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BOOK REVIEWS

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Book review: *Insects as sustainable food ingredients: production, processing and food applications*

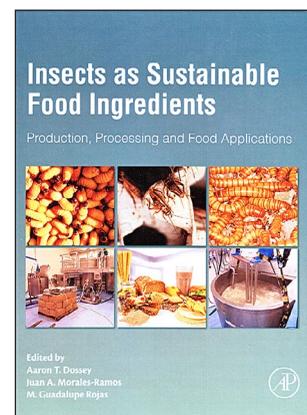
Edited by: Aaron T. Dossey, Juan A. Morales-Ramos and M. Guadalupe Rojas

Price: € 85 (hardcover)

Hardcover: xv + 385 pages

Publisher: Academic Press, London, UK (2016)

ISBN: 978-0-12-802856-8



This substantial volume covers the production and processing of edible insects, processed to be used as ingredients in food, feed and other applications in 10 chapters, contributed by in total 32 authors. The introductory chapter opens with a note of optimism, pointing to the rapidly increasing interest in the academic and commercial sectors for the potential of edible insects as sustainable sources of protein and other nutrients to help fulfil the needs of the growing human population. The estimated population size of 9 billion people in 2050 requires a doubling of current protein production rate. The production of insects is put in context of the agricultural production factors land, water and energy and advantages of insect farming are identified. The sharply increasing interest in academic research for farmed insect species worldwide is illustrated graphically. Psychological barriers influencing acceptance of insects by western consumers are outlined. The chapter closes with a summary of the following chapters and a call to foster a sustainable food system by developing the field of edible insects by integration of traditional ecological knowledge with agriculture and industry to ensure human and environmental health.

The second chapter presents a detailed treatise of the archaeological, historical, geographical and cultural aspects of edible insects. Current use is illustrated by a selection of examples. Several cultural factors that restrict the

acceptance of insects as food and educational campaigns to alleviate such restrictions are discussed. Promotion of insect consumption in industrialised countries is put forward as a necessary development to realise their full potential as a global food source.

The third chapter reviews nutrient content and health benefits of insects in a series of tables, summarising information from literature on the contents of water, protein, fat, minerals, vitamins, amino acid and fatty acid profiles. A number of errors in insect taxonomic names and classification occur in these tables and not all units of parameters listed have been stated. Values for commonly consumed protein-rich food sources have been included in each of the tables, allowing a direct comparison. Regrettably it must be noted that ca. 75% of the text has been copied *verbatim* from the 'Encyclopedia of Entomology' (Finke, 2005).

The fourth chapter deals with the efficiency of farming of edible insects and the impacts on livelihood, food security and environment. Also in this chapter a comparative perspective is taken, referring to values for mainstream vertebrate livestock and crop production. Evidence is reviewed that insect production has a more favourable ecological footprint than livestock production. This topic is also addressed in the introductory chapter but is reviewed

more in depth here. Commercial insect farming is advocated over wild harvesting since the nutritional composition can be controlled and inadvertent chemical contamination or infection is prevented. Indoor mass rearing of silkworms, house crickets and mealworms is discussed, including associated constraints and also outdoor farming or semicultivation of a number of species is described. Market potential and safety regulations are briefly touched upon.

In the next chapter the focus is on modern insect-based food industry. The first sections overlap with previous chapters but numbers presented in tables on e.g. water use differ between the chapters, causing confusion. The major species produced on industrial scales are discussed and recommendations for feed formulations, farming, product labelling, and in particular processing are reviewed. An inventory of 122 companies active in the insect-based food industry is given, the majority of which (108) are based in Europe and North America. Industrial niches are outlined and the supply chain is described.

Chapter 6 reviews insect mass production technologies and is the most extensive chapter of the book (50 pp.). Large-scale production is the foundation of the insect-based food industry. The quality of the feed given to the insects determines the composition of the insect biomass produced and nutritional requirements of the insects farmed are given due attention. A number of informative tables summarise available information. Mass rearing facilities, equipment, mechanisation and automation are discussed and production techniques are detailed for mealworms, black soldier fly, housefly, crickets and waxworms. Climate control in the rearing facilities is crucial for predictable and constant amounts and quality of the insects produced.

The following chapter addresses food safety and regulatory concerns, currently much debated issues, as the insect industry in the western world is young and cannot rely on extensive experience. At present no standardised or harmonised regulations are in place that guide this emerging industry. Regulatory considerations for insects as food are reviewed and the situation in different countries is outlined. Safety aspects, in particular toxicity hazards, are discussed

and the links with farming practices, processing, packaging and transport are indicated.

