



SAMSKĀRA AS A PRINCIPLE OF GUṆĀNTARĀDHĀNA IN AYURVEDA:
A CLASSICAL CONCEPTUAL REVIEW WITH CONTEMPORARY
PHARMACEUTICAL PERSPECTIVES

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Abstract

Background: Ayurveda recognizes that the pharmaceutical and therapeutic behaviour of a medicinal substance may be modified by deliberate processing. This principle is expressed through *Samskara* and the classical statement “*Samskāro hi gunantaradhanam*,” which places processing in a causal relationship with qualitative transformation. The principle has particular importance in *Rasashastra* and *Bhaishajya Kalpana*, where purification, levigation, trituration, heating, calcination and repeated processing are integral to pharmaceutical preparation.

Objective: To critically examine the classical concept of *Samskara* and *Gunantaradhana* and to develop a contemporary pharmaceutical framework for understanding process-induced changes in the quality, safety and functional behaviour of Ayurvedic medicines.

Materials and Methods: A narrative conceptual review was undertaken. Classical Ayurvedic literature was considered for definitions and pharmaceutical applications of *Samskara*. Contemporary peer-reviewed literature concerning *Bhavana*, *Shodhana*, mineral processing and analytical characterization was reviewed to identify experimentally demonstrable changes associated with pharmaceutical processing.

Results: Classical literature presents *Samskara* as a purposeful intervention capable of producing qualitative change. Contemporary evidence demonstrates that selected processes can alter particle size, surface characteristics, extractive values, chemical composition, toxic constituents and solid-state properties. These findings provide plausible experimental correlates for aspects of *Guṇāntarādhāna*, although a direct one-to-one mapping between an Ayurvedic *Guna* and a modern analytical variable cannot be assumed.

Conclusion: *Gunantaradhana* may be productively interpreted as a process–property–function paradigm. Future research should establish reproducible relationships between critical process parameters, critical quality attributes, chemical or structural transformation, biological activity and safety.

Keywords: *Ayurveda*; *Samskara*; *Gunantaradhana*; *Rasashastra*; *Bhaishajya Kalpana*; *Bhavana*; *Śodhana*; pharmaceutical processing; standardization; critical quality attributes.

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1. Introduction

Ayurvedic pharmaceuticals is based on the principle that the medicinal potential of a substance depends not only on its inherent nature but also on the manner in which it is collected, stored, purified, processed, combined and administered. The branches of *Rasashastra* and *Bhaishajya Kalpana* therefore describe a wide range of pharmaceutical operations designed to obtain a stable, acceptable, safe and therapeutically useful product. In this context, *Samskara* is more than a mechanical preparation step; it represents a purposeful intervention capable of modifying the attributes of a *Dravya*. [1–4]

The classical proposition “*Saṃskāro hi gunantaradhanam*” is particularly important because it links a process to a change in quality. The statement suggests that processing may create, enhance, diminish or otherwise modify properties. Such a concept is highly relevant to modern pharmaceutical science, where the final quality of a drug product is understood as an outcome of both raw-material attributes and manufacturing processes.

In contemporary pharmaceutical development, processing variables can influence particle-size distribution, surface area, morphology, polymorphism, dissolution, extractability, chemical stability and biological availability. Similar process sensitivity can be observed in Ayurvedic preparations. For example, *Bhavana* can alter the physical and surface characteristics of powders, *Shodhana* can reduce selected undesirable constituents, and thermal processing can alter the phase and composition of mineral materials. [5–10]

Despite these parallels, it would be scientifically inappropriate to equate a classical *Guna* directly with one modern laboratory parameter. Ayurvedic *Guna* is a multidimensional concept embedded in a specific theoretical framework. The appropriate objective of modern research is therefore not forced equivalence, but operationalization: identifying measurable process-related changes that may represent one aspect of the classical qualitative transformation. The present review examines *Samskara* as a pharmaceutical principle and proposes a process–property–activity framework for studying *Gunantaradhana*. Particular attention is given to *Bhavana*, *Shodhana*, *Mardana* and *Agni Samskara*, followed by discussion of standardization, critical quality attributes and future experimental approaches.

