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The larvicidal effects of black pepper (Piper nigrum L.) and piperine against insecticide resistant and susceptible strains of Anopheles malaria vector mosquitoes

Michael Samuel^{1,2}, Shúné V. Oliver^{1,2}, Maureen Coetzee^{1,2} and Basil D. Brooke^{1,2}

Abstract

Background: Insecticide resistance carries the potential to undermine the efficacy of insecticide based malaria vector control strategies. Therefore, there is an urgent need for new insecticidal compounds. Black pepper (dried fruit from the vine, Piper nigrum), used as a food additive and spice, and its principal alialoid piperine, have previously been shown to have larvicidal properties. The aim of this study was to investigate the larvicidal effects of ground black pepper and piperine against third and fourth instar Anopheles larvae drawn from several laboratory-reared insecticide resistant and susceptible strains of Anopheles arabiensis, An. coluzai, An. gambiae, An. quadriannulatus and An. funestus.

Methods: Larvae were fed with mixtures of standard larval food and either ground black pepper or piperine in different proportions. Mortality was recorded 24 h after black pepper and 48 h after piperine were applied to the larval bowls.

Results: Black pepper and piperine mixtures caused high mortality in the An. gambiae complex strains, with black pepper proving significantly more toxic than piperine. The An. funestus strains were substantially less sensitive to black pepper and piperine which may reflect a marked difference in the feeding habits of this species compared to that of the Gambiae complex or a difference in food metabolism as a consequence of differences in breeding habitat between species.

Conclusions: Insecticide resistant and susceptible strains by species proved equally susceptible to black pepper and piperine. It is concluded that black pepper shows potential as a larvicide for the control of certain malaria vector species.

Keywords: An. arabiensis, An. coluzzii, An. funestus, An. gambiae, An. quadriannulatus, Larvicides, Vector control

Background

Malaria is responsible for high levels of morbidity and mortality globally, with particular severity in sub-Saharan Africa [1]. This region is home to several of the most efficient malaria vectors, the principal species being Anopheles gambiae. An. coluzzii (formerly An. gambiae M form [2]), An. anabiensis and An. function. The former three species are members of the Anopheles gambiae species complex and the latter is the nominal member and only major vector of the Anopheles fionestus species group [3, 4].

Insecticide based vector control strategies primarily directed against adult mosquitoes have significantly decreased malaria incidence over the past decade, with indoor residual spraying of insecticides (IRS) and distribution of long-lasting insecticide-treated bednets (LLINs) being pivotal [1]. Additionally, and especially in light of the increasing incidence of insecticide resistance in target vector populations [5], larval source management (LSM) is playing an increasingly important role in vector control [6].

[&]quot;Wits Research Institute for Malaria, School of Fathology, Faculty of Health Sciences, University of the Willwatersrand, Johannesburg, South Africa "Centre for Opportunistic, Tropical & Hospital Infections, National Institute for Communicable Diseases, Johannesburg, South Africa