The following two chapters present detailed treatises of microbiological and allergenic hazards associated with insects as food and feed and their mitigation and preventive measures, and include useful summarising tables. Attention is paid to regulatory aspects and hazard analysis and critical control point plans and different preservation methods are discussed.

The last chapter deals with insect farming to produce feed for livestock. Although the title states that it is a brief summary, it presents an extensive overview of the outcomes of feeding trials performed with poultry, pigs, fish and invertebrate animals and discusses how insects can be employed to replace soybean and partially replace fish meals that are currently the major protein sources in feed and for which replacement is needed for sustainability reasons. The picture emerging from this overview is the huge potential for sustainable, efficient, high-quality insect-based feed production as this industry will develop and optimise its techniques and operational procedures to achieve standardisation. The appendix presents a table on 1,555 insect species used as food and feed, listing taxonomic name, common name, faunal zone, geographical occurrence and references.

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 and that inaccuracies in citations occur. If a next edition of the book is considered, more editorial scrutiny to prevent overlap and inconsistencies is desirable. Overall this book is a valuable and timely resource for all those interested in the topic of insects as food and feed, entomologists, human and animal nutritionists, food scientists, and entrepreneurs.

Reference

- Finke, M.D., 2005. Nutrient content of insects. In: Capinera, J.L. (ed.) *Encyclopedia of Entomology* (Volume 1). Springer, Dordrecht, the Netherlands, pp. 1563-1575.

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Book review: Edible insects of China

Authors: Ying Feng, Xiaoming Chen and Min Zhao

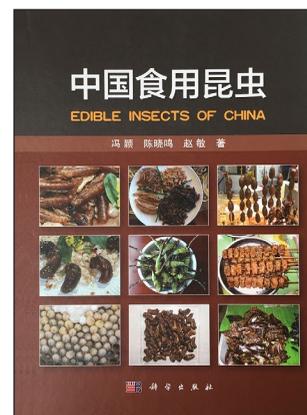
Price: ¥198

Hardcover: 313 pp.

Language: Chinese (with 5 pages English introduction)

Publisher: Science Press, Beijing, China (2016)

ISBN: 978-7-03-047057-7



Insects as food items have become a hot topic worldwide in recent decades. It might be a novel thing for many; however, in some countries, eating insects is a part of culture of hundreds of years. China is one, which has a long history of using insects as food and/or medicine. The book 'Edible insects of China' comprehensively covers this topic.

The authors of the book are scientists at the Research Institute of Resource Insects in Kunming, Yunnan. They conducted systematic surveys on the customs and practices of using insects as food in southwestern China, where this practice has been a part of their local culture for long. They have assembled their findings done over the past 20 years. Supplementing with related literature, they provide both basic information and recent developments on the topic of Chinese edible insects.

The book is written in Chinese with a preface in English written by the previous editor-in-chief of *Journal of Insects as Food and Feed* Alan L. Yen, and a 5-page English introduction providing a contextual background and a short description of each chapter. Fifteen chapters make this book. The first section (pages 1-106) provides a general introduction of edible insects and comprises six chapters. Chapter 1 introduces edible insects in a worldwide context with a synopsis of their historical uses in China. Chapter 2 provides nutrition details and health information of edible insects, elucidating the values and benefits of eating insects. Chapter 3 discusses safety aspects of insects when eaten. Toxicological evaluations carried out on 13 edible insects of China and this chapter provides a thorough overview of the possible toxicology of edible insects. The possible allergenic reactions that can arise with insect utilisation are discussed based on the mechanism of eating and inhalation. In Chapter 4, the authors talk of the relationships between

insects and humans, dealing with potential direct or indirect influences of insects on human health, on agriculture, and on ecosystems. They also discuss the influences on the environment when rearing edible insect, and they compare their findings with traditional animal husbandry practices. Chapter 5 explains general principles involved in insect farming and specific breeding techniques giving popular examples, such as mealworms, grasshoppers, bamboo caterpillars, dragonflies, and cockroaches. The message is that some of these insects can be reared in captivity, while for others it could only be done partially. They also indicate that some of the practices could be done as a small family business for extra income, while others could be developed into a large-scale industry. Chapter 6 illustrates the utilisation and prospects of edible insects. Direct consumption of insects is one method; indirect consumption via products made from insect material is another. The latter development is rearing insects to feed livestock, such as pigs, cows, exotic animals, and pets, further to home-raised chicken, ducks, and fishes as a protein supplement, which in contrast to conventional fodder is beneficial in being cost-effective and offering a better nutrition.

