International Journal of Engineering Research for Sustainable Development
Peer Reviewed International, Open Access Journal.
ISSN : 3067-2325 / Website: https://ijersd.com / Volume 2 /Issue 2 / April 2026

Original Article

Applications of Cowdung with Special reference to Medicinal Value in Indian Perspectives A Review: Traditional Knowledge, Scientific Evidence and Future Prospects

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Manuscript ID:
IJERSD-2026-020201

ISSN: 3067-2325

Volume 2

Issue 2

Pp. 1-6

April 2026

Submitted: 10 Mar. 2026

Revised: 18 Mar. 2026

Accepted: 10 Apr 2026

Published: 30Apr 2026

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Quick Response Code:

Web. https://rlgjaar.com

DOI: 10.5281/zenodo.19606090

DOI Link:
https://doi.org/10.5281/zenodo.19606090

Abstract

Cow dung has been used for centuries in India for ritual, agricultural and medicinal purposes. Recent scientific studies (2018-2025) examine its microbial communities, bioactive compounds, antimicrobial and wound-healing potential, and environmental impacts including antibiotic resistance genes. This review synthesizes traditional knowledge (Panchagavya and folk medicine), published experimental studies on antimicrobial, wound-healing, antioxidant and immunomodulatory activities, characterization of microbial consortia and metabolites, and safety concerns including pathogen carriage and antimicrobial resistance (AMR). We highlight mechanisms proposed for therapeutic effects, summarize agronomic and environmental co-benefits, identify major knowledge gaps, and propose evidence-based directions for rigorous translational research and safe use. Key recent contributions are discussed and the review concludes with recommendations for multidisciplinary studies to responsibly explore cowdung's medicinal potential.

Keywords: *Cowdung, Panchagavya, Medicinal applications, Antimicrobial, Microbiota, Traditional medicine, Wound healing, Safety, Antimicrobial resistance*

Introduction

Cow dung (also spelled "cow dung" or "cow-manure") has been part of Indian daily life and ritual for millennia; its uses traditionally include fuel, plaster, organic fertilizer, and components of Ayurvedic preparations such as Panchagavya (a mixture of milk, curd, ghee, urine, and dung) which is attributed with therapeutic benefits in classical and folk systems [1]. Scientific interest in cowdung has expanded beyond agronomy into microbiology, natural product chemistry, and biomedical research because (a) cowdung harbors diverse microbial communities including Bacillus and other genera that produce antimicrobial peptides and enzymes, and (b) extracts and processed products repeatedly show in-vitro antimicrobial, antioxidant, and other bioactivities in published studies [2], [3]. Recent reviews emphasize the multidimensional roles of cowdung in sustainable agriculture, rural livelihoods, and potential pharmaceutical and probiotic resources, underscoring both opportunity and the need for careful evaluation [2], [4]. Experimental papers and in-silico studies published through 2024 continue to report antibacterial and related activities for cow-derived preparations, renewing calls for standardized characterization, safety testing, and clinical validation [5].

This review focuses on the medicinal and health-related applications of cowdung from an Indian perspective: documenting traditional uses, summarizing laboratory and preclinical evidence, examining the microbiota and active constituents, assessing biosafety and AMR issues, and recommending pathways to translate promising leads into validated therapeutics or supportive health applications and provides standardized tables and SOPs to support future translational research.

Methodology of the Review

This narrative review synthesizes peer-reviewed articles, reviews, and preprints (2010-2024) found through targeted searches (PubMed, Google Scholar, institutional repositories, and preprint servers) for keywords: "cowdung", "cow dung", "Panchagavya", "cow dung antimicrobial", "cow dung microbiota", and "cow dung medicinal". Priority was given to Indian studies and recent (post-2018) literature. Where primary experimental data existed (antimicrobial assays, microbiome analyses, biochemical characterization), findings were extracted and compared across studies to present recurring trends and discrepancies.

How to cite this article:

Tiwari, M., Rajput, R. S., Sharma, B., Singh, A., & Singh, S. K. (2026). Applications of Cowdung with Special reference to Medicinal Value in Indian Perspectives A Review: Traditional Knowledge, Scientific Evidence and Future Prospects. International Journal of Engineering Research for Sustainable Development, 2(2), 1–6. https://doi.org/10.5281/zenodo.19606090

Where claims were predominantly traditional or anecdotal, they were noted and contrasted with available scientific evidence.

