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Anti-Inflammatory Potential of Musali Species: A Pharmacognostic, Phytochemical and Experimental Review

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Abstract: *Musali is a traditional herbal drug group that includes botanically distinct species such as Curculigo orchioides, Chlorophytum borivilianum, Asparagus adscendens, Chlorophytum tuberosum, Chlorophytum arundinaceum and Chlorophytum orchidastrum. The common name creates a practical problem for herbal medicine, because species with different morphology and phytochemistry may not show equivalent anti-inflammatory activity. This review summarizes the pharmacognostic identity, major phytochemical classes, reported anti-inflammatory relevance, experimental models and Quality by Design considerations for comparative Musali evaluation. Literature from the supplied thesis reference set indicates that C. orchioides and C. borivilianum have stronger evidence for anti-inflammatory or related pharmacological activity, while other Musali-like species require additional validation. Mechanistically, phenolic glycosides, saponins, flavonoids, sterols and polysaccharides may contribute to antioxidant action, modulation of inflammatory mediators, reduced vascular permeability and tissue protection. The review concludes that botanical authentication, marker-based standardization, controlled experimental design and endpoint-based comparison are essential before Musali species are used interchangeably in anti-inflammatory formulations.*

Keywords: Musali; anti-inflammatory; Curculigo orchioides; Chlorophytum borivilianum; phytochemistry; Shotha; herbal standardization; QbD

I. INTRODUCTION

Inflammation is a complex protective reaction involving vascular changes, immune-cell movement, mediator release and tissue repair. When excessive, recurrent or poorly regulated, the same process contributes to tissue injury and chronic pathological states [1]. Herbal drugs used for swelling, pain and inflammatory disorders are therefore frequently investigated in experimental models.

The Musali drug group is important in Ayurveda and ethnomedicine because it is associated with strength, nourishment, rejuvenation and tissue support. However, Musali is not one single botanical entity. Multiple plants may be used under Kali Musli, Safed Musli or related trade names, including Curculigo orchioides, Chlorophytum borivilianum, Asparagus adscendens and other Chlorophytum species. This creates a need for species-wise review and standardization [10,11,16,22,23].

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This review was prepared from the attached dissertation chapters and reference list to synthesize the anti-inflammatory relevance of selected Musali species, with emphasis on botanical identity, phytochemical plausibility, preclinical evidence, experimental model selection and quality control.