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Chili Pepper As Larvicidal

Leo M.L. Nollet, Hamir Singh Rathore

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Peppers Prasad S. Variyar, Inder Pal Singh, Vanshika Adiani, Penna Suprasanna, 2024-11-08 There is an increased awareness on the relevance of nutraceutical and functional foods as alternatives to harmful synthetic additives used in industry Different peppers with an abundance of bioactive compounds are highlighted in this book which provides a comprehensive evaluation of their importance as nutraceutical and functional foods to all stakeholders in the agri food and pharmaceutical industries Peppers Biological Health and Postharvest Perspectives is a valuable addition to the existing information resource on peppers Key features Highlights the advancements made in biodiversity biochemistry and biosynthesis of bioactive compounds of peppers Reviews the effects of processing methods on the quality of peppers to facilitate further research and development of foods having pepper as an essential nutritional component Provides help in selecting better processing methods for the management of nutritional attributes and health benefits of peppers The book provides a blend of basic and advanced information for postgraduate students researchers and scientists Spices & Culinary Herbs: Latest Laboratory, Pre-clinical, and Clinical Studies: Volume 6 Atta-ur-Rahman, M. Igbal Choudhary, Sammer Yousuf, 2024-08-13 Many herbs and spices in addition to their culinary use for taste contain chemical compounds which have medicinal uses For this reason herbs and spices have been used for treating various ailments since ancient times Modern scientific methods have enabled researchers to isolate and analyze bioactive compounds from herbs and spices to develop medicines for different diseases Science of Spices and Culinary Herbs presents current reviews on studies performed on herbs and spices This book series is an informative resource for medicinal chemists herbalists and biomedical researchers interested in the science of natural herbs and spices that are a common part of regional diets and folk medicine The sixth volume of this series features reviews on medicinal aspects of a selection of herbs and spices including Pimpinella anisum L Anise Aniseed Sinapis alba L Mustard Seeds Cinnamomum verum Cinnamon Tamarindus indica L Tamarind Curcuma longa Curcumin Glycyrrhiza glabra Licorice Handbook of Herbs and Spices K. V. Peter, 2001-08-17 Herbs and spices are among the most versatile and widely used ingredients in food processing As well as their traditional role in flavouring and colouring foods they have been increasingly used as natural preservatives and for their potential health promoting properties for example as antioxidants Edited by a leading authority in the field and with a distinguished international team of contributors the Handbook of herbs and spices provides an essential reference for manufacturers wishing to make the most of these important ingredients. The first group of chapters looks at general issues including quality indices for conventional and organically produced herbs spices and their essential oils The main body of the handbook consists of over twenty chapters covering key spices and herbs from aniseed bay leaves and black pepper to saffron tamarind and turmeric Each chapter covers key issues from definition and classification including chemical structure cultivation post harvest processing uses in food processing functional properties quality indices methods of analysis The Handbook of herbs

and spices is a standard reference for all manufacturers using herbs and spices in their products Fruit and Vegetable Phytochemicals Elhadi M. Yahia, 2017-08-29 Now in two volumes and containing more than seventy chapters the second edition of Fruit and Vegetable Phytochemicals Chemistry Nutritional Value and Stability has been greatly revised and expanded Written by hundreds of experts from across the world the chapters cover diverse aspects of chemistry and biological functions the influence of postharvest technologies analysis methods and important phytochemicals in more than thirty fruits and vegetables Providing readers with a comprehensive and cutting edge description of the metabolism and molecular mechanisms associated with the beneficial effects of phytochemicals for human health this is the perfect resource not only for students and teachers but also researchers physicians and the public in general Handbook of Oleoresins Gulzar Ahmad Nayik, Amir Gull, Tariq Ahmad Ganaie, 2022-06-07 An Oleoresin represents the true essence of spices enriched with volatile and non volatile essential oil and resinous fractions. The oleoresin represents the wholesome flavor of the spice a cumulative effect of the sensation of smell and taste Therefore it is designated as true essence of the spice and can replace spice powders in food products without altering the flavor profile Our earth comprises a plethora of spices that have carved a niche in the global market in medicinal and health related food products. These spices play a dual role as a food ingredient and a therapeutic agent preventing various diseases This industry has acquired tremendous attention not only from consumers but also from scientific communities and various food manufacturing organizations Handbook of Oleoresins Extraction Characterization and Applications is a snapshot of information on oleoresins production composition properties applications medicinal health properties and more It is designed to be a practical tool for the various professionals who develop and market spices and oleoresins Key Features Contains comprehensive information on the major oleoresins of the world Dicusses the extraction and characterization of major spice oleoresins Covers the safety and toxicity of oleoresins Sheds light on relationship between oleoresins and health benefits The world is moving towards natural products Spices lend color taste and flavor and oleoresins are good source of antioxidants and have preservative as well as therapeutic power Therefore it is important to understand and document the chemistry characterization properties and applications of oleoresins as found in this handbook Antioxidant Properties of Spices, Herbs and Other Sources Denys J. Charles, 2012-11-27 The scientific world and modern society today is experiencing the dawning of an era of herbal medicine Extensive research has shown that aromatic plants are important anti inflammatory antioxidant anti aging and immune boosting delectable foods with the magic and miracle to boost our immune system providing us with extended and an improved quality of life Apart from making bland recipes into welcoming or interesting victories herbs and spices have stirred the minds of the research community to look deeper into its active components from a functional perspective It is essential to present the scientific and medicinal aspect of herbs and spices together with the analysis of constituents its medicinal application toxicology and its physiological effects Herbs and spices with high levels of antioxidants are in great

