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REVIEWER'S REPORT

Manuscript No.: IJAR-57939

Title: Photochemistry and Therapeutic Properties of Bunium persicum (Boiss.)

Recommendation:
Accept after minor revision

Rating	Excel.	Good	Fair	Poor
Originality		✔		
Techn. Quality			✔	
Clarity			✔	
Significance	✔			

Reviewer's ID: JPR-Bilquees Hamza

Detailed Reviewer's Report

The manuscript under review provides a comprehensive conceptual synthesis of the existing literature surrounding *Bunium persicum* (Boiss.), a highly valued perennial medicinal spice belonging to the Apiaceae family, colloquially recognized across South and Central Asia as black cumin, kala zeera, or shahi zeera. The authors correctly frame the scope of this review by positioning the plant not merely as a traditional culinary flavor enhancer or food preservative, but as a complex reservoir of bioactive secondary metabolites with broad therapeutic potential. The ethnobotanical significance of this work rests on its attempt to consolidate scattered data regarding the plant's geographical distribution, traditional use-cases in indigenous medical systems, and modern laboratory validations of its crude extracts and isolated essential oils.

By investigating *Bunium persicum*, the paper addresses a critical intersection in modern pharmacognosy: the scientific validation of historical, empirical medicine through the lens of evidence-based chemistry and molecular biology. The scope successfully spans a diverse array of pharmacological activities, tracking the seed's reported antimicrobial, anti-inflammatory, antidiabetic, anticonvulsant, and gastrointestinal regulatory properties. This comprehensive approach makes the text highly relevant to natural product chemists, ethnopharmacologists, and functional food researchers who seek to identify plant-derived lead compounds for drug development or standardized nutraceutical formulations.

Methodologically, the paper functions as a traditional narrative literature review, gathering historical and contemporary data on the volatile and non-volatile chemical constituents of the plant's

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seeds. The phytochemical synthesis accurately highlights major mono- and sesquiterpenoids that define the plant's distinct aromatic and bio-reactive profile, including alpha-terpinene, limonene, dillapiole, p-mentha-1,4-dien-7-al, gamma-terpinene, and beta-pinene. The authors display a good awareness of classical references, correctly identifying how these hydrophobic volatile molecules are traditionally harvested via hydro-distillation and organic solvent extraction techniques.

However, to satisfy the demanding criteria of a top-tier peer-reviewed phytomedicine journal, the manuscript's analytical execution requires a major technical upgrade. A prominent structural deficiency in the current draft is a glaring typographical error in the primary title itself, which reads "Photochemistry and Therapeutic Properties..." instead of "Phytochemistry and Therapeutic Properties...". While photochemistry concerns the chemical effects of light, the entire content of the manuscript is dedicated exclusively to phytochemistry—the study of plant-derived chemicals. This fundamental error in the title, combined with a lack of precise quantitative ranges for the active constituents, severely undermines the paper's perceived scientific rigor, transforming what should be a precise chemical review into a surface-level summary.

The central thesis of the manuscript posits that the diverse therapeutic actions of *Bunium persicum*—ranging from acetylcholinesterase inhibition to pancreatic lipase suppression—are driven by the synergistic interplay of its multi-component chemical profile rather than a single isolated active principle. The authors construct this argument by matching specific traditional therapeutic claims with corresponding modern in vitro and in vivo laboratory models. For example, they link the traditional use of the spice as a digestive aid to documented antispasmodic and antidiarrheal activities, which are believed to be mediated by the modulating effects of volatile monoterpenes on gastrointestinal smooth muscle channels.

From a pharmacological standpoint, the paper highlights the plant's metabolic benefits, particularly its anti-inflammatory and antidiabetic actions, which help reduce oxidative stress and improve insulin sensitivity. The text explores how phenolic and flavonoid fractions within the seeds function as free radical scavengers, shielding cellular membranes from lipid peroxidation and breaking chronic inflammatory pathways. The manuscript effectively concludes that *Bunium persicum* represents a highly valuable, accessible, and non-toxic therapeutic agent whose diverse biological activities justify its transition from an indigenous spice to a formal candidate for clinical drug discovery.