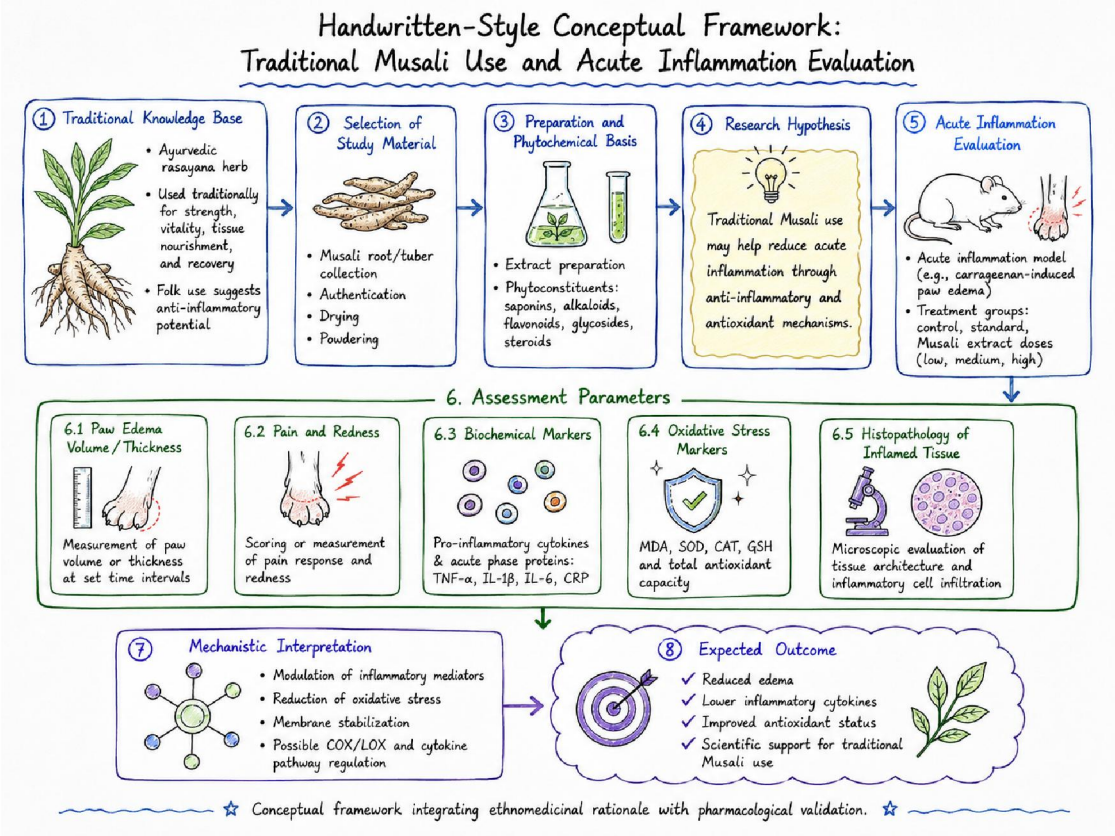

Figure 1. Conceptual framework linking traditional Musali use with acute inflammation evaluation.

II. REVIEW METHODOLOGY

The review is based on the provided thesis chapters covering introduction, literature review, drug profile, Quality by Design, materials and methods, results and references. The included literature focuses on inflammation biology, Ayurvedic Shotha, carrageenan-induced paw edema methodology, pharmacognosy of Musali species, phytochemistry and species-wise anti-inflammatory evidence. The synthesis is narrative and integrative rather than meta-analytic because quantitative effect sizes, extraction methods and endpoints differ across cited sources.

III. BOTANICAL DIVERSITY OF MUSALI

A major theme emerging from the supplied material is that Musali is a pharmacognostic group rather than a single uniform plant. Species identity is therefore the first quality requirement. Without authentication, the observed clinical or experimental response may reflect substitution rather than true inefficacy of the intended drug.

Table 1. Botanical diversity and pharmacognostic interpretation of selected Musali species

Species	Traditional/common relevance	Botanical implication	Review interpretation
Curculigo orchioides	Kali Musli / Black Musli	Hypoxidaceae; root/tuber; phenolic glycoside-rich profile	Best-supported candidate for acute anti-inflammatory evaluation.

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Chlorophytum borivilianum	Safed Musli	Asparagaceae; fleshy roots; saponin-rich drug	Moderate evidence for anti-inflammatory, anti-arthritic and supportive effects.
Asparagus adscendens	Shweta/Safed Musli-like plant	Asparagaceae; tuberous roots; adaptogenic and nutritive value	May support inflammation through immunomodulatory and tonic effects; acute anti-edematous evidence remains weaker.
Chlorophytum tuberosum	Safed Musli variant	Asparagaceae; substitute/variant	Requires more marker-based and comparative validation.
Chlorophytum arundinaceum	Safed Musli variant	Asparagaceae; less-studied species	Possible cytokine or immunomodulatory relevance, but limited direct evidence.
Chlorophytum orchidastrum	Fire Flash / ornamental comparator	Asparagaceae; less-established medicinal use	Weakest support as anti-inflammatory substitute; authentication concern.