demand as they tend to promote health and prevent diseases naturally assuring increased safety and reliability for consumers Herbs and spices are not only known for taste and flavor but today research has opened up a new realm in which the antioxidant properties of these aromatic plants provide preservation for foods and health benefits for consumers who look forward to concrete scientific research to guide them further and explore herbal medicine The aim of this book is to create awareness in society about the reliability of medicinal properties of certain herbs and spices through scientific and scholarly Therapeutic, Probiotic, and Unconventional Foods Alexandru Mihai Grumezescu, Alina Maria Holban, 2018-04-18 Therapeutic Probiotic and Unconventional Foods compiles the most recent interesting and innovative research on unconventional and therapeutic foods highlighting their role in improving health and life quality their implications on safety and their industrial and economic impact The book focuses on probiotic foods addressing the benefits and challenges associated with probiotic and prebiotic use It then explores the most recently investigated and well recognized nutraceutical and medicinal foods and the food products and ingredients that have both an impact on human health and a potential therapeutic effect The third and final section explores unconventional foods and discusses intriguing and debated foods and food sources While research has been conducted on the beneficial biological effects of probiotics and therapeutic food the use of these foods remains controversial To overcome the suspicion of the use of alternative homeopathic and traditional products as therapy this book reveals and discusses the most recent and scientifically sound and confirmed aspects of the research Compiles the most recent interesting and innovative research on unconventional and therapeutic foods Highlights the role of unconventional and therapeutic foods in improving health and life quality Discusses the implications of unconventional and therapeutic foods on safety Presents the industrial and economic impact of unconventional and therapeutic foods Therapeutic and Nutritional Uses of Algae Leonel Pereira, 2018-01-29 Algae have been used since ancient times as food fodder fertilizer and as source of medicine Nowadays seaweeds represent an unlimited source of the raw materials used in pharmaceutical food industries medicine and cosmetics They are nutritionally valuable as fresh or dried vegetables or as ingredients in a wide variety of prepared foods In particular seaweeds contain significant quantities of protein lipids minerals and vitamins There is limited information about the role of algae and algal metabolites in medicine Only a few taxa have been studied for their use in medicine Many traditional cultures report curative powers from selected alga in particular tropical and subtropical marine forms This is especially true in the maritime areas of Asia where the sea plays a significant role in daily activities Nonetheless at present only a few genera and species of algae are involved in aspects of medicine and therapy Beneficial uses of algae or algal products include those that may mimic specific manifestations of human diseases production of antibiotic compounds or improvement of human nutrition in obstetrics dental research thallassotherapy and forensic medicine Antiviral Secrets of Medicinal Plants Deepu Pandita, Anu Pandita, 2025-11-12 Plant based therapies are in tune with nature and have relatively little or no side effects

World Health Organisation WHO is a strong advocate of herbal inputs in modern systems of medicine This book contains detailed descriptions of 23 medicinal plants with antiviral properties. The molecules from these plants are known to be effective against viruses For instance alkaloids like perivine pericalline periformyline leurocristine leurosivine vincaleukoblastine perividine vindolinine and carosine derived from Catharanthus roseus are effective against viruses like herpes simplex virus type 1 vaccinia virus poliovirus and dengue virus type 2 DENV 2 Large amounts of pentacyclic triterpenoid saponins also referred as centelloids are present in C asiatica Asiaticoside centelloside madecassoside brahmoside brahminoside thankuniside sceffoleoside centellose asiatic brahmic centellic and madecassic acids are some of the terpenoids of this group Studies show the effectiveness of asiatic acid and their derivatives against the inhibition of human enterovirus 71 replication and anti HSV 1 and 2 activity of Centella asiatica is because of the asiaticoside The book is intended for botanists biotechnologists healthcare professionals and general readers interested in enhancing their knowledge on natural plant based sources of antiviral compounds Green Pesticides Handbook Leo M.L. Nollet, Hamir Singh Rathore, 2017-06-13 Green pesticides also called ecological pesticides are pesticides derived from organic sources which are considered environmentally friendly and are causing less harm to human and animal health and to habitats and the ecosystem Essential oils based insecticides started have amazing features This book gives a full spectrum of the whole range of essential oil based pesticides that may be used in pest control It discusses the uses and limitations including the recent advances in this area It describes the metabolism and mode of action and provides the present status of essential oil based pesticide residues in foodstuffs soil and water

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