Review On Transformation of Ayurvedic Kadha into Gummies While Retaining Therapeutic Effect.

Jyoti Rajesh Bind [1], Rahul Singh[2], Madhura Malkar[3], Altaf Choudhary[4]
[1,2,3,4]*Department of Pharmacy, Chhatrapati Shivaji Maharaj University, Panvel 410206*

***Abstract*—The term "Ayurveda" combines the Sanskrit words Ayur (life) and Veda (science or knowledge). It is one of the traditional medicinal systems, with an established history of many centuries. Indian herbs, which are widely used in the preparation of Ayurvedic medicines in the form of Kadha to control various respiratory disorders such as, cough, cold and flu. In a traditional Kadha (decoction) preparation, the entire process is done manually such as boiling, filtering and mixing of medicinal herbs and the aim of this research work was to skip all such manually process. The present work involves the formulation and evaluation of nutraceutical gummies incorporated with traditional Ayurvedic Kadha ingredients for natural relief from cough, cold, throat irritation and mild respiratory discomfort. A decoction was prepared using Tulsi, Ginger, Turmeric, Black Pepper, Cinnamon, Clove, Cardamom, Mulethi, and Black Cardamom, which are well recognised in Ayurveda for their immunomodulatory, antimicrobial and expectorant properties. The concentrated Kadha extract was incorporated into a gelatin/ pectin gummy base along with honey or jaggery as sweetening agents, citric acid for taste balance and preservation, fruit juice for flavour enhancement and optional natural colours. The prepared gummies were evaluated for physical appearance, pH, texture, stickiness, weight variation, sensory acceptability and stability. The proposed formulation aims to provide a child-friendly, palatable and easy-to-consume alternative to conventional Kadha or syrups. Based on formulation design, scientific rationale and expected evaluation outcomes, the developed gummies demonstrate potential as an effective natural supplement for respiratory wellness. Further stability and clinical acceptability studies may be conducted for large-scale validation.**

***Index Terms*—Kadha, Nutraceutical Gummies, Respiratory Wellness, Ayurveda**

I. INTRODUCTION

The modernization of traditional Ayurvedic kadha an herbal decoction composed of ingredients such as Tulsi, Ginger, Turmeric, Black Pepper, Cinnamon, Clove, Cardamom, Liquorice, and Black Cardamom into convenient gummy formulations represents a significant advancement in herbal medicine delivery. This transformation aims to enhance patient compliance and palatability while preserving the therapeutic efficacy rooted in centuries-old practices. The process leverages food-grade excipients like pectin (as a gelling agent), stevia (as a natural sweetener), citric acid (for tartness and preservation), and potassium sorbate (as an antimicrobial preservative). Recent literature highlights the potential of pectin-based hydrogels for encapsulating bioactive compounds, ensuring controlled release and stability (Said et al., 2023; Cao et al., 2020; Yang et al., 2022; Thakur et al., 1997). However, challenges remain regarding the retention of phytochemical integrity during processing and storage. Advances in encapsulation technologies and novel drug delivery systems are increasingly being applied to herbal medicines to address issues of stability, bioavailability, and standardization (Zou et al., 2024; Prabhakar et al., 2023; Aslam et al., 2024; Jadhav et al., 2023; Najafi et al., 2025). This review synthesizes current research on the formulation science behind converting kadha into gummies with a focus on ingredient integrity, bioactivity retention, and consumer acceptability.

II. METHODS

A comprehensive literature search was conducted across over 170 million research papers in Consensus including Semantic Scholar, PubMed, and other databases targeting studies on Ayurvedic kadha ingredients (Tulsi, Ginger, Turmeric, Black Pepper,

Cinnamon, Clove, Cardamom, Liquorice), their pharmacological properties, gummy formulation science (pectin/stevia/citric acid/potassium sorbate), encapsulation techniques for phytochemicals, and evidence for therapeutic effect retention in novel dosage forms. A total of 50 papers were identified; after screening for relevance to kadha-to-gummy transformation with a focus on ingredient integrity and efficacy retention, 22 papers were included in this review.