Physicochemical and Microbiological Composition

Cowdung is a heterogeneous matrix containing undigested plant residues, minerals, volatile compounds, and a diverse microbial community. Metagenomic studies report dominance of Firmicutes, Bacteroidetes and Proteobacteria in many samples; Bacillus spp., lactic acid bacteria and actinomycetes are frequently isolated. Chemical analyses reveal phenolics, fatty acids and VOCs that may contribute to biological activities.

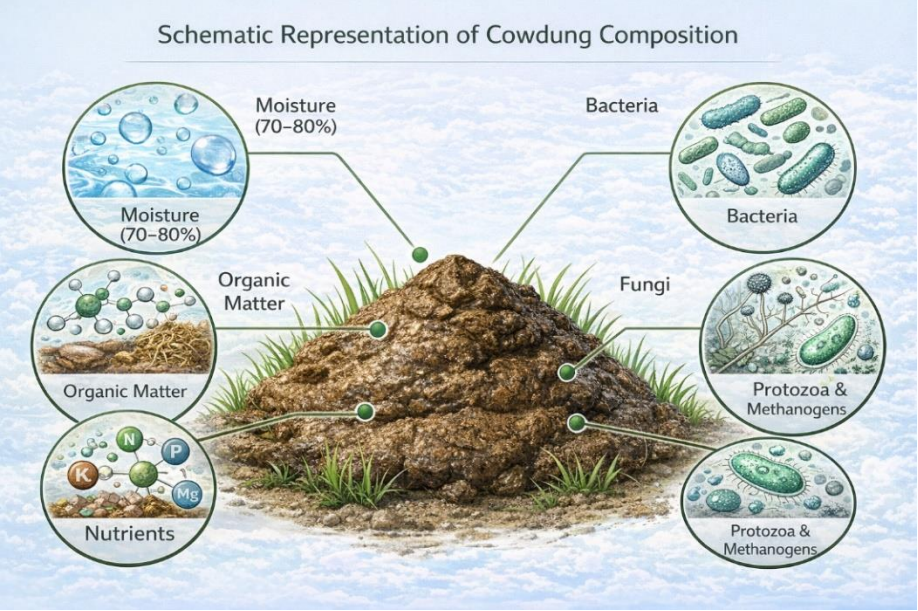

Figure 1. Schematic representation of cowdung composition (physicochemical components and microbial groups).

Table 1: Summary of Selected Recent Studies (Antimicribial & Wound Healing)

Study (Author, Year)	Sample / Extract	Test organisms / Models	Assay / Model	Key findings
Prasad et al., 2021 [PMC]	Cow products review	N/A	Review	Summarized microbial diversity and reported activities of cow products.
Banerjee et al., 2023	Cowdung (culture-based)	Soil & bacterial isolates	Culture & enzyme assays	Identified Bacillus and actinomycetes with enzyme and antagonistic activity.
Borjihan et al., 2023	Cow dung biochar hydrogel	MRSA-infected wounds	Animal wound model	Biochar-based hydrogel accelerated healing of MRSA-infected wounds.
Innovare / IJCPR study, 20xx	Methanol/Ethanol extracts	E. coli, K. pneumoniae, S. aureus	Disk diffusion, MIC	Solvent extracts inhibited common pathogens (variable potency).
Wilson et al., 2024 (bioRxiv)	Gir cow dung metagenome	Microbiome analysis	Shotgun metagenomics	Rich diversity; Bacillus spp. prominent; BGCs for bioactive compounds noted.
Pant et al., 2024	Cow-derived products (in-silico + in-vitro)	Bacterial targets	Molecular docking + in-vitro assays	Predicted interactions and validated antibacterial effects for select compounds.
Shrivas et al., 2025	Cattle manure survey	ARGs in manure	qPCR / metagenomics	Identified widespread ARGs across Indian states; highlighted AMR dissemination risk.

Traditional Uses and Cultural Context

- **Panchagavya and Folk Therapeutics**
  In Ayurveda and rural practice, *Panchagavya* has been recommended for a range of disorders-from digestive and metabolic conditions to general revitalization-with cowdung being one of the components used externally (e.g., poultices) and in ritualistic contexts believed to purify environments [1], [6]. Modern reviews compiling ethnomedicinal reports note uses such as topical application for skin conditions and admixture in decoctions for generalized tonic effects; however, robust clinical evidence is scarce.
- **Folk Topical Applications and Household Uses**
  Cowdung patties have traditionally been used to plaster floors and walls in rural India for their reported insect-repellent and antimicrobial properties. Cultural reverence for cows and the historical scarcity of synthetic disinfectants contributed to these practices; contemporary studies probe whether such effects are attributable to microbial metabolites or simple physical attributes after drying [3].

