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An analytical review of ingredients employed in agricultural bioformulations described in *Vishwavallabh*

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The paper reviews the ancient Indian agricultural practice (Bharatiya Paramparik Krishi) of preparation of bio-formulations as described in a 16th-century text called Vishwavallabh. Emphasized are the natural formulations of ancient times, which are used to promote plant growth, soil health, and sustainable farming. Bioformulations that have been mentioned in the text were formulated with the help of plant derivatives like leaf juices and root pastes, animal products like cow dung, milk, ghee, cereals like barley, pulses, seeds/fruits etc. Vishwavallabh systematically integrates the use of these bioformulations in soil health management, crop growth and physiology. Ingredients like milk-water, Priyala ash, rice water, Kunapajala (fermented animal-based manure), boiled horse gram water, fermented black gram flour, Vidanga, honey, sesame, ghee, barley with milk, cow dung, and jaggery etc. have been mentioned in different combinations specific for different plants and soil conditions. Recent studies also support their positive effects on plants for example the mineral content of milk promotes growth, rice water enhances soil microbes, and Kunapajala, an ancient formulation that recently gained popularity enhances flower and fruit yield. Still, many ingredients mentioned in the text have not been directly investigated empirically. This paper emphasizes that need for systematic studies of these traditional bioformulations for their biochemical properties and agronomic effects with a view to integrating them into contemporary sustainable and eco-friendly farming systems and to replacing harmful synthetic agrochemicals that degrade soil, biodiversity, and human health.

Keywords: Bharatiya Paramparik Krishi, Bioformulations, Cow dung, Plant growth, Soil health, Sustainable, Traditional agriculture, Vidanga, Vishwavallabh

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Traditional agricultural practices in India are rooted in a rich corpus of classical Shastras that make Bharatiya Paramparik Krishi, a well-structured science. Some texts, such as Krishi Parashara (Maharṣi Parashara, 400 BCE), Kashyapiya Krishi Sukti (Maharṣi Kashyapa, 800 CE), Vrikshayurveda (Surapala, 1000 CE), Upavana Vinoda (Sarangadhara, 13th century CE), and Vishwavallabh (Chakrapani Misra, 1540–1597 CE), describe the details of different agricultural operations like manuring, ploughing, sowing, irrigation, weeding, harvesting, weather forecasting, and crop classification. This shows that the agrarian traditions of Bharat are highly developed, sustainable and systematic. Many of these texts also describe several traditional bioformulations, *viz.*, Kunapajala, Panchagavya, Sasyagavya, and Amritpani which are coming into focus for their role in plant growth regulation and soil health improvement, and have been adapted by many Natural farming practitioners. This also assumes relevance in the contemporary context when the unbridled use of synthetic agrochemicals, viz., urea, DAP (Diammonium phosphate), calcium carbide, etc., has given rise to adverse impacts on soil health, ecological imbalance, and health risks to human beings. Agrochemicals such as DDT (dichlorodiphenyltrichloroethane), a widely used pesticide, have been linked to cancers, reproductive disorders, lung damage, birth defects, injury to the nervous system, and dysfunctions of the immune and endocrine systems[1]. Although banned in many countries, DDT continues to be used in certain regions. Excessive and prolonged use of agrochemicals has been shown to exert recurring detrimental impacts on soil health, plant systems, eventually the food chain and the broader ecosystem. The agro-chemicals retained in the soil and crops result in food toxicity,

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affect the underground water table, and induce harmful effects on the livestock, microorganisms, and cause "Heavy Metal Toxicity" (Cd, Pb, Zn, etc.) which damage the organs by disrupting the proteins[2]. Apart from agrochemicals, microplastics from plastic-coated fertilizers cause degradation in soil quality. Yang *et al*.[3] proved that microplastics disrupt soil microbial diversity, leading to ecological imbalance in soil. With the uncontrolled use of these agrochemicals, soil health, plant health and human health, everything is being affected. Therefore, it becomes very crucial to replace these agrochemicals with some eco-friendly and effective alternatives. Our ancient Indian texts, as described earlier, contain many such related formulations using different ingredients that were used as manures and bio-pesticides. In order to explore the full potential of these age-old formulations and to establish them as viable alternatives to chemical inputs, it becomes relevant to investigate systematically the processes of their preparation, biochemical properties, bioactive attributes, and scientifically measurable effects on plant and soil parameters.

