

Quality assessment of branded fennel powder using pharmacognostic parameters with reference to standard *Foeniculum vulgare*

Verma Anju¹  , Arham Mo¹  , Rai Neha¹  , and Sonar P. Kumar^{2*}  

¹Department of Pharmaceutical Science and Technology, Madan Mohan Malaviya University of Technology, Gorakhpur, Uttar Pradesh, India

²Government Pharmacy College, B.R.D. Medical College Campus, Gorakhpur, Uttar Pradesh, India

* Author to whom correspondence should be addressed

Received: 22-01-2026, Accepted: 18-03-2026, Published online: 22-03-2026



Copyright© 2026. This open-access article is distributed under the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

HOW TO CITE THIS

Verma et al. Quality assessment of branded fennel powder using pharmacognostic parameters with reference to standard *Foeniculum vulgare*. *Mediterr J Pharm Pharm Sci.* 2026; 6(1): 93-99. [Article number: 246].
<https://doi.org/10.5281/zenodo.19101211>

Keywords: Apiaceae, pharmacognostic evaluation, physicochemical property, phytochemical screening

Abstract: Fennel (*Foeniculum vulgare* Mill.), belonging to the Apiaceae (syn. Umbelliferae) family, is a well-known medicinal, aromatic, and vegetable plant widely used as a traditional spice throughout the world, and based on scientific evaluation and traditional applications, it remains one of the most commonly used herbal plants, having been employed in the treatment of over forty different kinds of illnesses. A comparison of pure fennel (*Foeniculum vulgare*) fruits with branded fennel powder was carried out based on morphological, phytochemical, and physicochemical parameters. Phytochemical constituents of the fennel extracts were analyzed by chemical tests and thin-layer chromatography, which revealed the presence of flavonoids, terpenoids, and glycosides. Phytochemical studies have revealed beneficial ingredients, including phenolic compounds, flavonoids, volatile compounds, fatty acids, and amino acids. The physicochemical parameters were evaluated using ash value, moisture content, extractive value, swelling index, and foaming index, which resulted in minor differences between the branded and pure *Foeniculum vulgare*. It is concluded that adulterants are added to branded fennel, but within harmful limits. The branded fennel powder was found satisfactory.

Introduction

Herbal medicines are defined by the World Health Organization as finished, labeled medicinal products that contain aerial or underground plant parts, or other plant material, or combinations thereof, whether in the crude state or as plant preparations, as active ingredients [1-4]. Herbal medicine, sometimes referred to as phytotherapy or plant therapy, is the use of plants or plant extracts for the treatment, prevention, or management of medical problems and general health promotion [5]. It is also called botanical medicine or herbalism, and is the practice of treating medical diseases with plants or plant extracts. This practice has existed for thousands of years and is an important part of traditional medical systems such as Ayurveda and Traditional Chinese Medicine [2]. It treats or prevents diseases using plant parts such as leaves, flowers, roots, seeds, and bark. Herbal remedies are available in many forms, such as topical ointments, teas, tinctures, tablets, and powders. Many medical conditions are treated with them, including digestive issues, skin problems, stress reduction, and immunological support [6]. Different perspectives on herbal medicine depend on the context in which it is used. But all purposes of the term refer to the same thing: to treat illness. Plants, plant materials,

herbal preparations, and finished herbal products with plant parts, other plant materials, or plant combinations as an active ingredient are all considered herbal medicines. [7].