Microbial Consortia and Bioactive Constituents

- **Microbiota of Cowdung**
  Cowdung is a complex matrix rich in organic matter supporting diverse bacteria, fungi, and actinomycetes. Several surveys identify Bacillus species (notably *Bacillus subtilis* and *B. pumilus*), lactic acid bacteria, and other environmental taxa that can produce enzymes, antimicrobial compounds, and volatile organic compounds (VOCs) beneficial for soil and potentially for health applications [2], [7]. Recent metagenomic and culture-based studies reveal that indigenous Indian cowdung contains strains with biotechnological potential, but also occasional opportunistic pathogens-prompting caution.
- **Chemical Constituents and Metabolites**
  Chemical analyses of cowdung extracts (methanol, ethanol, aqueous) show presence of phenolics, fatty acids, and small organic molecules that plausibly underlie observed antioxidant and antimicrobial activities. Specific compounds vary with diet, cow breed, and processing; standardized phytochemical profiling is limited but growing.

Pharmacological Activities-Summary of Evidence

This section compiles experimental findings from in-vitro, in-silico, and limited in-vivo studies relevant to medicinal applications.

- **Antimicrobial Activity**
  Multiple laboratory studies report antimicrobial activity of cowdung extracts against Gram-positive and Gram-negative bacteria (e.g., *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*) and some fungi, with solvent extracts (methanol, ethanol) generally superior to aqueous extracts [5], [8]. Disk diffusion and MIC assays show variable potency; activity is attributed to both microbial metabolites (bacteriocins, lipopeptides) and plant-derived compounds concentrated in dung. An in-silico + in-vitro study on cow urine distillate, related to cow products research, reported antibacterial potentials and predicted molecular interactions with bacterial targets [5].
- **Implication:** Cowdung is a source of antimicrobial compounds and probiotic/biocontrol microbes; however, most data are preliminary, heterogeneous, and lack standardized controls or modern pharmacological benchmarks.
- **Wound Healing and Topical Uses**
  Traditional use of cowdung poultices for minor wounds is reported in ethnographies. Some in-vitro and small animal model studies suggest that certain cowdung-derived microbial isolates or extracts may accelerate wound closure via antibacterial and immunomodulatory effects, but high-quality preclinical data are sparse and inconsistent across studies.
- **Antioxidant and Anti-inflammatory Effects**
  Phytochemical screenings show antioxidant activity in radical-scavenging assays for several cowdung extracts, which could contribute to purported anti-inflammatory benefits. Again, concentrations and clinical relevance remain unclear.
- **Immunomodulation and Metabolic Claims**
  Traditional claims include improved general immunity and metabolic regulation when using *Panchagavya*. Scientific testing of such systemic effects is limited; small laboratory studies and animal experiments offer suggestive signals but no robust clinical corroboration.

Non-Therapeutic Health Related Applications

- **Household Hygiene and Quality**
  Dried cowdung used as fuel emits smoke containing VOCs; paradoxically, some traditional claims hold that smoke fumigation reduces household pathogens and pests. Scientific evaluations are mixed, and smoke inhalation has known respiratory risks; thus, any hygienic benefits must be balanced against air quality harms.
- **Crafts, Surfaces, and Antimicrobial Surfaces**
  Recent socio-economic reports highlight artisanal uses (e.g., cowdung crafts) where its dry matrix may show some resistance to microbial colonization, possibly via residual metabolites-useful for low-cost, eco-friendly products but requiring microbial safety checks.

Safety, Pathogens, and Antimicrobial Resistance (AMR)

- **Pathogens Carriage and Zoonoses**
  Cowdung can carry zoonotic organisms (e.g., *Salmonella*, pathogenic *E. coli*, *Cryptosporidium* oocysts) particularly if cows are infected or if slurry is contaminated; thus raw use on skin or ingestion poses infection risks. Handling guidelines and processing (sterilization, fermentation) are essential for safety.
- **Antibiotic Resistance Genes and Environmental Dissemination**
  Recent environmental surveillance suggests cattle manure can be a reservoir and vector for antibiotic resistance genes (ARGs), influenced by antibiotic use in livestock [11], [(e.g., Shrivas et al., 2025]. This raises concerns about deploying dung-based products therapeutically or agriculturally without assessing AMR risk and implementing mitigation (composting, thermophilic treatment).