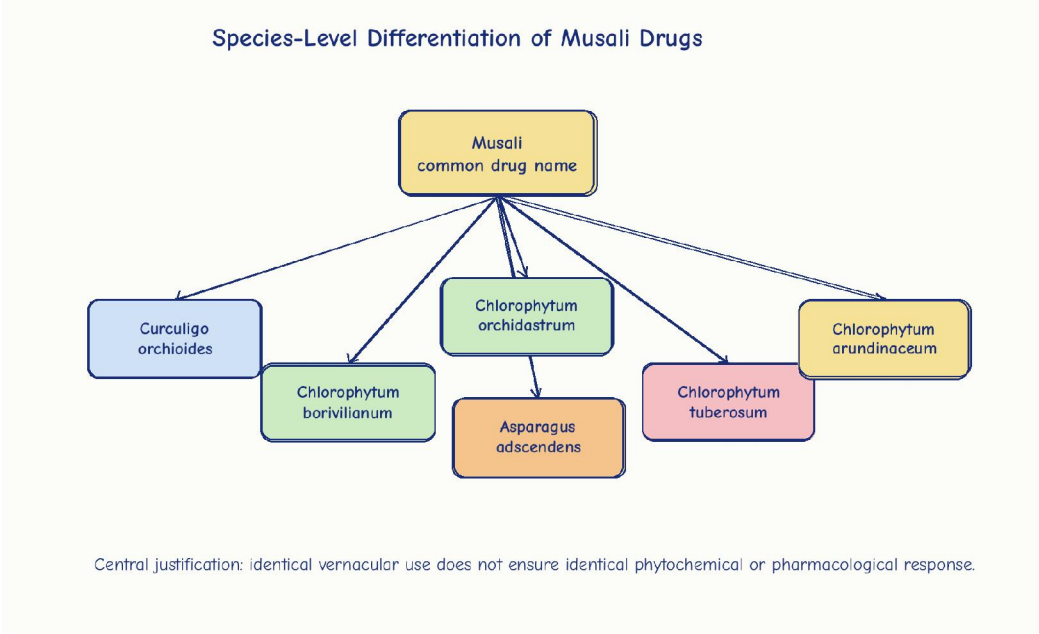

Figure 2. Species-level differentiation of Musali drugs.

IV. AYURVEDIC AND PHARMACOLOGICAL CONTEXT OF SHOTHA

In Ayurveda, inflammatory swelling is commonly discussed under Shotha or Shopha. Vata may be associated with pain and functional disturbance, Pitta with heat and redness, and Kapha with heaviness and chronic swelling. Modern interpretation can map these features to edema, mediator release, vascular permeability, oxidative stress and tissue infiltration.

The value of integrating Ayurvedic and experimental frameworks is that traditional indications can be evaluated through measurable endpoints without rejecting their clinical meaning. In the case of Musali, the question is not whether all species are useful as tonics, but whether they are equally relevant for acute inflammatory swelling.

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V. PHYTOCHEMICAL BASIS OF ANTI-INFLAMMATORY ACTIVITY

Musali species contain diverse phytochemical groups. C. orchioides is associated with curculigoside and phenolic glycosides, while C. borivilianum is commonly linked with steroidal saponins. Other species contain variable combinations of saponins, flavonoids, polysaccharides, sterols and related secondary metabolites. These compounds may influence inflammatory pathways through antioxidant effects, membrane stabilization, reduction of mediator release and modulation of immune signaling [2,4,8,9,16,20,22,23].

Table 2. Phytochemical classes and expected anti-inflammatory relevance

Phytochemical class	Representative relevance	Probable anti-inflammatory contribution
Phenolic glycosides	Curculigoside-like constituents in C. orchioides	Antioxidant action, reduced oxidative tissue injury, possible mediator modulation.
Saponins	Important in C. borivilianum and several Musali-like roots	Membrane stabilization, immunomodulatory effects and possible reduction of edema.
Flavonoids	Variable distribution across selected species	Free radical scavenging and possible inhibition of inflammatory enzymes.
Sterols and steroidal constituents	Reported in saponin-rich roots	Supportive modulation of inflammatory responses.
Polysaccharides and nutritive components	Common in fleshy/tuberous roots	Tonic and immunological support rather than immediate strong anti-edematous action.