III. RESULTS

3.1 Pharmacological Properties of Kadha Ingredients

The core ingredients used in traditional kadha Tulsi (Ocimum sanctum), Ginger (Zingiber officinale), Turmeric (Curcuma longa), Black Pepper (Piper nigrum), Cinnamon (Cinnamomum verum), Clove (Syzygium aromaticum), Cardamom (Elettaria cardamomum & Amomum subulatum), Liquorice (Glycyrrhiza glabra), Black Cardamom are well-documented for their immunomodulatory (Askar et al., 2025), antioxidant (Xiao, 2022), anti-inflammatory (Askar et al., 2025), antimicrobial (Askar et al., 2025), neuroprotective (Najafi et al., 2025), antidiabetic (Askar et al., 2025), and digestive benefits (Askar et al., 2025). These effects are attributed to a rich array of phytochemicals such as curcumin in turmeric (Najafi et al., 2025), piperine in black pepper (Najafi et al., 2025), eugenol in clove (Xiao, 2022), cinnamaldehyde in cinnamon (Askar et al., 2025), gingerols/shogaols in ginger (Xiao, 2022), glycyrrhizin in liquorice (Askar et al., 2025), cineole/terpinyl acetate in cardamom (Xiao, 2022).

3.2 Gummy Formulation Science: Pectin-Based Systems

Gummies formulated with pectin as the primary gelling agent offer a plant-based alternative to gelatin with favorable textural properties and stability profiles. Pectin hydrogels form three-dimensional networks that can encapsulate flavors and bioactives efficiently while providing rapid gelation and higher melting points compared to other biopolymers (Said et al., 2023; Cao et al., 2020; Yang et al., 2022; Thakur et al., 1997). The inclusion of stevia as a natural sweetener allows sugar reduction without compromising taste or texture; citric acid provides tartness and acts as a preservative alongside potassium sorbate for microbial stability. Studies show that pectin-based gummies can successfully encapsulate plant extracts while maintaining desirable organoleptic qualities and shelf-life stability comparable to conventional confectionery products (Said et al., 2023; Yang et al., 2022).

3.3 Retention of Bioactive Compounds During Processing

Processing conditions such as temperature control during decoction concentration or gummy molding are critical for preserving heat-sensitive phytochemicals like curcumin or essential oils from spices. Polyphenols a major class of active compounds present in many kadha ingredients are particularly sensitive to oxidation and thermal degradation during processing; however, encapsulation within pectin matrices or via micro/nanoencapsulation techniques can significantly improve their stability during storage and gastrointestinal digestion (Xiao, 2022; Siddiqui et al., 2022; Labuschagne, 2018; Yapar et al., 2025; Mudalip et al., 2021). Acidic environments provided by citric acid further stabilize polyphenols during processing.

3.4 Evidence from Polyherbal Gummies/Tablets

Recent studies on polyherbal gummies/tablets incorporating similar ingredients demonstrate successful retention of antioxidant activity (DPPH/FRAP assays), enzyme inhibition relevant to disease prevention (e.g., acetylcholinesterase inhibition for neuroprotection), microbiological safety within pharmacopeial limits, acceptable sensory profiles, and improved patient compliance compared to traditional decoctions or tablets (Jadhav et al., 2023; Najafi et al., 2025; Askar et al., 2025). Encapsulation methods such as spray drying or freeze drying have been shown to protect bioactive compounds from degradation while enabling controlled release upon consumption (Siddiqui et al., 2022; Mazár et al., 2025; Mudalip et al., 2021).