2. Classical Conceptual Foundation

The word *Samskara* is used in Ayurveda in more than one context, and its meaning is determined by the subject under discussion. In pharmaceutical practice it denotes a process or intervention through which a *Dravya* is prepared or modified for a particular purpose. Caraka places *Samskara* among the *Parāḍi Guna* and also explains its causal significance in relation to modification of properties.[1]

The statement “*Saṃskāro hi gunantaradhanam*” may therefore be understood as a concise formulation of a broader pharmaceutical principle: a suitable process can alter the functional attributes of a substance. The term *Gunantaradhana* should not be interpreted narrowly as the complete creation of a new substance. It can encompass acquisition of a new quality, enhancement of an existing quality, attenuation of an undesirable quality, or transformation of the way in which a substance behaves.

Classical pharmaceutical procedures support this interpretation. The selection of a particular processing medium, the duration and repetition of processing, the intensity of heating, the method of trituration and the prescribed endpoint are generally purposeful. The final product is consequently a product of both the starting material and the process.

From a contemporary perspective, this resembles the concept of a process-dependent quality profile. Two preparations made from nominally identical raw materials may differ if the processing medium, temperature, duration, mechanical energy or number of cycles differs. This observation is central to reproducibility in Ayurvedic pharmaceuticals.

3. *Guṇāntarādhāna*: Scope and Interpretation

Gunantaradhana can be organized into four broad functional categories: enhancement of desirable attributes, attenuation of undesirable attributes, acquisition of attributes from the processing environment, and structural or compositional transformation.

Enhancement refers to a process in which a desirable pharmaceutical or therapeutic characteristic is increased. Repeated *Bhavana* may, for example, alter fineness and surface characteristics. Attenuation refers to reduction of an unwanted property or constituent, as illustrated by selected *Shodhana* procedures for toxic drugs. Acquisition refers to interaction with a processing medium that may contribute soluble constituents or modify surface chemistry. Structural transformation includes changes produced by intensive mechanical or thermal processing.



These categories are conceptual and should not be mistaken for independent classical taxonomies. They are useful because they provide experimentally testable hypotheses while retaining the broader Ayurvedic meaning of qualitative transformation.

A critical methodological principle is that the final product should be compared with the starting material and, where possible, with appropriate process controls. Only such comparative designs can establish whether a particular *Samskara* caused a measurable change.

4. Determinants of *Samskara*-Induced Transformation

4.1 Starting material

The identity, authenticity, purity, particle size and initial chemical composition of the *Dravya* influence its response to processing. Raw-material variability can therefore confound interpretation of the final product.

4.2 Processing medium

In *Bhavana* and related procedures, the medium may function as a vehicle for soluble constituents, a wetting agent, a reactive environment or a source of additional material. Its concentration and volume should be documented.

4.3 Mechanical energy

Mardana changes particle size, contact area and mixing. Mechanical intensity, duration and equipment can influence reproducibility.

4.4 Thermal energy

Agni Samskara can produce dehydration, oxidation-reduction, phase transformation or decomposition. Temperature-time profiles are therefore critical process variables.

4.5 Time and repetition

Repeated processing may generate cumulative effects. The number of cycles should be treated as a measurable process parameter rather than merely a descriptive detail.

4.6 Apparatus and environment

The type of Yantra, batch size, humidity, airflow, drying conditions and storage environment can influence the final product.

5. *Bhavana* as a Practical Model of *Guṇāntarādhāna*

Bhavana is a wet trituration or levigation process in which a powdered material is repeatedly processed with a specified liquid medium. It is one of the most frequently discussed pharmaceutical *Samskaras* because it simultaneously introduces mechanical energy and prolonged contact with another substance. The process can be represented as wetting, mechanical size reduction, intimate mixing, possible extraction or deposition of soluble material, and drying. Each stage may contribute to the final pharmaceutical profile. The number of *Bhavana* cycles and the nature of the *Bhavana Dravya* may therefore be considered critical process variables.

Mitra et al. studied *Gandhaka Rasayana* prepared with different media and methods and found differences in physicochemical parameters. They specifically evaluated the effect of increasing *Bhavana* on particle size and used X-ray photoelectron spectroscopy to examine surface characteristics. The study reported notable differences between preparations with and without *Bhavana*. [5]

These findings support the general proposition that processing can produce measurable changes in a pharmaceutical material. Importantly, the study does not prove that every classical *Guna* corresponds to a single measured parameter. Rather, it demonstrates that a classical process can be studied as a scientifically observable intervention.