Results and Discussion

Across the reviewed literature, there is consistent evidence for in-vitro antimicrobial activity of cowdung extracts, especially organic solvent extracts, and for the presence of microbial taxa capable of producing bioactive molecules. However, variability due to animal diet, environment, sampling, extraction solvent and assay methods is the primary barrier to comparability. Wound healing benefits shown in certain engineered formulations (e.g., cow dung biochar hydrogels) are not equivalent to raw dung application and involve material design to control release and biocompatibility.

1. **Experimental Antimicrobial Assays**

- **Methanol/Ethanol extracts show activity:** Multiple peer-reviewed articles from Indian journals reported that methanol and ethanol extracts of cowdung inhibited *S. aureus* and *E. coli* in disk diffusion assays; methanol extracts commonly produced larger zones of inhibition than aqueous extracts [8].

2. **Microbiota Profiling and Potential Probiotic Strains**

- **Indigenous microbiota with beneficial properties:** A 2023 review and culture-based work found Bacillus spp. and other microbes producing enzymes and antagonistic substances; such isolates show potential for biocontrol in agriculture and possibly as sources of antimicrobial peptides for pharmaceutical exploration [3].

Table 2: Proposed SOP for Collection and Pre-processing of Cowdung Sample for Biomedical Research

Step	Procedure	Rationale	Safety notes
1.Sample metadata	Record cow breed, diet, location, date/time	Essential for reproducibility	Ensure consent from owner
2.Aseptic collection	Use sterile tools; collect inner dung, avoid soil contamination	Reduces environmental contamination	Wear PPE
3. Transport	Place in sterile containers; cool (4°C) and transport within 24h	Preserves microbiota	Avoid cross-contamination
4.Subsampling	Aliquot for microbiome, chemical, and bioassays	Parallel analyses possible	Label clearly
5. Processing	For culture: immediate plating; for DNA: freeze at -80°C; for extracts: dry and solvent extraction	Stabilizes samples	Follow biosafety level 2 practices
6.Pathogen screening	Test for Salmonella, pathogenic E. coli, Cryptosporidium	Safety clearance before handling	If positive, autoclave before disposal
7.ARG screening	qPCR / metagenomics for resistance genes	Assess AMR risk	Report findings transparently

3. **Computational and In-Vitro Studies on Cow Products**

In-silico + in-vitro investigations: A 2024 study modeled interactions of compounds from cow urine distillate with bacterial proteins and validated antibacterial effects in vitro, demonstrating a pathway for modernizing traditional knowledge into testable hypotheses [5]. Although this study focused on urine distillate rather than dung, it exemplifies the translational research approach applicable to cowdung constituents.

4. **Preprints and Ongoing Research (Microbial Ecology of Dung)**

- **Manure as microbial resource:** A 2024 preprint highlights the complex and beneficial microbial taxa in cow-dung manure and suggests opportunities to mine dung for industrially useful enzymes and bioactive molecules, while warning about variability and biosafety [12].