Fennel (*Foeniculum vulgare*) is an herbaceous plant that grows in diverse habitats, and the whole plant is used for therapeutic and industrial purposes. It belongs to the family Apiaceae, which has about 3.780 species available worldwide. Numerous studies demonstrate that plants in this family are used in industry. They are a potential source of drugs, including flavonoids, coumarins, terpenoids, triterpenoid saponins, polyacetylenes, and steroids due to their chemical significance, as phytochemicals and secondary metabolites. These active ingredients have a variety of functions in the food and beverage industries as well as in medicine, repellents, spices, beverages, cosmetics, and fragrances. This family of ethnobotanical plants, fennel, is small, resistant, perennial, and is found practically everywhere in the world [8]. It develops several short-lived, erect stems that emerge from a long-lived crown and grows in enormous clumps up to two meters tall. Its alternately precise leaves resemble ferns and are delicately divided into numerous thread-like fragments. It produces yellow blooms in large flat clusters at the apex of the stem. When handled or crushed, their leaf emits a strong aniseed-like odour [9]. The large, spherical bunches (7-15 cm across) of small yellow flowers (1-3 mm diameter) are found close to the branch tips. These flower clusters are made up of several smaller clusters (umbels) of 10-30 blooms each and are held on stalks (peduncles) up to 12 cm long. The individual blooms are carried on considerably shorter stalks (i.e., pedicels) that are 1-7 mm long, whereas each smaller cluster (5-15 mm across) has its own stalk up to 6 cm long. Five yellow petals are tightly wrapped around each blossom. They have two styles and a tiny ovary with five petals. [10]. The taxonomical classification of fennel is as follows: It belongs to the division: Magnoliophyta, class: Magnoliopsida, order: Apiales, family: Apiaceae, genus; *Foeniculum*, and species: *Foeniculum vulgare* [11]. According to research reports, *F. vulgare* has 42.3% carbohydrates, 9.5% protein, 10.0% fat, 13.4% minerals, 18.5% fibre, and 6.3% moisture. The vitamins and minerals found in these include calcium, sodium, potassium, phosphorus, iron, thiamine, riboflavin, niacin, and vitamin C [12]. The composition of fennel varies depending on its source. Fenchone constitutes 40-50%, while estragole and anethole together account for 50-60%. Anethole is an important component of anise oil. When present, the colourless compound fenchone, which has a strong camphor-like flavour, imparts an unpleasant bitter note to several industrial oils (**Figure 1**) [13]. Vernacular names of *Foeniculum vulgare* are represented in **Table 1** [11].

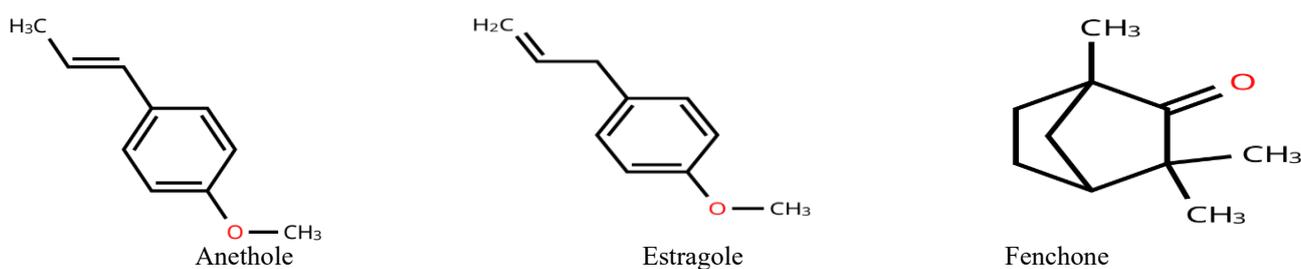


Figure 1: The molecular structure of major chemical constituents of *Foeniculum vulgare*

Table 1: Vernacular names of *Foeniculum vulgare* [11]

Regional language	Regional name
English	Fennel
Hindi	Saunf
Urdu	Saunf
Sanskrit	Misi, Madhurika
Bengali	Marui, Panmauri
Telugu	Sopu
Assamese	Guvamuri
Tamil	Shombu
Punjabi	Saunf
Marathi	Badishop

Materials and methods

Sample collection and preparation: Fennel fruits and branded fennel powder were purchased from the local market in Gorakhpur, Uttar Pradesh, India, in October 2025. The fruits were ground into powder using a mixer grinder and stored in an airtight container for laboratory analyses when needed (**Figure 2**).



Figure 2: Fennel fruit

Fennel fruit Microscopy: The fruit of *Foeniculum vulgare* in transverse section shows a single-layered cuticularized epicarp, a parenchymatous mesocarp containing five vascular bundles beneath the ridges and six schizogenous oil ducts (vittae-four dorsal and two commissural), a thin endocarp of elongated lignified cells, and a seed with a thin testa enclosing an endosperm rich in fixed oil globules and aleurone grains [14-16].

Powder Macroscopy: **Table 2** shows that the pure fennel powder is brownish-yellow in colour with a characteristic odour and sweet taste, whereas the branded fennel powder is greenish-yellow in colour with a characteristic odour and a strongly aromatic taste (**Figures 3 and 4**).