Results Timeline

- 1997
  - 1 paper: (Thakur et al., 1997)- 2018
  - 1 paper: (Labuschagne, 2018)- 2019
  - 1 paper: (Snyder, 2019)- 2020

- 2 papers: (Cao et al., 2020; Paul & Criado, 2020)- 2021
- 1 paper: (Mudalip et al., 2021)- 2022
- 4 papers: (Yang et al., 2022; Xiao, 2022; Siddiqui et al., 2022; Lim et al., 2022)- 2023
- 4 papers: (Said et al., 2023; Prabhakar et al., 2023; Jadhav et al., 2023; Dubey & Dixit, 2023)- 2024
- 2 papers: (Zou et al., 2024; Aslam et al., 2024)- 2025
- 4 papers: (Najafi et al., 2025; Askar et al., 2025; Yapar et al., 2025; Mazár et al., 2025)

Figure 3: Timeline showing evolution from traditional kadha to modern herbal gummies/tablets; larger markers indicate more citations.

Top Contributors

Type	Name	Papers
Author	Jianbo Xiao	(Najafi et al., 2025)
Author	B. R. Thakur	(Harbourne et al., 2013)
Author	Nurul Saadah Said	(Said et al., 2023)
Journal	Critical reviews in food science and nutrition	(Harbourne et al., 2013)
Journal	Gels	(Said et al., 2023)
Journal	eFood	(Najafi et al., 2025)

IV. DISCUSSION

The reviewed literature supports the feasibility of transforming ayurvedic kadha into convenient gummy formulations while retaining much of its therapeutic potential provided that formulation science is rigorously applied to preserve key phytochemicals during processing. The use of pectin as a gelling agent is particularly advantageous due to its compatibility with plant extracts and ability to form stable gels at relatively low temperatures minimizing degradation risks for sensitive actives like curcumin or essential oils from spices such as cardamom or clove (Said et al., 2023; Yang et al., 2022). Stevia enables sugar-free options suitable for diabetic populations without sacrificing palatability.

Studies highlight that synergistic effects among kadha ingredients may be preserved or even enhanced when delivered together within a single matrix due to improved compliance/adherence compared to multi-ingredient regimens or raw consumption (Askar et al., 2025). However, some loss of volatile compounds or partial degradation may occur depending on process parameters; thus, optimization is crucial.

While direct clinical trials comparing traditional kadha decoction versus gummy delivery are limited, evidence from analogous polyherbal gummies/tablets suggests comparable antioxidant activity and disease-modifying potential when standardized extracts are used at appropriate dosages (Jadhav et al., 2023; Najafi et al., 2025). Sensory evaluation consistently shows higher acceptability among children/adults for gummies than bitter decoctions potentially increasing real-world effectiveness through better adherence.

Claims & Evidence Table

Claim	Evidence Strength	Reasoning	Papers
Pectin-based gummies can encapsulate herbal actives while maintaining texture/stability	Evidence strength: Strong (8/10)	Multiple studies show successful incorporation/retention using pectin systems; widely adopted in functional foods	(Said et al., 2023; Cao et al., 2020; Yang et al., 2022)
Key phytochemicals from kadha ingredients retain significant activity post-processing	Evidence strength: Moderate (7/10)	Antioxidant/enzyme inhibition assays confirm preservation after conversion into solid dosage forms	(Xiao, 2022; Siddiqui et al., 2022)
Synergistic effects among kadha ingredients may be preserved/enhanced by unified delivery	Evidence strength: Moderate (6/10)	Literature suggests combined delivery improves compliance/effectiveness vs individual components	(Askar et al., 2025)
Sugar-free sweeteners like stevia maintain palatability without affecting bioactivity	Evidence strength: Moderate (6/10)	Stevia shown compatible with plant extracts; does not degrade actives under standard conditions	(Yang et al., 2022)
Some loss/degradation of volatile/heat-sensitive compounds possible during processing	Evidence strength:	Heat exposure can reduce certain essential oils/flavonoids unless optimized; encapsulation helps mitigate loss	(Siddiqui et al., 2022)

	Moderate (5/10)		
Direct clinical equivalence between kadha decoction vs gummy not yet fully established	Evidence strength: Weak (3/10)	Few head-to-head trials exist; most data extrapolated from analogous polyherbal products/formulations	(Jadhav et al., 2023)

Figure undefined: Key claims and support evidence identified in these papers.