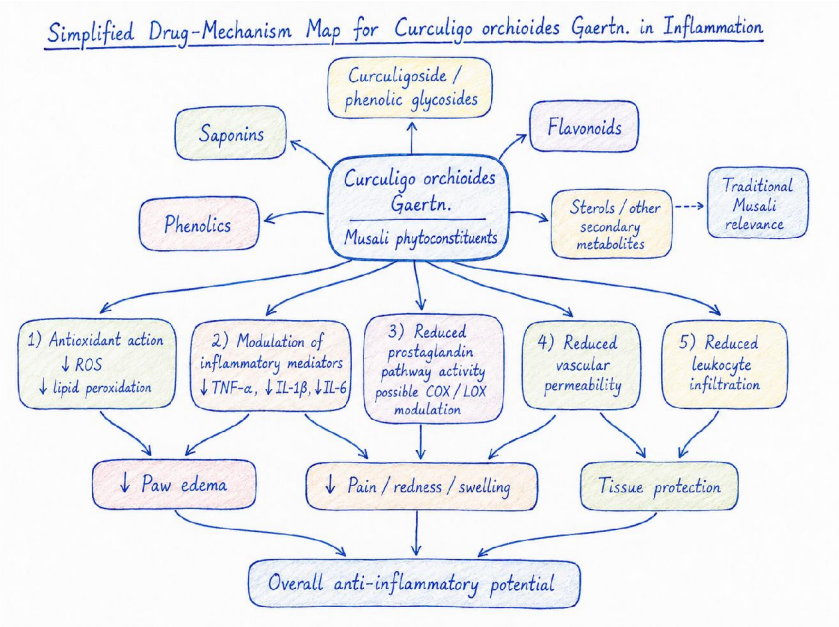

Figure 3. Simplified drug-mechanism map for Curculigo orchioides in inflammation.

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VI. EVIDENCE FROM INDIVIDUAL MUSALI SPECIES

6.1 Curculigo orchioides

Curculigo orchioides has the strongest evidence base among the reviewed Musali species. Experimental reports describe anti-inflammatory and analgesic actions of root/tuber or rhizome fractions, including activity in carrageenan-induced paw edema and chronic inflammatory models [8,9]. Reviews also highlight its broad pharmacological profile and phytochemical richness [16,22,30]. The presence of phenolic glycosides and saponins provides a plausible basis for antioxidant and mediator-modulating effects.

6.2 Chlorophytum borivilianum

Chlorophytum borivilianum is widely used as Safed Musli and has attracted considerable attention due to saponin-rich roots. Literature cited in the dissertation reports anti-inflammatory, anti-arthritic and analgesic activities of ethanol fractions or saponin constituents [2,4,6,7,23]. However, the evidence suggests a supportive or moderate anti-inflammatory role rather than consistent superiority over C. orchioides in an acute edema model.

6.3 Asparagus adscendens and other Musali-like species

Asparagus adscendens and related Musali-like species may contribute nutritive, adaptogenic or immunomodulatory effects. Their anti-inflammatory role may be indirect, especially through stress-cytokine modulation or antioxidant support [18,19,24]. Chlorophytum tuberosum and C. arundinaceum require stronger direct anti-inflammatory and marker-standardized studies [25,26,33]. Chlorophytum orchidastrum is less established and should not be assumed to be therapeutically interchangeable with medicinal Musali species [27,31].

