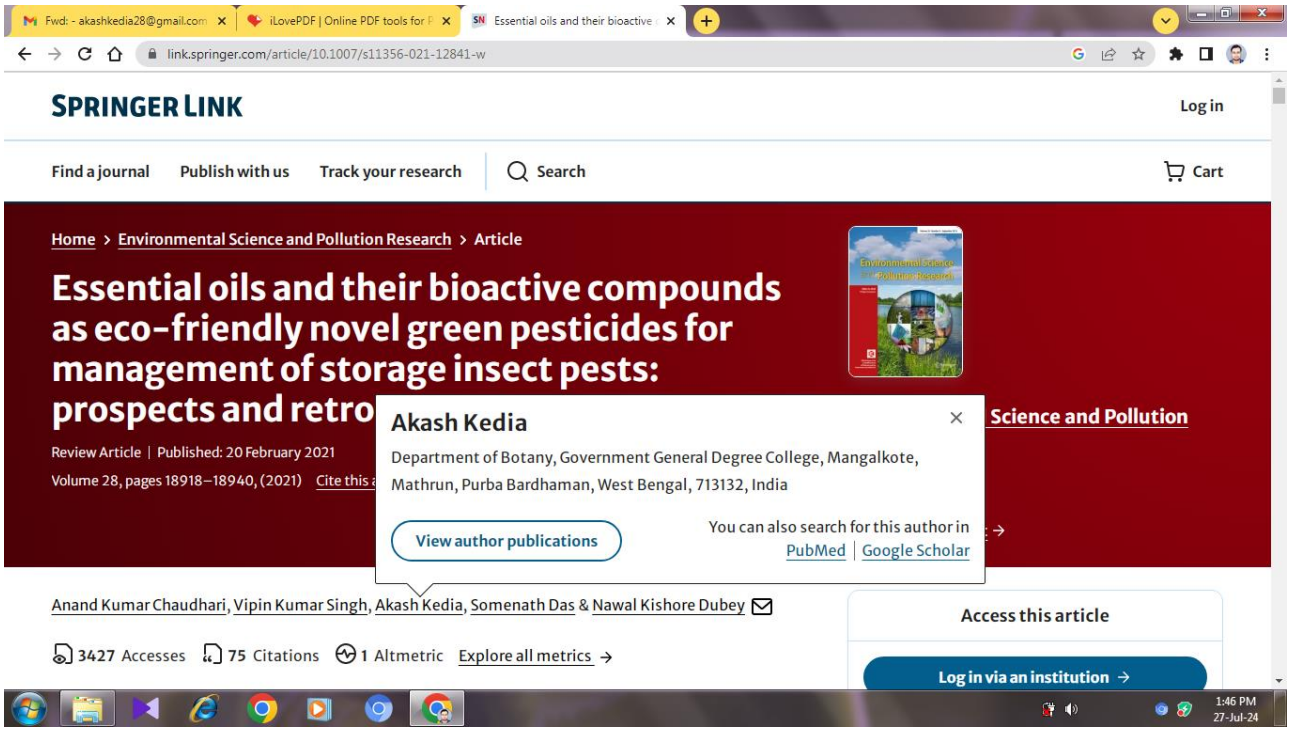

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REVIEW ARTICLE

Essential oils and their bioactive compounds as eco-friendly novel green pesticides for management of storage insect pests: prospects and retrospects

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Abstract

The control of storage insect pests is largely based on synthetic pesticides. However, due to fast growing resistance in the targeted insects, negative impact on humans and non-target organisms as well as the environment, there is an urgent need to search some safer alternatives of these xenobiotics. Many essential oils (EOs) and their bioactive compounds have received particular attention for application as botanical pesticides, since they exhibited high insecticidal efficacy, diverse mode of action, and favourable safety profiles on mammalian system as well as to the non-target organisms. Data collected from scientific articles show that these EOs and their bioactive compounds exhibited insecticidal activity via fumigant, contact, repellent, antifeedant, ovicidal, oviposition deterrent and larvicidal activity, and by inhibiting/altering important neurotransmitters such as acetylcholine esterase (AChE) and octopamine or neurotransmitter inhibitor γ-amino butyric acid (GABA), as well as by altering the enzymatic [superoxide dismutase (SOD), catalase (CAT), peroxidases (POx), glutathione-S-transferase (GST) and glutathione reductase (GR)] and non-enzymatic [glutathione (GSH)] antioxidant defence systems. However, in spite of promising pesticidal efficacy against storage pests, the practical application of EOs and their bioactive compounds in real food systems remain rather limited because of their high volatility, poor water solubility and susceptibility towards degradation. Nanoencapsulation/nanoemulsion of EOs is currently considered as a promising tool that improved water solubility, enhanced bio-efficacy, stability and controlled release, thereby expanding their applicability.

Keywords Essential oils · Bioactive compounds · Storage pests · Synthetic pesticides · Mechanism of action · Nanoencapsulation

Introduction

Stored food commodities are prone to postharvest loss (up to 30%) in quality as well as quantity due to infestation by different groups of insects. The most common storage insect pests causing considerable loss include *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae), *C. chinensis* (L.) (Coleoptera: Bruchidae), *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), *S. zeamais* (Motsch.) (Coleoptera: Curculionidae), *S. granarius* (L.) (Coleoptera: Curculionidae), *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae), *T. confusum* (du Val) (Coleoptera: Tenebrionidae), *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae), *Acanthoscelides obtectus* (Say) (Coleoptera: Bruchidae), *Lasioderma serricorne* (L.) (Coleoptera: Anobiidae), *Liposcelis bostrychophila* (Badonnel) (Psocoptera: Liposcelididae), *Oryzaephilus surinamensis* (L.) (Coleoptera: Silvanidae) and *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae). These cosmopolitan primary pests of stored food commodities have been reported to pose a threat to agricultural products during their storage not only by damaging the stored cereals by feeding on them, but also by providing suitable medium for other contaminants such as fungi and bacteria (Kłyś et al. 2017).

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