V. CONCLUSION

Transforming ayurvedic kadha into modern gummy formulations using pectin/stevia/citric acid/potassium sorbate is scientifically feasible with substantial evidence supporting the preservation of key therapeutic properties if formulation parameters are optimized. This approach offers improved patient compliance through enhanced palatability/convenience while retaining much of the original health benefits associated with traditional kadha.

VI. RESEARCH GAPS

Despite promising results from analogous polyherbal products/gummies/tablets containing similar ingredients/processes, direct comparative studies between traditional decoctions versus gummy delivery are lacking especially regarding long-term clinical outcomes across diverse populations.

Research Gaps Matrix

Topic/Outcome	Antioxidant Activity	Clinical Efficacy Retention	Sensory Acceptability	Paediatric Use
Pectin-based Gummies	8	2	7	2
Traditional Kadha Decoction	10	5	2	GAP
Polyherbal Tablets	5	2	2	GAP

VII. OPEN RESEARCH QUESTIONS

Future research should focus on direct clinical comparisons between traditional kadha decoctions versus standardized gummy formulations across age groups/populations; optimization strategies for maximal phytochemical retention during processing/storage; long-term safety/compliance outcomes.

Question	Why
How does the clinical efficacy of ayurvedic kadha gummies compare directly to traditional decoctions?	Direct head-to-head trials will clarify whether convenience gains come at any cost to efficacy or safety.
What are optimal processing parameters for maximal phytochemical retention during gummy manufacturing?	Identifying best practices ensures highest possible preservation of active compounds post-processing.
How do pediatric/adult populations differ in response/compliance with kadha gummies versus other formats?	Understanding demographic differences will guide targeted product development for maximum public health impact.

Key Citations: (Said et al., 2023): Pectin Hydrogels: Gel-Forming Behaviors.(Cao et al., 2020): Egg-box model-based gelation.(Yang et al., 2022): Gelation behaviors of some special plant-sourced pectins.(Xiao, 2022): Recent advances on the stability of dietary polyphenols (Jadhav et al., 2023): Novel Drug Delivery Systems for Delivery of Herbal Medicine (Najafi et al., 2025): Advancement in nanocarrier-mediated delivery.(Siddiqui et al., 2022): Novel insights on extraction and encapsulation techniques.(Askar et al., 2025): A Review on Pharmacological Importance of Polyherbal Formulation (Labuschagne, 2018): Impact of wall material physicochemical characteristics.(Mazár et al., 2025): Advances in Spray-Drying.(Yapar et al., 2025): Critical Processes for Stability Enhancement.(Mudalip et al., 2021): A short review on encapsulation.(Thakur et al., 1997): Chemistry and uses of pectin--a review
These search results were found and analyzed using Consensus, an AI-powered search engine for research. Try it at https://consensus.app. © 2026 Consensus NLP, Inc. Personal, non-commercial use only; redistribution requires copyright holders' consent.

REFERENCES

[1] M. Askar, N. Thangjam, and A. Kumar, "A review on pharmacological importance of polyherbal formulation," Research Journal of Pharmacy and Technology, 2025, doi: 10.52711/0974-360X.2025.00275.

[2] A. Aslam et al., "Herbal pharmaceuticals and contemporary developments in innovative drug delivery systems," International Journal of Pharmacy & Integrated Health Sciences, vol. 6, no. 1, 2024, doi: 10.56536/ijpihs.v6i1.195.

[3] L. Cao, W. Lu, A. Mata, K. Nishinari, and Y. Fang, "Egg-box model-based gelation of alginate and pectin: A review," Carbohydrate Polymers, vol. 242, p. 116389, 2020, doi: 10.1016/j.carbpol.2020.116389.

[4] S. Dubey and A. Dixit, "Preclinical evidence of polyherbal formulations on wound healing: A systematic review on research trends and perspectives," Journal of Ayurveda and Integrative Medicine, vol. 14, 2023, doi: 10.1016/j.jaim.2023.100688.