Table 3. Thematic summary of literature evidence used in the review

Reference focus	Key evidence type	Review use
Inflammation biology and disease relevance [1,3]	General immunological background	Supports need for anti-inflammatory screening.
Carrageenan paw edema model [15]	Classical animal model methodology	Justifies acute edema endpoint.
C. borivilianum saponins [2,4,6,7]	Anti-inflammatory/anti-arthritic preclinical evidence	Supports Safed Musli as a comparator species.
C. orchioides fractions and tubers [8,9,16,20,22]	Anti-inflammatory, analgesic and supportive mechanistic evidence	Supports Kali Musli as lead candidate.
Asparagus/Chlorophytum variants [18,24-27,33]	Adaptogenic, immunomodulatory or limited direct evidence	Supports cautious interpretation of variants.

VII. EXPERIMENTAL MODELS AND ENDPOINT INTERPRETATION

The carrageenan-induced paw edema model remains a useful first-line model for acute anti-inflammatory screening. It allows time-course observation of early and late inflammatory phases. However, interpretation should consider vehicle, dose timing, animal variability, paw measurement precision and endpoint-specific limitations. A reduction in paw volume supports anti-edematous activity, but mechanistic confirmation requires cytokine, enzyme, oxidative stress and histological endpoints.

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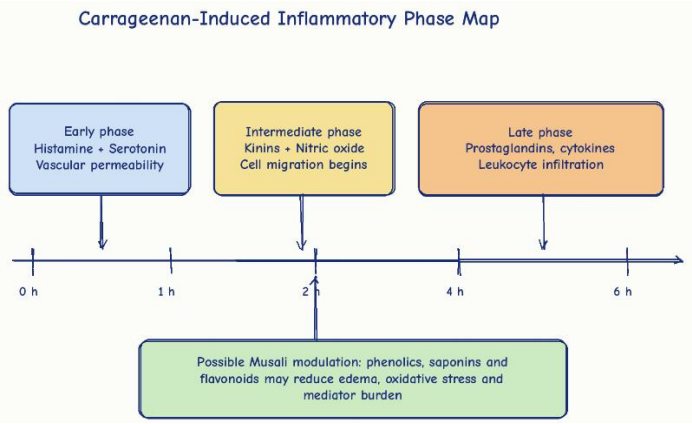

Figure 4. Carrageenan-induced inflammatory phase map.

VIII. QUALITY BY DESIGN IN HERBAL ANTI-INFLAMMATORY STUDIES

QbD is especially relevant in herbal pharmacology because the quality of the output depends on the quality of the starting material and the consistency of each procedure. Critical material attributes include species identity, root maturity, moisture, ash, extractive value and marker content. Critical process parameters include drying, grinding, sieving, storage, dose preparation, gavage, carrageenan injection, paw volume measurement, histology and statistics.

Table 4. QbD elements for reliable Musali anti-inflammatory evaluation

QbD component	Application to Musali studies	Control measure
QTPP	Comparable anti-inflammatory profile of Musali species	Predefined endpoints and ranking criteria.
CQA	Paw volume reliability, histology, safety observations	Calibration, measurement logs and blinded recording.
CMA	Botanical identity, phytochemical profile, moisture/ash	Authentication, voucher specimen and basic phytochemistry.
CPP	Drying, powdering, dosing, carrageenan injection, timing	SOPs, training and documented deviations.
Risk control	Misidentification, dose error, animal variability	Randomization, coded samples and repeated measurements.