Table 2: Powder Macroscopy

Organoleptic characters	Pure fennel powder	Branded fennel powder
Colour	Brownish - yellow	Greenish - yellow
Odour	Characteristic	Characteristic
Taste	Sweet	Strongly aromatic

Figure 3: Standard fennel powder



Figure 4: Branded fennel powder



Total ash value: First, a silica crucible was heated for 30 min and then allowed to cool in a desiccator before weighing. About 4-5 g of the sample was weighed and placed evenly in the crucible. The sample was incinerated in a muffle furnace by gradually increasing the temperature from 500°C to 600°C until free of carbon. After heating, the crucible was cooled in a desiccator, weighed, and the percentage ash was calculated on a dry weight basis [17, 18].

Water-soluble ash value: 25 ml of water was added to the crucible containing the total ash and then boiled for 15 min. The insoluble material was collected on an ashless filter paper, washed with hot water, and then ignited

in a crucible for 15 min at a maximum temperature of 450°C. By deducting the weight of the insoluble residue from the total ash weight, the water-soluble ash was determined on a dried basis [17, 18].

Acid-insoluble ash value: 25 ml of hydrochloric acid (70.0 g/l) was added to the crucible containing the total ash, protected with a watch glass, and then boiled gently for 5 min. The watch glass was rinsed with 5.0 mL of hot water, and the liquid was added to the crucible. The insoluble matter was collected on ashless filter paper, washed with hot water until the filtrate was neutral. Filter paper containing the insoluble matter was transferred into the original crucible. Dried it on a hot plate and ignited to constant weight. The residue was allowed to cool and weighed. The content of acid-insoluble ash was calculated in milligrams per gram of air-dried material [18].

Moisture content: The moisture content was determined by heating a clean, dry Petri dish and allowing it to cool in a desiccator. The empty Petri dish was weighed accurately. 2-3 grams of the powdered drug sample were placed in the Petri dish and weighed again. The sample was then dried in a hot-air oven at 100-105°C until a constant weight was obtained. After drying, the Petri dish was cooled in a desiccator and weighed. The weight loss was recorded as the moisture content and determined as a percentage [18, 19].

Water-soluble extractive value: 5 g of powdered fennel were weighed and recorded. 100 ml of chloroform was added to the conical flask containing the powdered substance. After adding the stopper, the conical flask was shaken occasionally for 6 hrs. Then the flask was allowed to stand for 18 hrs. Once the maceration procedure was completed for a full day, the sample was filtered using filter paper. The weight of a dried China dish was noted. 25 ml of the filtrate was poured into a China dish. Placed the dish in a water bath and evaporated the contents till dry. Placed the dish in a 105° hot-air oven for 6 hrs., cooled in a desiccator for 30 min, and weighed to a constant weight. The percent of water-soluble extract was calculated with respect to the air-dried powder [18, 120].

Ethanol-soluble extractive value: 5 g of powdered fennel was weighed and recorded. 100 ml of ethanol was added to the conical flask containing the powdered substance. After adding the stopper, the conical flask was shaken occasionally for 6 hrs. The flask was allowed to stand for 18 hrs. Once the maceration procedure was completed for a full day, the sample was filtered using filter paper. The weight of a dried dish was recorded. 25 ml of the filtrate was poured into a China dish. Placed the dish in a water bath and evaporated till dry. Placed the China dish in a 105° hot-air oven for 6 hrs., cooled in a desiccator for 30 min, and weighed to a constant weight. The percent of alcohol-soluble extract was calculated with respect to the air-dried powder [18, 20].

Swelling index: Weighed 1.0 g of the powdered sample and transferred it to a 25 ml measuring cylinder. 20 ml of water was added to the cylinder. Every 10 min, the measuring cylinder was shaken well for one hr., then it was sealed with a stopper and left for 24 hrs. The swollen volume was calculated, and the change in the swelling factor was recorded as previously reported [18, 21].

Foaming index: 1.0 g of the powdered material was transferred into a 500 ml conical flask with 100 ml of water and boiled for 30 min. After cooling, filtering, and making up, the total volume was adjusted to 100 ml. A test tube was taken and marked from 1 to 10. Filtrate was transferred in increments of 1 ml, 2 ml, and so on up to 10 ml into 10 test tubes with stoppers. Added water to each test tube till the liquid volume reached 10 ml. Shake the test tubes longitudinally for 15 sec (two shakes per second) after closing them with a stopper. Then allowed to stand for 1.0 min, and the foam's height was recorded as previously mentioned [18, 22].

