Session VI. Insects in the future

**Insects on the menu**

Marcel Dicke  
Wageningen University & Research, The Netherlands  
E-mail address: marcel_dicke@wur.nl

Major challenges facing humanity Feeding the rapidly growing human population is a challenge with many facets: the need for producing 70% more food in 2050 compared to 2010 is challenging in itself. Yet, it is even more challenging in the context of environmental and population changes, nutrition crises, and health issues. Moreover, this challenge is closely connected to other challenges, including mitigation of climate change, avoiding waste by developing a circular economy, conserving biodiversity, and supporting human health (Fig. 1). These challenges can only be met when we fundamentally change the way we produce food because current food production methods face serious limitations in terms of land use and greenhouse gas production [2,3]. Most of this is the result of the inefficient conversion of feed-to-meat by conventional livestock, especially cattle [3]. At present, 80% of global agricultural land is used to produce livestock, and increasing the production of meat will have major negative consequences for land use and climate change. Hedens et al. [2] concluded that a reduction in ruminant meat consumption is indispensable for meeting the maximum 2°C target above the pre-industrial level. An excellent, sustainable, alternative to conventional meat is available in insects. Insects are the most abundant group of animals on Earth with one million species being described and an estimated 5 million species still to be discovered. More than 2000 insect species are known to be consumed by humans ([https://www.wur.nl/en/Research-Results/Chair-groups/Plant-Sciences/Laboratory-of-Entomology/Edible-insects/Worldwide-species-list.htm](https://www.wur.nl/en/Research-Results/Chair-groups/Plant-Sciences/Laboratory-of-Entomology/Edible-insects/Worldwide-species-list.htm)) (Fig. 2). Their nutritional content varies between species, but in general the protein content is similar to that of conventional meat, while insects contain more unsaturated fatty acids [4]. Moreover, the high mineral content of insects in comparison to conventional meat is particularly interesting, considering the worldwide prevalence of iron and zinc deficiency. For instance, anaemia is a global public health problem affecting a quarter of the human population [5].

Insects in a circular economy Insects can transform rest streams such as food waste or rest streams from food industry into high-value protein products. In doing so, they are valuable components of a circular economy. Recent reports show that insects can make important contributions to global food security [6] and that producing insects for food and feed has prospects for rapid commercial and societal uptake. Insect production has a much smaller ecological footprint, in terms of land and water use and greenhouse warming potential compared to the production of pigs and cattle [6–8]. This is especially due to the much better feed-to-meat conversion ratio of insects: ca. 2.2 kg feed required per kg of edible weight production for crickets, whereas this is more than 10 times higher (25 kg per kg edible weight produced) for beef [4,9]. Moreover, important feed sources for livestock production currently include fish meal and soybean meal, both obtained from a market competing between human food and animal feed. In addition, the use of fishmeal poses an increasing threat to the viability of marine and aquatic ecosystems [10]. In recent years, important developments have been initiated in the private sector that can contribute to the urgently needed changes in food production systems, i.e. the production of insects as food and feed [6,11,12]. Important developments are being made in the commercial production of insects as food and feed ([www.ipiff.org](http://www.ipiff.org)). These new production systems provide an important contribution to addressing several of the main challenges that we face, including resource, land, and water scarcity [12].

![Fig. 1](https://example.com/fig1.png)

**Fig. 1** The challenge of feeding the rapidly growing human population is closely connected to other challenges, including mitigation of climate change, avoiding waste by developing a circular economy, conserving biodiversity, and supporting human health.

![Fig. 2](https://example.com/fig2.png)

**Fig. 2** Menu of a restaurant in Hanoi, Vietnam.
**Future** To effectively develop insects as food and feed, a first step should be to rehabilitate insects and leave the ‘nasty, dirty and avoidable’ image behind. This will require extensive information on the environmental and nutritional benefits as well as in assuring food safety aspects [13]. In the context of the positive change in the perception of insects as human food that we have seen in the western world in the past two decades, it is clear that a lot can be accomplished in the years ahead. Yet, much research needs to be done for this, especially in a multidisciplinary and transdisciplinary context. Topics to investigate include, e.g., production of insects on various rest stream, consequences for insect health and immunity, insects and food quality, economics, consumer behaviour, food technology, human health aspects, ethics and value chain development. Such studies will help to develop a new food sector that is likely to provide the growing human population with a novel protein source whose production is much more sustainable than current production of animal protein. Moreover, this new food sector also has excellent opportunities to contribute to achieving various of the global development goals [14,15].

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**References**


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