BOOK REVIEW

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Book review: Insects as food and feed: from production to consumption

Edited by: Arnold van Huis and Jeffery K. Tomberlin

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This book covers the production, processing and consumption of edible insects in twenty-two chapters with contributions of various authors and edited by renowned scientists in the edible insects world. The chapters are grouped in six sections covering an introduction, tropical production systems, production technology and management, industrial production systems, nutritional quality and processing, regulation, ethics and promotion and finally future prospects. Facts are presented in tables, figures and photos to support the discussions. The high resolution photos add the much needed effect and are properly credited. The book opens with a preface that outlines the history of edible insects, their potential and the challenge to mass produce insects at low costs.

The first section of chapters introduces edible insects. The first chapter opens by pointing to the ever increasing demand for animal protein due to an ever increasing population. The authors build a case for edible insects as a serious alternative to conventional meat products and feedstock such as fishmeal. The second chapter highlights some of the insect products namely honey, silk, shellac and cochineal harvested by humankind. Some important ecosystem services provided by insects such as pollination, dung burial, removal of carrion, pest control and recreation are discussed. The chapter notes some of these ecosystem services that may have been disregarded and are likely to regain momentum and stimulate new insect-producing industry. Chapter three deals with the environmental aspects of insect production.

The second section of chapters reviews edible insect production systems in the tropics where wild harvesting

is common. Chapter four introduces simple farming systems in the tropical countries. The fifth chapter provides an overview of four species of crickets and describes the rearing systems. The chapter emphasises that cricket farming has significant implications on rural development and rural economy in low- and middle-income countries. Chapter six describes a farming design that could be used to produce palm weevil larvae in sub-Saharan Africa. The system is suitable for small-scale production, is less destructive to the raffia ecosystem and is more productive than wild harvesting. The seventh chapter describes the biology, rearing conditions and utilisation of grasshoppers for food and feed. A step-by-step process of starting a grasshopper colony is described and completed with photos. The chapter emphasises the need for modern techniques in grasshopper production in order to increase availability and commercial value.

The third section of chapters evaluates production technology and management for mass production of insects. Chapter eight introduces the term 'entotechnology' which is defined as the 'extensive array of techniques and methods being used and being developed by this rapidly developing industry'. The chapter familiarises the reader with some aspects of entotechnology for mass production of insects by industrial methods even though some of the issues discussed are also relevant to small-scale production facilities. Chapter nine discusses challenges and precautions that need to be considered when breeding and maintaining high quality insect populations. These are techniques geared towards maintaining fitness and that facilitate adaptation to the production environment. The chapter further discusses factors that can be manipulated in order to favour certain

traits in the insects. Chapter ten provides an overview of the natural enemies in insect production systems. Specifically, the chapter identifies 46 natural enemies of the palm weevil, 6 viruses infecting crickets and gives recommendations on how to manage the enemies.

The fourth section of chapters discusses industrial production systems for specific insects. The eleventh chapter introduces industrialisation of insect farming and notes that mass production of insects is more complex than one would expect. Chapter twelve specifically focuses on the black soldier fly; methods used for rearing and challenges associated with mass production for waste management and protein production. The chapter points out that further studies are needed to ensure that we are producing safe food and feed especially bearing in mind the types of wastes used in rearing. Chapter thirteen reviews the biology of the housefly along with an assessment of the nutritional composition, its use as feed and production techniques. The chapter notes that the techniques currently being used in mass production need to be refined to optimise conversion of wastes to protein in addition to improvement of containment of adults to minimise distribution into surrounding areas. Chapter fourteen evaluates mealworms as a promising beetle for the insects industry. The chapter discusses optimal rearing conditions, their potential health implication and nutritional value. It is noted that the mealworm is a promising insect with several companies in Europe focusing in its production for food and feed. The fifteenth chapter begins by summarising the lifecycle and optimal rearing conditions for crickets and further offers practical guidance on how to produce crickets. However, the chapter notes that cricket farming is still marred with inefficiencies but opines that, overtime, efficiencies will improve and crickets will become more sustainable to produce compared to other domestic animals.

The fifth section of chapters discusses the nutritional value and processing of edible insects. Chapter sixteen reports on the nutrients present in insects as published by various authors and how the nutrients can be altered by processing including simple cooking techniques. The chapter notes that insects are high in essential nutrients which complement plant source foods and hence are suitable for production of human food and animal feed. The chapter also concludes that species, life stage and diets are major determinants of nutrient composition. Chapter seventeen evaluates insect processing in order to deliver safe and high quality raw materials and ingredients for food and feed applications. The chapter gives an overview of unit operations such as decontamination, drying, comminution methods and fractionations of specific constituents. Examples for whole insect processing pathways are also presented.

The sixth section of chapters reviews regulation, ethics and promotion of edible insects. Chapter eighteen evaluates the health risks and EU regulatory framework concerning edible insects. Overall, the chapter notes the need to have insects safe for human and animal consumption with EU having legislations that restrict their marketing. The chapter further notes that at this moment insects may only be reared on a limited variety of substrates. However, it's expected that with more scientific evidence some of the restrictions surrounding rearing and marketing of the insects will be loosened in future. Chapter nineteen gives an overview of ethical concerns arising from insect production for food and feed. The chapter raises issues with the scientific uncertainty surrounding the question whether insects can experience welfare and which definition of animal welfare would apply to production systems. Genetic modification in insect breeding is another ethical issue raised. Chapter twenty revolves around creating an enabling environment for production and consumption of edible insects as food and feed. The chapter outlines efforts by international agencies, donors, investment communities, academia and other actors including those stimulating consumer acceptance for insects as food and feed. Chapter twenty one considers the state of edible insect product development and promotion as an impetus for moving the industry forward globally. The chapter evaluates food standards governing insect product development around the world as well as avenues that may be exploited to change perceptions in various populations. The chapter appendixes a list of entrepreneurs across the globe with their involvement in the insect value chain.

The last section of chapters looks at the future prospects of edible insects. Chapter twenty-two sums insect industry either for food and/or feed ranging from rearing, insect welfare, and harvesting, processing, marketing and legislative framework. The chapter also emphasises the need for creating an enabling environment for the industry to thrive. The chapter concludes that the market prospects are very promising as predicted by various market studies.

Overall, each chapter closes with conclusions which are in some cases brief and in others extensive, including recommendations. Critical notes are that there is quite some overlap between several chapters needing more editorial scrutiny in future publications. This book is a valuable and timely resource for all actors in the edible insect industry. It is also uniquely interesting to note that the book is accompanied by Open Access e-learning materials (<https://e-insects.wageningenacademic.com>) with high resolution photographs and 360 degrees view of insect species, relevant information and questions to test your knowledge on edible insects. I think that this would also serve as an excellent university class textbook and a reliable reference volume on edible insects.