Thin-layer chromatographic analysis: The ethanolic extract of branded and pure (original) *Foeniculum vulgare* was subjected to thin-layer chromatography for separation of different components (fenchone, anethol, etc.). Ready-made aluminum silica gel plate GF 254 was used, and a detection iodine chamber and ammonia solution. The different solvent system for the identification of compounds was used: Toluene: ethyl acetate (9: 3), Toluene: ethyl acetate: formic acid (9: 3: 1.25), hexane: ethyl acetate (6: 4) [23].

Results

Physicochemical analysis: The physicochemical analysis of pure and branded *Foeniculum vulgare* powder showed that the branded sample had higher moisture (12.5% w/w), water-soluble ash (7.33%), and extractive values (water: 20.8%, alcohol: 10.8%) compared to the pure sample. The pure fennel powder showed a lower moisture (7.75% w/w) and a higher swelling index (0.5). Both samples showed similar ash values and a foaming index of < 100, indicating comparable purity and stability. The physicochemical properties of branded and pure *Foeniculum vulgare* are mentioned in **Table 3**.

Table 3: Physicochemical properties of branded and pure *Foeniculum vulgare*

Parameter	Pure fennel powder	Branded fennel powder
Moisture content	7.75% w/w	12.5%w/w
Ash value	7.33%	7.00%
Water-soluble ash value	4.33%	7.33%
Acid-insoluble ash value	15.0%	18.0%
Water-soluble extractive value	10.4%	20.8%
Alcohol soluble extractive value	8.8%	10.8%
Foaming index	< 100	< 100
Swelling index	0.5 ml	0.3 ml

Initial phytochemical screening: The content of phytochemicals and metabolites such as carbohydrates, proteins, flavonoids, tannins, steroids, reducing sugars, alkaloids, and glycosides was examined in the ethanolic extract of branded and pure *Foeniculum vulgare* [24]. The preliminary phytochemicals of *Foeniculum vulgare* branded and pure powder are shown in **Table 4**.

Table 4: Preliminary phytochemical screening of *Foeniculum vulgare* branded and pure powder

Chemical test	Pure fennel powder	Branded fennel powder
Carbohydrate	+ve	+ve
Protein	-ve	-ve
Steroid	-ve	+ve
Glycosides	-ve	-ve
Flavonoids	+ve	+ve
Tannins	+ve	+ve

Note: +ve indicates present and -ve indicates absent

Thin-layer chromatographic analysis: For pure fennel fruits and branded fennel powder, the TLC analysis yielded R_f values of 0.82 and 0.77, respectively.

Discussion

In this study, branded fennel powder containing pure *Foeniculum vulgare* (L.) fruits was evaluated for physicochemical and pharmacognostic parameters. This helps with the screening of the pure plant sample and the branded sample. A variety of adulterants are found in marketed drugs. Thus, this study describes different laboratory methods for their detection. The fruits of *Foeniculum vulgare* (L.) (pure and brand) were studied for pharmacognostic characteristics, namely powder macroscopy, and physicochemical parameters: moisture content, ash value, such as total ash, acid insoluble ash, water soluble ash, extractive value, such as water-soluble extractive value and alcohol soluble extractive value, foaming index, and swelling index were all determined. The phytochemical screening of the crude extracts of fruits of *Foeniculum vulgare* (L.) (pure and brand) was carried out to ascertain the presence of its constituents, such as alkaloids, carbohydrates, proteins, flavonoids, triterpenoids, steroids, tannins, and glycosides. However, most of the medicinally potent phytoconstituents were present in the ethanolic extract [25-27]. Thin-layer chromatography has been used

with different solvent systems to identify the exact chemical constituents present in the extracts [28]. The findings evaluated physicochemical differences between standard and branded fennel powder: moisture content, water-soluble ash value, acid-insoluble ash value, alcohol-soluble extractive value, and water-soluble extractive value. The higher water-soluble ash value and acid-insoluble ash value in the branded powder indicate the presence of more inorganic residues, such as salts, sand, or other impurities, compared to the pure powder. This may suggest that the branded product may contain added or contaminating inorganic materials. This means the branded drug contains higher alcohol-soluble active constituents than the pure one, indicating a better solubility and possibly a higher concentration of phytochemicals in the branded sample. The thin-layer chromatography analysis revealed that the R_f value of pure fennel fruits was 0.82, while the branded fennel powder showed an R_f value of 0.77. The slight variation in R_f values indicates similar phytoconstituents in both samples, with minor differences that may be due to processing, formulation, or the presence of additional components in the branded fennel powder.