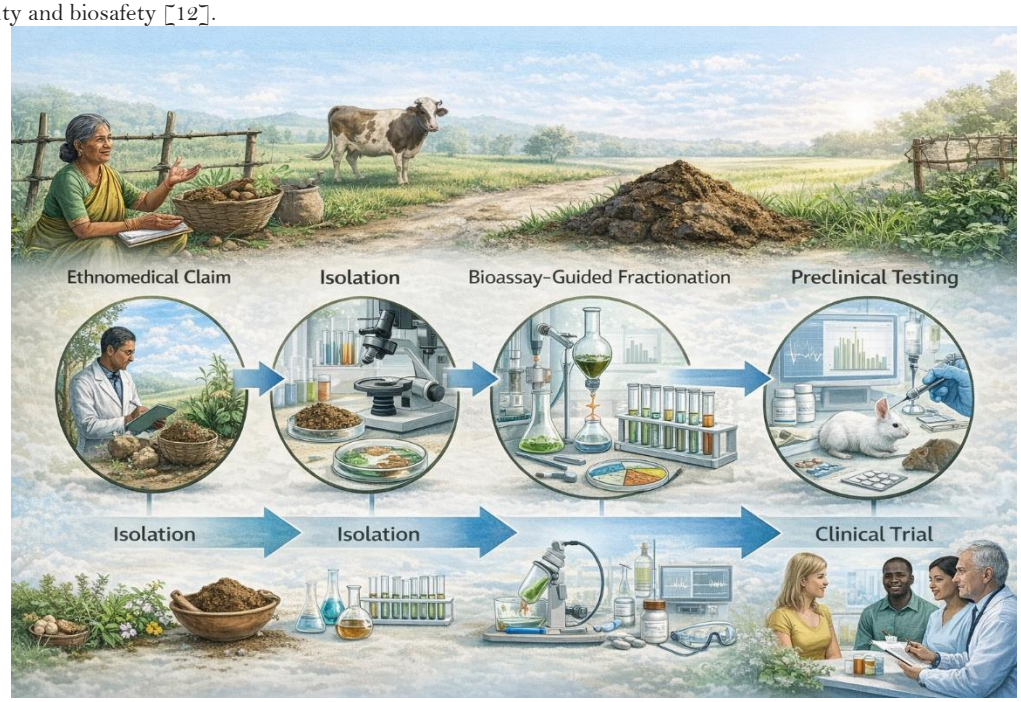

Figure 2. Proposed translational pipeline: from ethnomedical claim → isolation → bioassay guided fractionation → preclinical testing → clinical trials.

Discussion-Interpreting the Evidence

Strength in the Literature

- Recurrent demonstration of in-vitro antimicrobial and antioxidant activities across independent groups.
- Consistent identification of Bacillus and other microorganisms with biotechnological potential.
- Strong ethnomedical and cultural context supporting further investigation.

Limitations and Challenges

- Heterogeneity in sample origin (cow breed, diet, environment), extraction methods, and assay protocols undermines comparability.
- Predominance of in-vitro assays with few standardized in-vivo or clinical studies.
- Insufficient safety testing- including pathogen screening and ARG assessment- before any therapeutic recommendations. Recent environmental AMR surveillance points to the need for caution.

Research and Translational Recommendations

- **Standardization:** Develop standard operating procedures for sample collection, extraction, and characterization (metadata: cow breed, diet, locality).
- **Bioassay-guided fractionation:** Use activity-guided purification to isolate and chemically characterize bioactive molecules, followed by structure elucidation and mechanistic studies.
- **Microbiome and functional metagenomics:** Apply shotgun metagenomics to map functional genes (e.g., biosynthetic gene clusters for antimicrobials) and ARGs.
- **Safety pipelines:** Mandatory pathogen and ARG screening; adopt composting/thermophilic treatment protocols to mitigate risks before any human topical or environmental application.
- **Preclinical models and clinical translation:** Once safety and efficacy signals are robust, pursue controlled animal studies and, if promising, small human trials with ethical oversight.
- **Socioeconomic and cultural integration:** Consider traditional knowledge holders in research design; explore low-cost product development (e.g., wound

Gaps in Knowledge

- Lack of randomized controlled trials or rigorous clinical studies testing cowdung-derived products for defined medical indications.
- Sparse chemical identification of the molecules responsible for reported antimicrobial or wound-healing effects.
- Insufficient data on long-term safety and potential for ARG dissemination from dung-based materials when used in households or agriculture.

Conclusion

Cowdung is a traditionally valued, biologically rich material with multiple reported medicinal and health-related uses in India. Modern research corroborates several in-vitro bioactivities and highlights a promising microbial and chemical resource base for drug discovery and biotechnological applications. However, the evidence remains preliminary; rigorous standardization, safety evaluation (particularly for zoonotic pathogens and AMR), and well-designed preclinical/clinical studies are essential before recommending therapeutic uses. With careful interdisciplinary research that respects traditional knowledge and addresses biosafety, cowdung could contribute to sustainable, culturally concordant health applications and rural livelihoods. The tables and SOP provided here are intended to accelerate reproducible studies and safer translation.

Acknowledgement

I would like to express my sincere gratitude to all those who have contributed to the successful completion of this review titled *"Applications of Cowdung with Special Reference to Medicinal Value in Indian Perspectives: A Review of Traditional Knowledge, Scientific Evidence and Future Prospects."*

I am deeply thankful to my guide and mentors for their valuable guidance, continuous encouragement, and insightful suggestions throughout the preparation of this review work. Their academic support and constructive feedback greatly enhanced the quality of this study.

I also extend my heartfelt thanks to the faculty members and the institution for providing the necessary resources, reference materials, and a supportive academic environment that enabled me to complete this research successfully.

My sincere appreciation goes to researchers, scholars, and authors whose published works and scientific studies formed the foundation of this review and helped in understanding both traditional Indian knowledge systems and modern scientific perspectives.

Financial support and sponsorship

Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

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