Recommendations for Manuscript Improvement

Correcting Fundamental Nomenclature and Title Errors

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The primary and most urgent recommendation to elevate the manuscript's academic credibility is the immediate correction of the primary title and all associated section headers. The current choice of the term "Photochemistry" is scientifically incorrect and creates a deep mismatch with the actual content of the paper, which contains zero data regarding light absorption, quantum yields, or photochemical reactions. The authors must thoroughly replace "Photochemistry" with "Phytochemistry" throughout the entire title, abstract, keywords, and text. Additionally, the authors must ensure that the botanical nomenclature is standardized, maintaining the italicization of *Bunium persicum* (Boiss.) across all pages and checking that the authority name is correctly cited according to the International Plant Names Index.

Introducing Structural Chemistry and Quantitative Profiling Matrices

While the manuscript lists several key active components like p-mentha-1,4-dien-7-al, limonene, and dillapiole, the description remains purely nominal and lacks chemical depth. To achieve publishable standards for a premier natural products journal, the authors should integrate a comprehensive, multi-column narrative profile or detailed text matrix mapping out these secondary metabolites. This section must specify the exact chemical classes of each compound, their average percentage yield ranges within the essential oil as determined by Gas Chromatography-Mass Spectrometry (GC-MS), and their structural characteristics. Describing how geographic cultivation factors, soil conditions, and extraction methods cause these percentage compositions to shift will provide readers with a clear understanding of the plant's chemical variability.

Deconstructing Specific Molecular Mechanisms of Action

The current review of the plant's therapeutic properties is highly descriptive, often stating that the seeds possess "antidiabetic" or "anti-inflammatory" actions without explaining the underlying molecular mechanisms. The authors should expand this section to look closely at the precise cellular pathways involved. When discussing antidiabetic activity, for instance, the text should explain whether the active extracts function by inhibiting alpha-glucosidase and alpha-amylase enzymes in the gut, stimulating GLUT-4 translocation in skeletal muscle, or protecting pancreatic beta-cells from oxidative apoptosis. Similarly, the commentary on anti-inflammatory mechanisms should explicitly track how the isolated compounds modulate the expression of cyclooxygenase-2 (COX-2), inducible nitric oxide synthase (iNOS), and nuclear factor-kappa B (NF-κB) signaling. This mechanical depth will elevate the paper from a generic summary to a high-quality pharmacological review.

Differentiating Essential Oil Efficacy from Polar Extract Profile

The manuscript currently blends the biological activities of *Bunium persicum* essential oils together with its aqueous and methanolic extracts, which obscures important pharmacological distinctions. The authors need to introduce a clear conceptual division that distinguishes the therapeutic applications of the volatile

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essential oil from those of the polar solvent extracts. The narrative must clarify that while the essential oil's benefits are primarily driven by hydrophobic monoterpenes and sesquiterpenes, the antioxidant and systemic metabolic activities of the polar extracts are dominated by hydrophilic polyphenols, tannins, and glycosides. Explicitly separating these chemical fractions and comparing their distinct toxicological profiles, bioavailability, and cellular targets will significantly improve the manuscript's clarity and utility.

Completing and Standardizing the Bibliographic Metadata Records

A thorough audit of the concluding reference bibliography reveals numerous incomplete citations, missing metadata fields, and formatting inconsistencies, particularly among historical 1980s data and recent 2016 through 2019 pharmacological reports. Multiple entries are missing essential publication details, such as journal volume numbers, issue designations, specific digital object identifiers (DOIs), or definitive page ranges. The authors must systematically review the entire reference list to complete these missing components and ensure that every entry conforms perfectly to a singular, standardized academic style manual, such as the APA seventh edition or the Vancouver style manual, which is a mandatory requirement for indexing in major biomedical databases.

Cleaning Minor Typographical Slippages and Layout Artifacts

Finally, the review copy contains minor mechanical formatting shifts, uneven line spacing around major section transitions, and occasional paragraph alignment errors that affect its professional presentation. There are a few instances where punctuation marks are misplaced next to biochemical terms, alongside minor spelling slips within the introductory abstract paragraphs. The authors must carefully proofread the entire document to eliminate these visual artifacts. Ensuring that the manuscript possesses a flawless visual layout will provide a polished, highly professional appearance that matches the therapeutic importance of the ethnobotanical data.

Editorial Recommendation

This manuscript is recommended for **publication with minor revisions**. The authors have selected a highly valuable, original, and impactful topic by synthesizing the medicinal and therapeutic properties of *Bunium persicum*, a plant of significant economic and ethnopharmacological importance. The identification of the primary volatile components is accurate, and the attempt to capture the plant's diverse biological activities addresses a clear need in modern phytotherapy literature.