Conclusion: The higher water-soluble ash and acid-insoluble ash in the branded powder indicate the presence of greater amounts of inorganic residues and impurities compared to the pure powder. This may suggest that the branded product is of lower purity and quality, possibly due to the addition of extraneous matter or inadequate processing. The pure powder appears to be more authentic and suitable for medicinal use than the branded product.

References

1. Valduga AT, Gonçalves IL, Magri E, Finzer JR. Chemistry, pharmacology, and new trends in traditional functional and medicinal beverages. *Food Research International*. 2019; 120: 478-503. doi: 10.1016/j.foodres.2019.01.030
2. Bhat R, Bhat SS, Nisarga P. A systematic review and meta-analysis of traditional Chinese medicine in Parkinsonism. *Mediterranean Journal of Medical Research*. 2025; 2(4): 169-178. doi:10.5281/zenodo.17344302
3. Rana P, Rani MR, Tripathi V, Kashyap A. Bridging traditional medicine and endocrinology: Assessing herbal and ayurvedic therapies for hypothyroidism. *Mediterranean Journal of Pharmacy and Pharmaceutical Sciences*. 2026; 6(1): 57-61. doi: 10.5281/zenodo.18800493
4. Rafi IK. Cough care with medicinal herbs: Safe and natural alternatives. *Mediterranean Journal of Medicine and Medical Sciences*. 2025; 1(2): 17-22. doi: 10.5281/zenodo.16763823
5. Wang H, Chen Y, Wang L, Liu Q, Yang S, Wang C. Advancing herbal medicine: Enhancing product quality and safety through robust quality control practices. *Frontiers in Pharmacology*. 2023; 14: 1265178. doi: 10.3389/fphar.2023.1265178
6. Miranda JJ. Medicinal plants and their traditional uses in different locations. In: *Phytomedicine*. Academic Press; 2021. ISBN: 9780128169094.
7. Ahmad S, Gupta A, Katiyar CK. Clinical research on herbal/ASU/traditional drugs in India. In: *Evidence-based validation of herbal medicine*. Elsevier; 2022. ISBN: 9780128241097.
8. Martin TG, Campbell S, Grounds S. Weeds of Australian rangelands. *Rangeland Journal*. 2006; 28(1): 3-26. doi: 10.1071/RJ06003
9. Tekiela S. *Wildflowers of Wisconsin Field Guide*. Adventure Publications; 2021. ISBN-13 : 978-1647551094
10. Wiart C. Fennel (*Foeniculum vulgare* Mill.). In: *Handbook of Medicinal Plants of the World for Aging*. CRC Press. 2023. doi: 10.1201/9781003301455-64. ISBN-13: 978-1032293974.
11. ISBN: 9781591933236.
12. *The Ayurvedic Pharmacopoeia of India*. Government of India, Ministry of Health and Family Welfare, Department of AYUSH. New Delhi, India. Part I, Vol. I, 2006: 128.
13. Rather MA, Dar BA, Sofi SN, Bhat BA, Qurishi MA. *Foeniculum vulgare*: A comprehensive review of its traditional use, phytochemistry, pharmacology, and safety. *Arabian Journal of Chemistry*. 2016; 9: S1574-S1583. doi: 10.1016/j.arabjc.2012.04.011
14. Kumar A, Kumar A, Saini R. Standardization of herbal drug *Foeniculum vulgare*. *International Journal of Educational and Applied Sciences Research*. 2022; 9(1): 39-48. doi: 10.5281/zenodo.7074322
15. Telci I, Demirtas I, Sahin A. Variation in plant properties and essential oil composition of sweet fennel. *Ind Crops Prod*. 2009; 30(3): 333337. doi: 10.1016/j.indcrop.2009.06.006
16. Badgajar SB, Patel VV, Bandivdekar AH. *Foeniculum vulgare* Mill: A review of its botany, phytochemistry,

