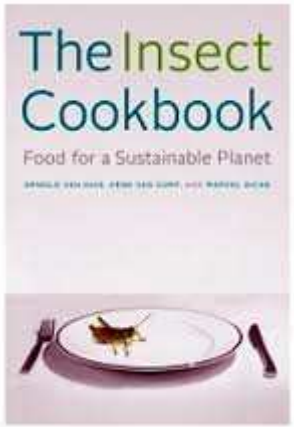
ANSES Self-referral on "the use of insects as food and feed and the review of scientific knowledge on the health risks related to the consumption of insects"

Recent publications and projects

A growing interest from manufacturers and consumers!



Many questions?

A self-referral on …

- **Literature review of knowledge on the health hazards of insect consumption**

- **Study of the hazards of insects and insect products for food and feed**
  - Rearing of insects and food production
  - Health hazards: biological, physical, chemical, allergic, etc.
  - Nutritional and environmental dimensions briefly discussed

- **Limitations of the scope of this expertise**
  - Question of the impact of insects on food security
  - Health risk assessment for individual insect species or insect products
  - Consumption in the form of protein preparations (insect extracts)
  - Issues relating to the welfare of insects at the different rearing/production stages
  - Biosafety in farms
  - Insect/plant interactions and plant health
  - Entomopathogens and insect health
  - Health risks associated to the collection of edible insects from the environment (wild capture)

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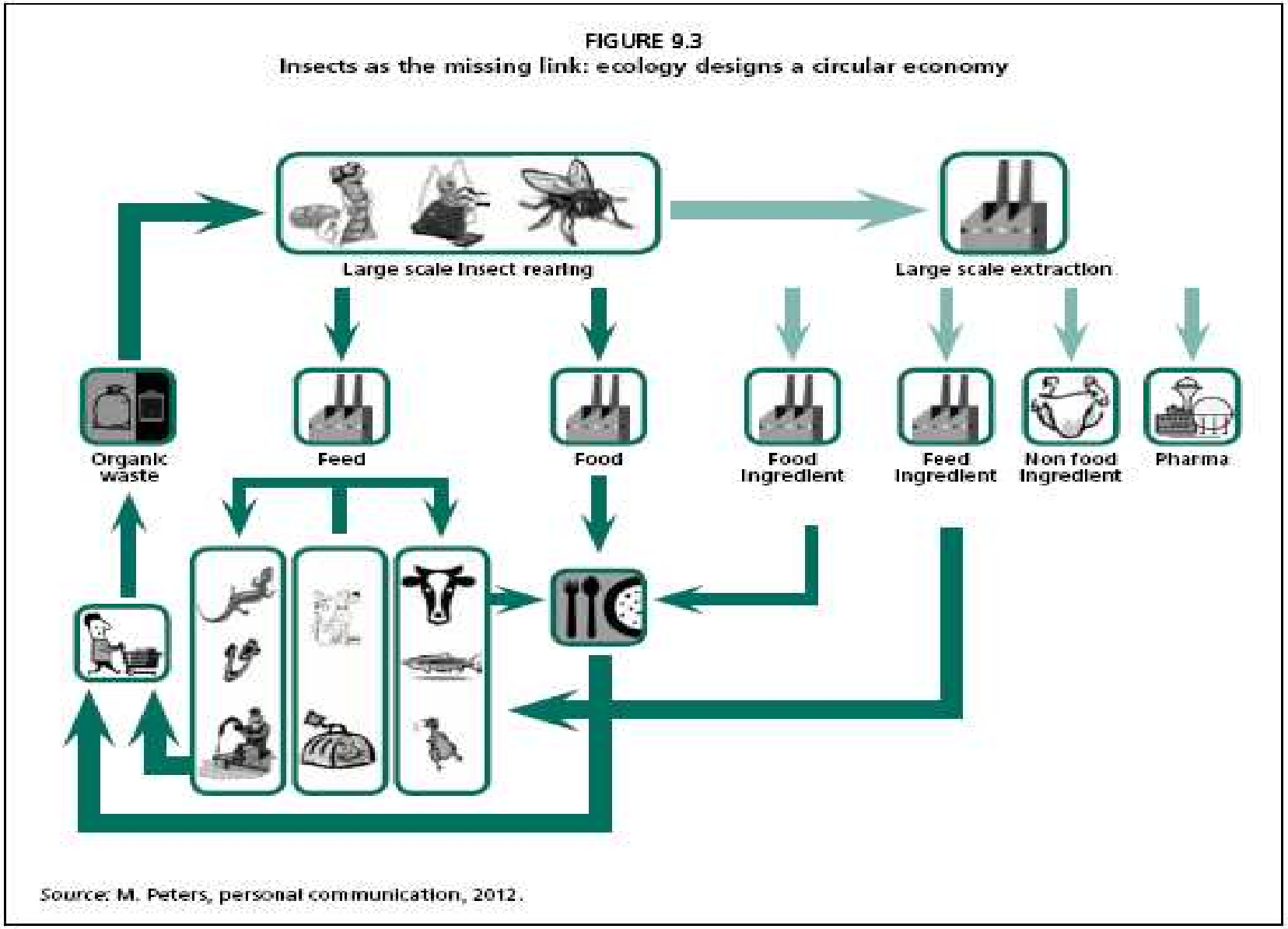
Insects in an integrated system



From Arnold van Huis et al. FAO Forestry Paper 171, 2013

Rearing/production of insects

- **Systems for rearing edible insects**
  - Strict containment system and rearing conditions: ventilation, lighting, humidity…
  - Growing substrate: dry and rigid and a source of drinking water
  - Adapted food supply: dietary preferences and processing capacity

- **Slaughter**
  - 24-hour fasting to purge digestive tract
  - Freezing 24h at -18° C (microbiological decontamination not ensured)
  - Boiling (1-5min) (destroys vegetative flora and parasites, not spores)

