing, blanching, grinding)

Number of neurons brain animals

- Fruitfly 100,000
- Cockroach 1,000,000
- Mouse 75,000,000
- Human 85,000,000,000
Insect products of the future

- Cricket bread
- Termite sauce
- Liquorice waterbug
Add Roasted Cricket Bitters to Tonight’s Cocktail

News articles Oct. 2015

Food World News

This Kickstarter Campaign Lets You Make Cocktails – With Cricket Bitters!

Oct 28, 2015 10:40 AM EDT | By Martha Ignaco

Would You Eat Bugs If They Came In A Boozy Cocktail?

Cricket Bitters are meant to be the gateway drug to insect cuisine.

This Fast-Food Cricket Milkshake Might Save the World
Insects as food and feed have a bright future

Thanks to people from developing countries