- pharmacology, and toxicology. Biomed Research International. 2014; 2014: 842674. doi: 10.1155/2014/842674
17. Diaz-Maroto MC, Pérez-Coello MS, Cabezudo MD. Chemical composition of the essential oil of fennel (*Foeniculum vulgare* Mill.) fruits. Journal of Agricultural Food and Chemistry. 2006; 54(18): 6814-6818. doi: 10.1021/jf0613383
 18. Bukhari H, Shehzad A, Saeed K, Sadiq BM, Tanveer S, Iftikhar T. Compositional profiling of fennel seed. Pakistani Journal of Food Sciences. 2014; 24(3): 132-136. doi: 10.5539/jas.v1n1p66
 19. Mukherjee PK. Quality Control of Herbal Drugs: An approach to evaluation of botanicals. 1st Ed. Business Horizons; 2002; 380-421. ISBN: 9788180612039.
 20. Ahmadi H, Mollazade K, Khorshidi J, Mohtasebi SS, Rajabipour A. Some physical and mechanical properties of fennel seed (*Foeniculum vulgare*). Journal of Agricultural Science. 2009; 1(1): 66-75. doi: 10.5539/jas.v1n1p66
 21. Chamundeeswari D, Kanimozhi P, Kumar V, Reddy C. Formulation and evaluation of Churna for digestive property. Sri Ramachandra Journal of Medicine. 2007; 39. Corpus ID: 12643944.
 22. Trease GE, Evans WC. Pharmacognosy. 11th Ed. Macmillan Publishers; 1989: 257. ISBN: 9780702029332.
 23. Kokate CK, Purohit AP, Gokhale SB. Analytical Pharmacognosy. 30th Ed. Pune: Nirali Prakashan; 2005: 99. ISBN: 9788185790121.
 24. Purkayastha S, Narain R, Dahiya P. Evaluation of antimicrobial and phytochemical screening of fennel, juniper, and kalonji essential oils against multidrug-resistant clinical isolates. Asian Pacific Journal of Tropical Biomedicine. 2012; 2(3): S1625-S1629. doi: 10.1016/S2221-1691(12)60465-1
 25. Jamwal NS, Kumar S, Rana AC. Phytochemical and pharmacological review on *Foeniculum vulgare*. Pharma Science Monitor. 2013; 4(3): 327-341. Corpus ID: 73556050.
 26. Narendra RD, Hina DM, Thkre Rutuja T, Vinod MT, Gajbhiye AR, Kamble PD. Medicinal potential of fennel seed: A review. International Journal of Zoological Investigations. 2023; 9(2): 1001-1019. doi: 10.33745/ijzi.2023.v09i02.112
 27. Nkollo MI, Ngwuede RN, Efejene IO, Olele H, Iwelumo BC, Chibugwu C, Aisuodionoe EM. Phytochemistry and pharmacological insights into *Kalanchoe pinnata*: A brief review. Mediterranean Journal of Medical Research. 2025; 2(2): 26-31. doi: 10.5281/zenodo.15368110
 28. Han KSS, Win KT. Chemical compositions, nutritional values, total phenolic content, and antioxidant activity from *Eleocharis dulcis*. Mediterranean Journal of Medicine and Medical Sciences. 2026; 2(1): 28-35. doi: 10.5281/zenodo.18636582
 29. Elmarimi NA, Haman MR, Abuhadra MN, Sherif FM. Pharmacognostical and biological evaluation of cultivated *Syzygium cumini* (L.) skeels (Jambolan) in Libya. EC Pharmacology and Toxicology. 2019; 7(7): 721-734. doi: Nil

Author's contribution: VA & KPS conceived and designed the study. AM & RN collected data. VA, AM & RN contributed to data analysis, and all authors contributed to data analysis and interpretation. VA & KPS drafted the manuscript. All authors approved the final version of the manuscript and agreed to be accountable for its contents.

Conflict of interest: The authors declare the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical issues: The authors have considered ethical issues, including plagiarism, informed consent, data fabrication or falsification, and double publication or submission.

Data availability statement: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.

Generative AI disclosure: No Generative AI was used in the preparation of this manuscript.