[5] N. Harbourne, E. Marete, J. Jacquier, and D. O'Riordan, "Stability of phytochemicals as sources of anti-inflammatory nutraceuticals in beverages: A review," Food Research International, vol. 50, pp. 480–486, 2013, doi: 10.1016/j.foodres.2011.03.009.

[6] S. Jadhav, S. Kale, S. Rathod, and N. Kohale, "Novel drug delivery systems for delivery of herbal medicine," International Journal of Advanced Research in Science, Communication and Technology, 2023, doi: 10.48175/IJARSCT-8698.

[7] P. Labuschagne, "Impact of wall material physicochemical characteristics on the stability of encapsulated phytochemicals: A review," Food Research International, vol. 107, pp. 227–247, 2018, doi: 10.1016/j.foodres.2018.02.026.

[8] W. Lim, S. Kumar, and F. Ali, "Advancing knowledge through literature reviews: 'What', 'why', and 'how to contribute'," The Service Industries Journal, vol. 42, pp. 481–513, 2022, doi: 10.1080/02642069.2022.2047941.

[9] J. Mazár et al., "Advances in spray-drying and freeze-drying technologies for the microencapsulation of instant tea and herbal powders: The role of wall materials," Foods, vol. 14, 2025, doi: 10.3390/foods14030486.

[10] S. Mudalip, M. Khatiman, N. Hashim, R. Man, and Z. Arshad, "A short review on encapsulation of bioactive compounds using different drying techniques," Materials Today: Proceedings, vol. 42, pp. 288–296, 2021, doi: 10.1016/j.matpr.2021.01.543.

[11] F. Najafi et al., "Advancement in nanocarrier-mediated delivery of herbal bioactives: From bench to beside," Natural Products and Bioprospecting, vol. 15, 2025, doi: 10.1007/s13659-025-00550-7.

[12] J. Paul and A. Criado, "The art of writing literature review: What do we know and what do we need to know?," International Business Review, 2020, doi: 10.1016/j.ibusrev.2020.101717.

[13] P. Prabhakar et al., "Revolutionizing herbal medicine: Exploring nano drug delivery systems," Sumatera Medical Journal, 2023, doi: 10.32734/sumej.v6i3.12799.

[14] N. Said, I. Olawuyi, and W. Lee, "Pectin hydrogels: Gel-forming behaviors, mechanisms, and food applications," Gels, vol. 9, 2023, doi: 10.3390/gels9090732.

[15] S. Siddiqui, A. Redha, Y. Esmaeili, and M. Mehdizadeh, "Novel insights on extraction and encapsulation techniques of elderberry bioactive compounds," Critical Reviews in Food Science and Nutrition, vol. 63, pp. 5937–5952, 2022, doi: 10.1080/10408398.2022.2026290.

[16] H. Snyder, "Literature review as a research methodology: An overview and guidelines," Journal of Business Research, 2019, doi: 10.1016/j.jbusres.2019.07.039.

[17] B. Thakur, R. Singh, H. Handa, and M. Rao, "Chemistry and uses of pectin: A review," Critical Reviews in Food Science and Nutrition, vol. 37, no. 1, pp. 47–73, 1997, doi: 10.1080/10408399709527767.

[18] J. Xiao, "Recent advances on the stability of dietary polyphenols," eFood, 2022, doi: 10.1002/efd2.21.

[19] X. Yang, K. Yuan, F. Descallar, A. Li, X. Yang, and H. Yang, "Gelation behaviors of some special plant-sourced pectins: A review inspired by examples from traditional gel foods in China,"

Trends in Food Science & Technology, 2022, doi: 10.1016/j.tifs.2022.06.012.

[20] E. Yapar, M. Özdemir, and T. Sirirak, "Critical processes for stability enhancement of phyto-ingredients: A comprehensive review," Current Pharmaceutical Biotechnology, 2025, doi: 10.2174/0113892010377710250731193153.

[21] J. Zou et al., "Unleashing the potential: Integrating nano-delivery systems with traditional Chinese medicine," Nanoscale, 2024, doi: 10.1039/D3NR06102G.