The second section of the book (p. 107-292) offers detailed descriptions of edible insects of China. Details of 324 edible insect species are supplied. Among them, a total of 174 species belonging to 11 orders, 64 families, 173 genera has been supplied with detailed nutrient analysis as relevant to medicine, food, or animal feed. Chapters are lay out by insect orders. Chapter 7 covers the mayflies and alderflies. Chapters 8, 9, and 10 deal with dragonflies, termites, and grasshoppers, locusts, katydids, and crickets, respectively. Chapters 11, 12, 13, 14, and 15 elucidate the bugs, beetles,

moths and butterflies, bees, wasps, and ants, flies and roaches, respectively.

In general, the book provides complete information on edible insects of China with their history, diversity, application, and techniques. It not only provides nutrient details of edible insects of China, but also depicts the benefit of eating insects from a food security and health care point-of-view. Insects as food and medicine have a strong representation in Chinese culture. Readers can find prominent examples of Chinese edible insects well covered in this book. For example, the fungal infected caterpillar, *Ophiocordyceps*, is a common and highly valuable commodity in Chinese medicine market. Wasps and ants have versatile relevance as food and/or medicine in Chinese market. Local wild bees providing special flavoured honey, wasp and ants of different life stages as food and medicine have become important ingredients in many medicinal practices. Bamboo caterpillars are useful

as snacks. These are widely used and have grown into industrial production. Even faeces of some insects can be used! The faecal pellets of caterpillars feeding on specific plants can make distinct teas. This book includes useful information on insect teas. The larvae of the gall-inducing beetle *Sagra femorata purpurea* Lichtenstein are often extracted and made into a delicious dish. Meloid beetles and *Palembus demestoides* have special medicinal use.

Overall, this book provides a detailed coverage of information on Chinese edible insects supplemented with sufficient photos and tables. In a hypercritical sense, we will say that this book has covered less of cultural aspects. However, that does not impede its usefulness as a valuable volume on the topic selected. We think that this would also serve as an excellent university class textbook and a reliable reference volume on edible insects especially to those who read Chinese.

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Book review: Edible insects of the world

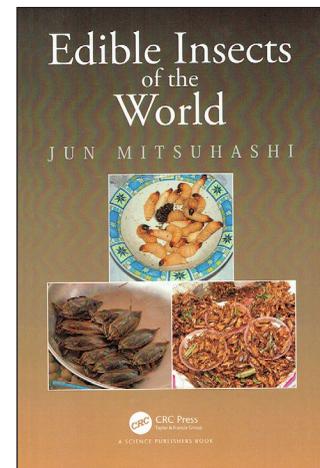
Author: Jun Mitsuhashi

Price: £ 108.00 / \$ 169.95 (hardcover), £ 75.60 / \$ 118.97 (e-book)

Hardcover: 286 pp.

Publisher: CRC Press, Boca Raton, FL, USA (2017)

ISBN: 978-1-4987-5657-0 (hardcover)



Will the world want to read 'Edible insects of the world'?

It arrived yesterday and it's here on my desk right now in front of me: the hardback version of Jun Mitsuhashi's book 'Edible insects of the world', published by CRC Press of the Taylor & Francis Group (Boca Raton, London, New York). The three photographs on the cover aren't exactly brilliant and no explanation is given what they show, but representing beetle larvae (perhaps those of the palm weevil *Rhynchophorus* sp.), giant waterbug adults (perhaps *Lethocerus* sp.), and platefuls of crickets, the photographs give an idea of what this book is supposed to be about: the variety of edible insects in the world. There are 8 colour

plates in the book with photos of very mediocre quality, some with insets, which are so small that one needs a magnifying glass (to see the pixels). However, why just these photos had been chosen to illustrate the book and what exactly their role is remains obscure. No additional black and white illustrations or line drawings of insects are included.

Mitsuhashi has published two earlier accounts of edible insects of the world, one of 270 pages in 1984, titled 'Sekai no shokkyou konchuu' [世界の食用昆虫] and another one, 403 pages thick, in 2008, titled 'Sekai konchuu shokkou taizen' [世界昆虫食大全]. I possess the latter and being able to read some Japanese found it a very informative and

detailed tome. Naturally I was eager to see how his latest book in English with a publication date of 2017 would stand up to a comparison.