- **Processing and preservation techniques**
  - Dehydration in a ventilated oven (60-110° C)
  - Deep-frying (>160° C)
  - Toasting
  - Freeze-drying

- **Preservation**
  - Whole or fractionated insects/flour (after grinding)
  - Optimal conservation methods (cooking, acidification, fermentation…)
  - Packaging finished products (sealed to avoid becoming rancid)

Health hazards (1)

- **Chemical:**
  - Toxic substances:
    - o Phanerotoxic insects (with external venomous features)
      ⇒ **Consumption of larvae is preferable**
    - o Cryptotoxic insects (able to store or synthesise toxic chemical elements)
      ⇒ **Vigilance on the quality of the substrates and food**
      ⇒ **Bioaccumulation of pesticides**
      ⇒ **Planned use of veterinary medicines**
  - Anti-nutritional factors (phytic acid, oxalates, tannins, thiaminase, chitin)
    ⇒ **Methods to eliminate these substances**

Tenebrio molitor larvae

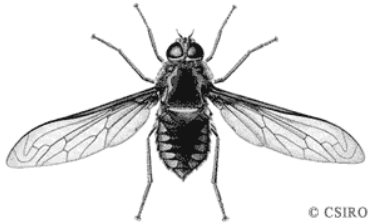
- **Physical:**
  - Hard parts (elytra, rostrums, wings…)
    ⇒ **Inform consumers**

Housefly
(*Musca domestica)*

- **Allergic:**
  - Allergens: myosin, troponin, a-amylase, tropomyosin, arginine kinase
  - Pan-allergens common to arthropods, arachnids, crustaceans and insects
  - Possibility of cross-reactions or cross-allergies
    ⇒ **Characterisation of major species-specific allergens**
    ⇒ **No toxicological study involving whole insects, insect proteins or insects products**

Health hazards (2)

- **Microbiological:**
  - Parasitic: linked to the consumption of insects
    - Parasitic infections dues to cercaria and metacercaria via aquatic insects or insects living close to water
    - Parasitic infections dues to nematodes (intermediate hosts Coleoptera and Blattodea)
    - Intestinal myases caused by Diptera larvae
    - Toxoplasmoses due to cockroaches and some Diptera
    - ⇒ **Better knowledge of the parasite/insect relationships**
    - ⇒ **Identification of good farming and production practices**
    - ⇒ **Assessment of the effectiveness of treatments (such as freeze-drying)**
    - ⇒ **Deworming strategies**



  - Viral: **undocumented**

  - Fungal:
    - Most common isolates: *Aspergillus*, *Penicillium*, *Fusarium*, *Cladosporium*, & *Phycomycetes* (Initial contamination by leaves and soil; Recontamination related to poor drying and storage conditions)
    - Production of mycotoxins by *Aspergillus, Penicillium, Fusarium* (Aflatoxins in worms widely consumed in Africa)

  - Non-conventional transmissible agents: more information required;
    ⇒ **Not to be ruled out**

Health hazards (3)

- **Bacterial hazards:**
  - Origins of the hazards:
    - Carriage (natural or accidental) of proven bacterial hazards and their toxins for humans and animals (intrinsic flora of insects e.g. digestive tube, or extrinsic origin related e.g. to the environment)
    - Rearing conditions, handling, processing and preservation
  - Bacterial agents identified:
    - *Bacilli*, from contaminated soil as a farming substrate
    - Spores on the cuticle of insects
    - Isolation of *S. aureus*, *P. aeruginosa* and *B. cereus* from *Oryctes monocerus* (beetle consumed in Africa)
    - Lack of positive results for *Salmonella* or *Listeria*
    - Conventional, known food contaminants

⇒ **Very little information on the insect/toxicogenesis relationship**

⇒ **Complete analysis of microbial hazards required for insects to be used in food and feed**

Black Soldier Fly adults and larvae (*Hermetia illucens*)

Health safety

- **Most insect pathogens (entomopathogens) are considered harmless to humans and animals as there is a strong phylogenetic distance with invertebrates and vertebrates**
- **Insects are rich in nutrients and high humidity => favourable environment for the growth of microorganisms**
- **Origins of health hazards:**
  - Species-specific:
    - Microbial hazards (intrinsic or vectorised)
    - Foreign bodies (hard parts)
    - Allergens
    - Toxic substances (intrinsic or bioaccumulated)
  - Farming practices: substrate/ feed/ practices (e.g.: veterinary drugs), processing or transport conditions and conservation
- **Define and implement control measures to ensure food safety**
  - Health safety, preparation and conservation closely linked
  - Implementation of a HACCP procedure: key to the development of the edible insect sector
  - Definition of good farming practices and good practices for manufacturing insect products

Conclusion

- **Lack of data on sanitary issues and related subjects such as environmental impact of insect production, nutritional value…**

- **Special precautions in relation to the use of insects in food and feed (rearing, processing, preparation, marketing)**
  => Highlighting a strong lack of scientific information to allow a full risk analysis

- **Better understanding of the insect matrix and its interactions with biological agents (and other etc.):** remediation technologies, conservation, etc.

- **Exclude wild capture / rearing under health control (BP/ HACCP)**
  - Non-definitive positive list of authorised insects
  - Negative list of insects prohibited for consumption (hazards identified) subject to appropriate cleansing methods

- **Current recommendations**
  - Best not to eat raw insects
  - Prevent allergic risk among people with a favourable terrain
  - Need clear communication

Thank you for your attention

Opinion available at:

In French:
https://www.anses.fr/fr/documents/BIORISK2014sa0153.pdf

In English:
https://www.anses.fr/fr/documents/BIORISK2014sa0153EN.pdf