A further implication is that the processing medium may influence the final product beyond simple wetting. Soluble components may be transferred, surface characteristics may change and the degree of particle aggregation may be modified. These hypotheses should be evaluated using chromatographic, spectroscopic and microscopic methods rather than assumed.

Repeated *Bhavana* should consequently be investigated using dose-response-like process designs, such as comparison of zero, one, three, five and multiple cycles, with appropriate controls. This would permit identification of whether a measurable attribute changes progressively or reaches a plateau.

6. *Shodhana* as a Model of Reduction and Modification

Shodhana is traditionally applied to selected substances to improve their suitability for therapeutic use. Depending on the material, the procedure may include heating, boiling, immersion, trituration, quenching, washing or repeated treatment with a specified medium. In modern terms, the process may

include extraction, hydrolysis, denaturation, dissolution, phase transfer or other chemical and physical changes.

Abrus precatorius is a useful example because the raw seeds contain the highly toxic protein abrin. Barve and Ojha compared untreated and processed seed extracts and reported differences in chromatographic profile and acute toxicity, with the processed material showing a substantially safer profile while retaining hair-growth activity.[6]

Dhoble and Majumdar investigated a water-based processing procedure and used multiple experimental approaches, including protein analysis, hemagglutination, cytotoxicity and animal models. Their results supported reduction of toxic activity following processing while retaining anti-inflammatory potential.[7]

Earlier work by Singh and colleagues also reported depletion of hypaphorine and abrin-associated material following *Shodhana* of *Abrus* seeds.[8] A later review summarized evidence across several poisonous medicinal plants and proposed that *Shodhana* may reduce toxic principles or alter them into less harmful forms, although the mechanisms vary by substance.[9]

These findings demonstrate the scientific value of the classical process, but they also emphasize the need for material-specific validation. It would be inappropriate to generalize the detoxification demonstrated for one drug to all *Shodhana* procedures. Each drug-process combination requires independent analytical and toxicological confirmation.

7. *Mardana*, Particle Size and Surface Transformation

Mardana involves mechanical trituration and contributes to particle-size reduction, mixing and homogenization. In pharmaceutical science, particle size and surface area influence wetting, dissolution, suspension behaviour, extraction efficiency and contact with biological fluids.

The importance of particle transformation is evident in experimental work on *Bhavana* and mineral preparations. In *Gandhaka Rasayana*, increasing processing intensity was associated with differences in particle characteristics.[5] Such changes may influence the apparent pharmaceutical behaviour of the product even when the gross chemical identity remains recognizable.

Particle size should therefore be measured quantitatively using validated methods such as laser diffraction or microscopy. Morphological

characterization can complement size distribution and help distinguish primary particles from agglomerates. Future studies should also evaluate whether mechanical processing changes dissolution, dispersibility or extractability. These endpoints provide a functional bridge between the physical transformation and potential biological consequences.

8. *Agni Samskara*, *Māraṇa* and Solid-State Transformation

Thermal processing is a major component of *Rasashastra*. *Paka*, *Svedana*, *Putā* and *Marāṇa* employ heat under different conditions and are expected to influence the physical and chemical state of the starting material.

Experimental studies of mineral preparations demonstrate that the changes can be substantial.

Mohaptra and *Jha* examined *Swarna Makshika Bhasma* and reported differences between raw and processed material using X-ray diffraction and scanning electron microscopy. The processed material showed altered phase composition and substantially smaller, more uniformly arranged particles.[10]

Similarly, Hiremath and colleagues prepared *Rasaka Bhasma* through *Shodhana* and *Marāṇa* and evaluated its physicochemical characteristics as part of a standardization approach.[11] Such studies support the view that thermal and mechanical processing can create a new physicochemical profile rather than merely reducing the size of the original material.

Contemporary analytical characterization of mineral preparations may include X-ray diffraction for phase identification, scanning electron microscopy for morphology, energy-dispersive spectroscopy for elemental distribution, inductively coupled plasma techniques for elemental quantification and X-ray photoelectron spectroscopy for surface chemical states.

The analytical interpretation should remain cautious. Detection of a particular phase or particle-size range does not itself establish therapeutic efficacy or safety. These findings must be integrated with validated pharmaceutical, toxicological and pharmacological data.