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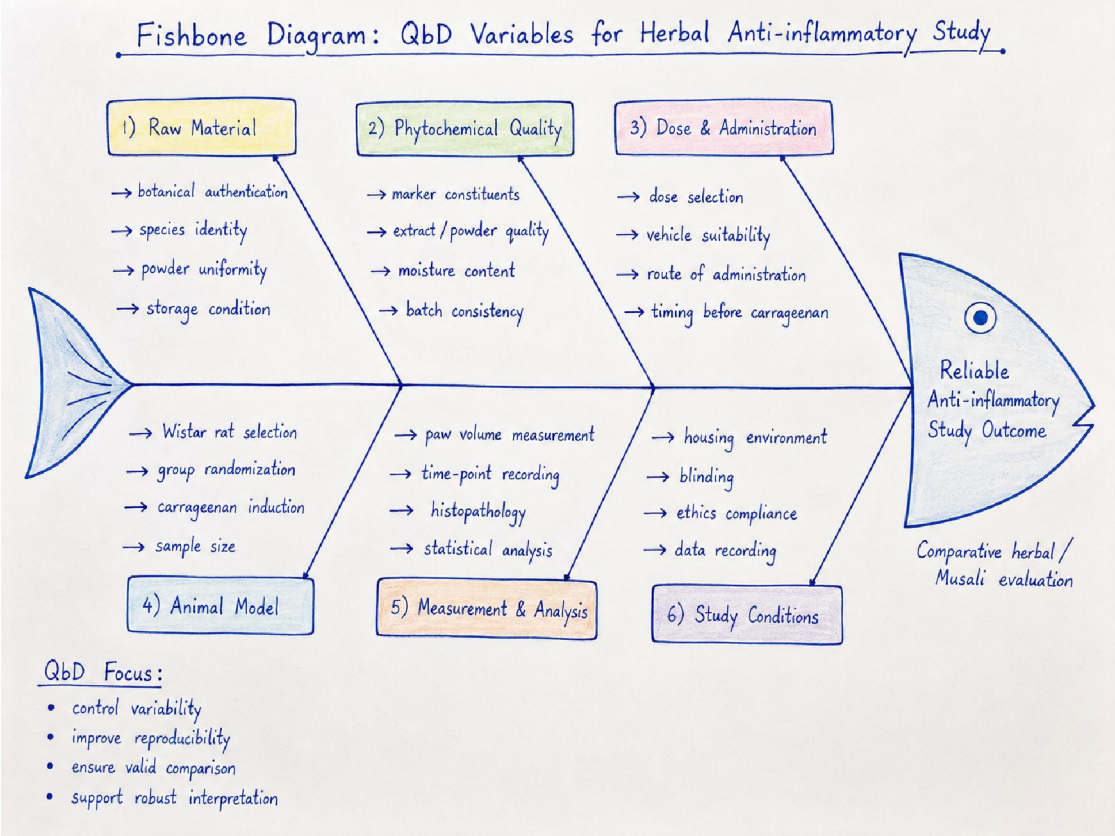

Figure 5. Fishbone diagram of QbD variables for herbal anti-inflammatory study.

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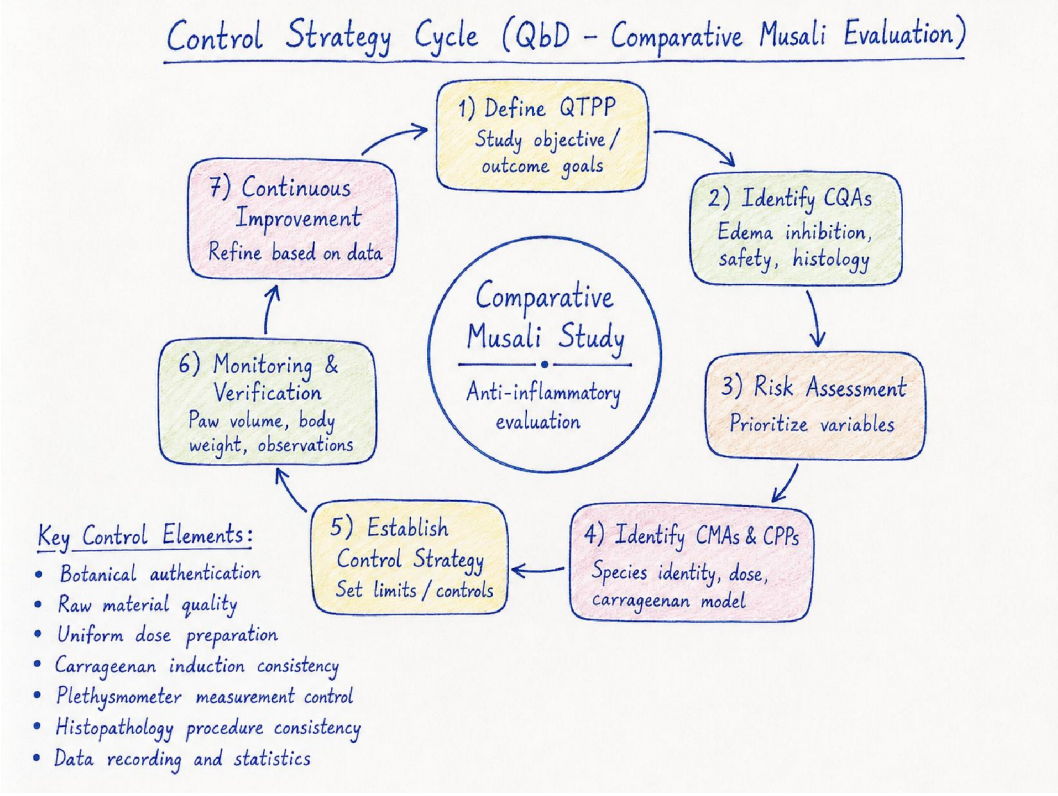