While his 2008 book mentions approximately 1,900 species (Mitsuhashi, 2008), the book in front of me, as it says on its back, is supposed to list '2,140 edible insects which have been identified along with scientific names...insect names are arranged much like a dictionary, first by taxonomic group and then by country.' Too bad only, that there is no index at the end of the book with alphabetically arranged names of species or taxonomic groups. So, if you want to confirm, for example, whether the photo on the cover shows grubs of the palm weevil *Rhynchophorus* sp. and want to search for the insect's name in an index, you can't. In fact, in order to find any particular food insect and to learn where in the world it is perhaps consumed, you first need to know which of the 18 insect orders mentioned in the book it belongs to and which page to consult (the book's content information will tell you the page that the order you are searching for is covered). This is, of course, no problem for entomologists, but then you have to go through the chapter and see if you can locate the family that the species you are looking for, is listed. And that could be a little more difficult for the non-specialist. Family names, however, are given in bold and in alphabetical order; genera and specific names under the various families are also given in alphabetical order and, as is customary, are written in italics. Morphological details like coloration or sizes of insects are not included.

Once you have located the species (more on whether you can rely on the name given in the book further below) that you were searching for, you can obtain some information on the country in which the insect is used and also quite frequently on how it is used, e.g. raw, dried, fried or cooked and whether a species has a medicinal role to play (which is very good). But the distinction as to whether a species is primarily consumed as a food item and therefore deserves to be called edible or is only of therapeutic value is not always clear. However, what is considerably more unsatisfactory, is when in connection with a species it is simply stated as on p. 53 that *Cerococcus quercus* is used by 'Some American Indian tribes...(Essig 1934 and 1965); or on p. 54 for *Andropogon gayanus* (is it actually a species of grass or an insect?) that it is a cicada, adults of which are used as a 'food item in Africa (Van Huis 2008); or for *Cicada flamata* on the same page that 'adults are fried in China (Chen and Feng 1999)'. South America, Africa, China and many other countries mentioned in the book are huge in area, often with an enormous variety of ethnic groups, each with its own food preferences and food cultures and a more detailed information as to where in each region used and by which tribal or ethnic group would have been desirable, so that one would not have had to search for and consult the cited literature.

Actually taking a look at the cited references can give one an idea as to how up-to-date a book is. With a publication year of 2017 one could perhaps have expected Mitsuhashi's book to reflect the surge of activity of the last 10 years in the field of entomophagy, but of the 534 references (many of them secondary references cited in other people's publications) only 3 are of the year 2011, two each of 2012 and 2013, none thereafter. For references with publication dates from 1700-1799 and before, however, I could find at least 10 references. More recent and important reviews have, thus, remained unaccounted for, which is a shame given the many important works on insects as human food that have appeared since 2011.

It is my habit before I read a book thoroughly, to just flick it open and read a random page to get a first impression. When I did that with this book, it happened to open on page 226, where I could read under the heading Honduras 'Poybiidae: *Polybia* spp.' (no reference given). I had never heard of a family by the name of Poybiidae and checked whether there had perhaps been a name change. However, it seems that species of the genus *Polybia* are still Vespidae and that there isn't any Poybiidae family. On the next page, p. 227, under the heading Mexico and Cerambycidae, I can read '*Arhopalus* sp., and *Arophalus* *afin rusticus*' (*Arhopalus rusticus* would have been correct); then there is the family 'Ditiscidae' (it should have been Dytiscidae) mentioned, and *hyllus* with a capital is to be found for the dynastid beetle '*Dynastes Hyllus*'. A few pages further under Bolivia one finds 'Termicidae' instead of Termitidae. What the book's section titled 'Districts' on pages 259-263 is supposed to contribute eludes me, for there are no explanations why a few (presumably key insect) species are listed and what exactly determines a 'district'. Europe, for instance, is divided into three districts: 'Europe general', 'South Europe' and 'Lapland'; for the West Indies only 'West Indies general' is given as a district on page 260, to which 4 lines are devoted: two list 3 species of beetles and two (one a repeat of the first) refer to Orthoptera Acrididae with *Oedipoda corallipes* mentioned twice. However, neither is it clear whether adults or larvae are consumed nor is it understandable why species mentioned as edible for the West Indies on page 229, like *Melipona beechei fulvipes*, *Pyrophorus* sp., and *Gryllus campestris*, do not feature on page 260 in connection with the West Indies under the heading 'Districts'.

For South America we find the district 'Amazonia', but how is it defined given that Brazil-Guyana (with a single species of edible insect, i.e. *Rhynchophorus palmarum*) and Brazil-Venezuela (also with two edible species, i.e. *Simulium rubithorax* and *Atta sexdens*) feature as separate districts? Mexico isn't mentioned at all, not under North or South America (page 260). Finally, under the heading 'The Middle and Near East' on page 263, how is the district 'Barbary' defined and how come the 'Crimea' is in this group?

