frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 04 November 2026
DOI 10.3389/fsufs.2026.1831992

Check for updates

OPEN ACCESS

EDITED BY
Rakesh Kumar Gupta,
Woxsen University, India

REVIEWED BY
Sajib Al Reza,
Mawlana Bhashani Science and Technology University, Bangladesh
Paushali Mukherjee,
Indian Institute of Technology Guwahati, India

*CORRESPONDENCE
Sarathadevi Kirushanthan
✉ rsarathadevi@univ.jfn.ac.lk
Thatchaneshkanth Subramaniam
✉ thachanesh@univ.jfn.ac.lk

RECEIVED 16 March 2026
REVISED 25 June 2026
ACCEPTED 20 August 2026
PUBLISHED 04 November 2026

CITATION
Kartheevan S, Kathirkamanathan T, Kirushanthan S and Subramaniam T (2026) Characterization of whey based edible coating enriched with heen bovitiya (*Osbeckia octandra* L.) for shelf-life extension of cooked meatballs.
Front. Sustain. Food Syst. 10:1831992.
doi: 10.3389/fsufs.2026.1831992

COPYRIGHT
© 2026 Kartheevan, Kathirkamanathan, Kirushanthan and Subramaniam. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Characterization of whey based edible coating enriched with heen bovitiya (*Osbeckia octandra* L.) for shelf-life extension of cooked meatballs

Saagarey Kartheevan[1], Thadchajini Kathirkamanathan[1], Sarathadevi Kirushanthan[1]* and Thatchaneshkanth Subramaniam[2]*

[1]Department of Agricultural Chemistry, Faculty of Agriculture, University of Jaffna, Kilinochchi, Sri Lanka, [2]Department of Animal Science, Faculty of Agriculture, University of Jaffna, Kilinochchi, Sri Lanka

Introduction: Cooked meatballs are highly susceptible to lipid oxidation and microbial spoilage, limiting their shelf life. This study developed a whey protein-based edible coating enriched with phytochemicals from Heen bovitiya (*Osbeckia octandra* L.) leaf extract, incorporating mangosteen peel anthocyanin as a pH-responsive freshness indicator.
Methods: Seven formulations were prepared by varying Heen bovitiya extract concentrations (C - 0%, H1 - 0.1%, H2 - 0.2%, H3 - 0.5%, H4 - 1.0%, H5 - 1.5%, and H6 - 2.5% v/v) in a heat-denatured whey protein matrix (90 °C, 15 min) with glycerol (1% v/v) as a plasticizer. Antioxidant activity was assessed by TPC, TFC, and DPPH assays, and film physical, mechanical, and barrier properties were characterized. Storage quality of coated meatballs was monitored over 15 days of refrigeration via pH, TBARS, weight loss, total plate count, and visual anthocyanin color change.
Results: The Heen bovitiya leaf extract yielded a TPC of 888.37 ± 0.10 mg GAE/g, TFC of 2.27 mg QE/g, and an IC_{50} of 37 μg/mL. Film formulation H1 (0.1% extract) demonstrated the most balanced physicochemical and mechanical performance: moisture 13.38±0.35%, tensile strength 3.46 ± 0.11 MPa, elongation at break 16.51% ± 0.10%, and solubility 59.27% ± 0.22%. Among all formulations, H6 (2.5% extract) demonstrated the greatest shelf-life extension in the storage study by reducing lipid oxidation, weight loss, and microbial growth. H1 was selected as the optimal film formulation for physical and mechanical performance, while H6 was independently selected for the storage study based on its superior antioxidant loading capacity.
Discussion: Incorporating natural plant antioxidants proved to be a safe and effective alternative to synthetic preservatives.

KEYWORDS
anthocyanin, edible coating, Heen bovitiya (*Osbeckia octandra L.*), mangosteen peel, meatballs, shelf life, whey protein