9. Classical and Contemporary Quality Assessment

Ayurvedic pharmaceuticals includes organoleptic and classical quality tests, while contemporary quality systems use measurable critical quality attributes. These approaches can be complementary when each is interpreted within its proper domain.

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Classical/process concept	Possible contemporary correlate	Suggested evaluation
<i>Samskara</i>	Process-dependent transformation	Define and validate critical process parameters
<i>Bhavana</i>	Wet milling and contact with processing medium	Particle size, microscopy, chromatography, surface analysis
<i>Shodhana</i>	Purification or detoxification	Targeted chemical analysis and toxicology
<i>Mardana</i>	Mechanical size reduction	Particle-size distribution and morphology
<i>Agni Samskara</i>	Thermal transformation	Temperature profile, XRD, DSC/TGA, spectroscopy
<i>Marana</i>	Integrated mechanical and thermal transformation	Phase, morphology, elemental speciation
Classical <i>Bhasma Pariksha</i>	Traditional endpoint assessment	Correlate selected tests with validated physical/chemical attributes

10. Process–Property–Activity Framework

A useful contemporary interpretation of *Gunantaradhana* is a process–property–activity framework. The framework begins with defined process parameters, proceeds through measurable physical or chemical transformation, results in changes in critical quality attributes, and finally examines whether those changes influence biological activity or safety.

The sequence may be expressed as: Process parameters → transformation → critical quality attributes → biological exposure → pharmacological response and safety.

Process parameters include the identity and quantity of the starting material, processing medium, temperature, duration, number of cycles, mechanical energy, atmosphere and drying conditions. Transformation may involve particle-size reduction, extraction,

deposition, chemical reaction, phase change or denaturation. Critical quality attributes include identity, purity, particle size, morphology, marker content, phase composition, dissolution, stability and toxicological profile.

This framework has two advantages. First, it avoids reducing an Ayurvedic concept to a single modern variable. Second, it allows researchers to design experiments that can falsify or support specific mechanistic hypotheses.

11. Standardization of Samskara

Standardization of the final product alone is insufficient when the manufacturing process itself is a determinant of quality. Ayurvedic pharmaceutical studies should therefore report critical process parameters in addition to end-product measurements. For *Bhavana*, minimum reporting should include identity and authentication of the starting material, initial particle size, medium, quantity, concentration, duration, number of cycles, equipment, mechanical conditions, temperature and drying method. For thermal procedures, the temperature–time profile, heating rate, maximum temperature, atmosphere and cooling conditions should be recorded.

Batch size and operator-dependent variables should also be considered. Where possible, automated recording of temperature, humidity and processing time can reduce variability.

Process validation should compare multiple independent batches. Reproducibility should be demonstrated for both process parameters and critical quality attributes. This approach would strengthen the evidence base for claims concerning *Gunantaradhana*.

12. Safety, Efficacy and the Problem of Overinterpretation

An important distinction must be maintained between evidence of transformation and evidence of therapeutic benefit. A change in particle size, elemental state or chromatographic fingerprint does not automatically establish increased efficacy.

Likewise, the absence of a detected toxic constituent in one analytical method does not prove complete detoxification. Toxicological conclusions require validated methods appropriate to the toxicant and route of exposure.

This distinction is particularly important for metallic and mineral preparations. Contemporary analytical research has demonstrated significant changes in several *Bhasma* preparations, but safety and efficacy

must be established for each preparation, dose and manufacturing method rather than generalized from one formulation to another. [10–13]

Accordingly, a responsible research pathway should proceed from classical rationale to pharmaceutical characterization, chemical characterization, biological testing, toxicological evaluation and, where appropriate, clinical investigation.

13. Research Gaps

- Operational definitions of *Gunantaradhana* remain insufficiently standardized for experimental research.
- Many studies do not report critical process parameters in enough detail to permit replication.
- Comparative designs separating the effect of the processing medium from the effect of mechanical energy are limited.
- Longitudinal studies examining the cumulative effect of repeated processing are uncommon.
- Analytical changes are not always linked to biological activity or safety outcomes.
- Batch-to-batch reproducibility and process validation require greater emphasis.
- Classical endpoint tests need systematic correlation with modern critical quality attributes.
- More studies should use validated analytical methods and transparent reporting standards.