Figure 6. Handwritten-style QbD control strategy cycle for comparative Musali evaluation.

IX. COMPARATIVE INTERPRETATION AND RESEARCH GAPS

Across the supplied thesis material, the comparative interpretation is that C. orchioides is the strongest anti-inflammatory Musali candidate in the acute paw edema model, followed by C. borivilianum. Other species show weaker, variable or insufficiently validated activity. This hierarchy supports the position that botanical substitutes must be validated before use in inflammation-focused formulations.

Several gaps remain. Many studies use different extracts, doses, models or endpoints, making direct comparison difficult. Standardized marker quantification is often limited. Chronic inflammation models, cytokine panels, COX/LOX assays, oxidative stress markers, pharmacokinetic observations and dose-response studies are needed to confirm whether acute paw edema findings translate into broader therapeutic relevance.

Another gap is the limited integration of traditional classification with modern outcome-based ranking. Future studies should define the intended use clearly: a species may be valuable as a Rasayana or tonic but less relevant for rapid acute edema suppression. This distinction prevents inappropriate generalization across the Musali group.

Table 5. Evidence strength and future research gaps for selected Musali species

Species	Evidence strength for anti-inflammatory use	Major gap
C. orchioides	Relatively strong preclinical support	Requires marker-based extract standardization and mechanistic assays.
C. borivilianum	Moderate support from saponin-related studies	Needs direct comparison with C. orchioides under identical conditions.
A. adscendens	Supportive/adaptogenic relevance	Needs more acute inflammation and cytokine-based studies.

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C. tuberosum	Limited evidence	Needs authentication, extract standardization and dose-response data.
C. arundinaceum	Limited/moderate immunomodulatory indications	Needs direct anti-edematous validation.
C. orchidastrum	Weakest anti-inflammatory support	Should not be substituted without evidence.

X. CONCLUSION

The review concludes that the Musali group should be understood as botanically and pharmacologically diverse. Curculigo orchioides appears to be the most promising candidate for anti-inflammatory evaluation, while Chlorophytum borivilianum has moderate supportive evidence. Asparagus adscendens, C. tuberosum, C. arundinaceum and C. orchidastrum require stronger validation before they are used interchangeably in inflammation-focused formulations. Future research should integrate pharmacognostic authentication, phytochemical marker standardization, QbD-based experimental control and mechanistic assays to develop scientifically reliable Musali-based anti-inflammatory preparations.

XI. DECLARATIONS

Conflict of interest: The authors should declare any financial or non-financial conflicts.
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Author contribution: [Insert contribution statement according to journal guideline].

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