After these somewhat disenchanting exploratory findings I decided to read the book thoroughly from its preface on page V to the end on page 286. It immediately became clear that a purist of the English language would not be too happy with sentences like ‘Based on the enhancement of general people’s interest to entomophagy...’ or ‘the number of edible insect species is one of frequent questions about entomophagy. It is very difficult to answer for such questions...’ and ‘There were many literatures, which present author could not see directly.’ Actually given the difficulties with inaccurately identified species (not by the author Mitsuhashi, but many of the authors whose works he cited), synonyms, wrongly spelt names, taxonomic revisions and uselessness of vernacular names, one must admire the courage that Mitsuhashi had to undertake the task of listing the world’s edible insects and one wonder if it might not have been easier to provide a list of inedible insects.

The book is divided into three very unequal parts, namely: Part I (designated ‘The list of edible insects in order of taxonomic group’, pages 1-220), Part II (designated ‘List of edible insects by countries or districts’, pages 223-258), and Part III (simply called ‘References’, pages 265-286). In between parts II and III on pages 220 and 221 the total numbers of edible species in the various orders and families are given. The difficulties that Mitsuhashi faced, already become apparent on the first few pages of the book and here are a few examples: on page 3 under ‘Small square.gill mayflies’ the genus *Povilia* is mentioned. However, apart from the often ridiculous sounding non-scientific English names of the insects’ families and supposedly vernacular names in the book, *Povilia* should have correctly been *Povilla* (an African burrowing mayfly, cf.; Copeland *et al.*, 2011). On page 11 one finds *Aelopos tamulusus* (correct it should be *A. tumulus*); on page 13 *Cantatops spissus* (correct it should be *Catantops spissus*), on the same page *Caredeniopsis nigropunctatus* (correct it should be *Cardeniopsis nigropunctatus*); on page 14 *Chondracris rosea pbrunner* (correct it should be *Chondracris rosea brunneri*); on page 15 *Diabolocanthops* should be *Diabolocatantops*; on page 16 *Hieroglyphus concolour* should be *H. concolor* and it goes on like that almost to the end of the book (e.g. on page 206 *Trachilogastir* should be *Trichilogaster*).

On page 17 for *Locusta mahrattarum* it is mentioned that ‘the Mussulmauns’ are using these insects for a meal. The people referred to as Mussulmauns are nowadays known as muslims! Because of the innumerable errors, false spellings of insect names, wrong identifications and other inaccuracies in this book (geographic locations), how useful can this book be? The number of identified insects (if one accepts the identifications) is bound to be little more than an estimate, but the book will be cited for having provided a number: 2,140 edible insects. The brief information given for each species listed and how (as well as approximately where in the world and by whom) it is used can be quite

useful since such statements are often (but unfortunately not always) given with a reference to the publication that the information has been obtained from. Yet, I still believe it should be the responsibility of the author or editor of a book to check whether or not information obtained from other publications is correct or has been superseded and therefore is to be cited or not. I do not wish to blame the author of this book, Tokyo Agricultural University’s Emeritus Professor Jun Mitsuhashi for the shortcomings of this book, but I am surprised that no editor appears to have had a critical look at the manuscript before sending it to print and nobody seems to have carefully proofread the galleys. I cannot help but feel that the publisher was in a rush, hoping to cash in on the current fad on anything ‘entomophagic’.

To do justice to Dr Mitsuhashi, I briefly wish to mention his 2008 book written in Japanese which, although suffering from the same problems with the scientific terminology, categorisation and identification of the species, is vastly superior to this book in English and to those readers who can at least read a little Japanese I can recommend the Japanese version. It starts with a history and the uses of insects as food in the world and then, after dealing thoroughly with Japan and China, goes through the uses of insects in other countries, continent by continent. An index of scientific names of those insects mentioned in the book is given in Roman alphabetic spelling on 10 pages at the end of the book. The Japanese version contains far more information, is more detailed, richly illustrated (although the photos are tiny and in black and white), and devotes 45 of its 403 pages to insect products like honey, royal jelly, propolis, manna, honeydew, insect galls, etc. It provides some information on mineral and vitamin contents of the edible insects and contains 18 pages of tables covering hundreds of edible species, for which data on protein, fat, carbohydrate and ash contents plus energy values per 100 g of insect in Kcal or kj are included.

The hardcover version of the 2017 English book, according to a brief check on the web, sells for around 150 US\$ or 108 British Pounds. It’s up to the individual to decide if s/he wishes to spend that kind of money on this book and I can certainly not speak for any potential buyer. However, I’ve already made up my mind and know what I will do if faced with the question: buy or not to buy.

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