14. Future Experimental Strategy

A rigorous study of *Gunantaradhana* should begin with a clearly authenticated raw material and a fully documented classical process. The study should include an untreated control, a process control where appropriate, and one or more treatment intensities.

Physical characterization may include particle-size distribution, morphology, surface area and moisture. Chemical characterization may include HPTLC, HPLC, LC-MS or GC-MS according to the material. Mineral preparations may require XRD, SEM-EDX, ICP-MS or XPS. Thermal behaviour can be studied using DSC and TGA.

Biological testing should be selected only after the pharmaceutical transformation has been characterized. Where a toxicity claim is made, targeted toxicological assays should be included. Where an efficacy claim is made, a validated pharmacological model should be used.

An ideal experimental dataset would therefore allow the researcher to answer four questions: what was processed; how was it processed; what changed; and did the change matter biologically?

15. Discussion

The concept of *Samskara* provides a distinctive contribution to Ayurvedic pharmaceutics because it emphasizes that a medicinal material is not simply an ingredient but the outcome of a defined transformation pathway. The classical statement linking *Samskara* with *Gunantaradhana* can therefore be viewed as an early conceptual statement of process-dependent pharmaceutical quality.

Contemporary evidence supports several components of this interpretation. *Bhavana* has been shown to influence particle and surface characteristics.[5] *Shodhana* of *Abrus* seeds has been experimentally associated with reduction of toxic activity while retaining selected biological effects. [6–9] Thermal and mechanical processing of mineral materials has produced measurable changes in phase composition and morphology. [10,11]

These findings do not prove the entire classical theory by modern standards, but they demonstrate that the underlying pharmaceutical proposition is testable. This distinction is important. Scientific validation should identify which aspects of the classical concept are supported by measurable evidence and which remain theoretical or require further investigation.

The strongest research opportunity lies in integrating classical process knowledge with contemporary quality-by-design principles. Instead of treating *Samskara* as a historical description, researchers can define process parameters, measure critical quality attributes and investigate the relationship between transformation and biological function.

Such an approach may also improve reproducibility in Ayurvedic manufacturing. When a formulation depends on repeated levigation, specific heating conditions or purification with a defined medium, these steps should be treated as critical manufacturing variables rather than incidental procedural details.

Ultimately, *Gunantaradhana* should be approached as a hypothesis-generating concept that can guide pharmaceutical research. Its scientific value will increase when classical descriptions are translated into transparent, reproducible and experimentally verifiable process–property relationships.

16. Limitations

This is a narrative conceptual review rather than a systematic review or original experimental investigation. The available literature is heterogeneous with respect to materials, processing methods, analytical techniques and outcome measures.

Classical concepts such as *Guna* and *Gunantaradhana* are multidimensional and cannot be reduced to one modern laboratory variable. The contemporary correlations proposed in this article should therefore be treated as functional research frameworks rather than definitive equivalences.

Some classical references are drawn from traditional texts whose editions and pagination may vary. Researchers preparing a final citation list should verify the exact edition used by the author before submission.

17. Conclusion

Bhavana, Shodhana, Mardana, Agni Samskara and Marana represent distinct pharmaceutical processes through which the transformative potential of Samskara can be understood and investigated. Contemporary investigations have demonstrated measurable changes in particle characteristics, surface chemistry, toxic constituents and mineral phase composition following selected processes. [5–11]

A scientifically rigorous approach should therefore integrate classical process descriptions with critical process parameters, critical quality attributes, analytical characterization, biological evaluation and safety assessment. Such a process–property–activity framework can provide a systematic approach to studying Gunantaradhana while preserving the conceptual integrity of Ayurvedic pharmaceuticals.

At its core, the concept emphasizes that the therapeutic and pharmaceutical character of a medicinal substance is not determined solely by its inherent nature, but can also be shaped by the processes it undergoes. This enduring principle is succinctly expressed in the classical statement, “**Samskāro hi gunantaradhanam,**” highlighting the transformative role of appropriate processing in shaping the qualities and pharmaceutical identity of a medicinal substance.

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The author declares no conflict of interest.

Ethical Approval

Not applicable. This manuscript is a conceptual/literary review and does not involve human participants, animals or identifiable patient data.

Author Contributions

Dr. Praveen Mylapur: conceptualization, literature review, manuscript drafting and finalization. Dr. Pradeep Agnihotri: academic guidance, critical review and supervision.

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