Despite increasing scientific interest in traditional agricultural formulations such as Kunapajala, Panchagavya, and Jeevamrit, there remains a significant gap in the literature regarding the systematic evaluation of ingredients described in classical agricultural treatises. While Vishwavallabh contains numerous formulations intended for plant growth promotion, flowering, fruit development, and plant rejuvenation, the individual ingredients employed in these formulations have not been comprehensively reviewed in relation to contemporary scientific evidence. This review systematically maps the ingredients described in Vishwavallabh onto modern bioformulation research and evaluates the available scientific evidence supporting their potential roles in sustainable agriculture. By bridging traditional agricultural knowledge and contemporary plant science, this review aims to identify research gaps and provide directions for future investigations into these traditional formulations.

Methodology

This review adopts a narrative literature review approach to examine the ingredients employed in agricultural bioformulations described in Vishwavallabh. Relevant verses related to plant nutrition, growth promotion, flowering, fruit development, and plant rejuvenation were identified from the Poshanavidhi section of Vishwavallabh-Vrikshayurveda.

Scientific literature pertaining to the ingredients mentioned in these formulations was searched. Peer-reviewed journal articles, review papers, conference proceedings, and authoritative books published primarily in English were considered. Studies directly addressing plant growth, soil health, microbial activity, nutrient dynamics, bioformulation activity, and sustainable agricultural applications were prioritized.

The objective of the review was to synthesize available evidence regarding the agricultural relevance of ingredients described in Vishwavallabh and identify areas requiring further scientific investigation.

Vishwavallabh: An ancient Indian text on agriculture

Vishwavallabh, written by Chakrapani Mishra in the 16th century CE, is one of the most advanced agricultural treatises (Sastra) of medieval India, representing agriculture as an integrated science based on principles of soil management, crop physiology, environmental balance, and practical field operations[4]. The text integrates knowledge of soil science, botany, plant propagation, and organic resource management, based on the principles of Vrikshayurveda, to describe the entire spectrum of agricultural activities. It focuses on soil selection, land preparation, timely sowing, seed treatment, irrigation, weeding, pruning, plant protection, and crop harvesting. Different varieties of formulations have been described in Verses that are capable of enhancing germination, promoting vegetative growth, inducing flowering, enhancing fruit set, increasing fruit size, deepening color, and improving sweetness and aroma. These formulations, prepared with plant juices, leaf pastes, fruit extracts, root materials, oilcakes, cow dung, urine, milk products, etc, reflect an evolved empirical understanding of bioformulation action, a science developed as a part of Bharatiya Krishi. Thus, Vishwavallabh forms an important basis for modern bioformulation research and provides valuable insights into early ecological farming innovations within the Indian Knowledge Systems.

Formulations and ingredients mentioned in Vishwavallabh

Vishwavallabh contains one of the earliest and most elaborate accounts of natural plant bioformulations for growth, fruiting, and quality improvement. The treatise enumerates several classes of organic formulations: those derived from plants (leaf juices, root pastes, fruit pulps, stem sap, floral extracts), animal sources (cow dung, cow urine, milk, ghee, curd, buttermilk), and a variety of soils and

minerals. Various combinations of these materials may be used on seeds, roots, bark, or fruits to bring about rapid germination, early growth acceleration, flowering in sterile plants, fruit set stimulation, increase in fruit size, colour expression, sweetness, and repeated harvest flushes. Practices involving coating of seeds with mineral–plant preparations, root-zone application of fermented extracts, scraping of bark followed by organic pasting, blending of soil with different extracts, and exposure of treated roots to cycles of moisture and sunlight essentially reflect a deep empirical understanding of plant hormone responses and soil–plant interactions. Vishwavallabh is an early articulation of the science of bioformulations, rooted entirely in natural materials and sustainable agronomic reasoning.

Selected verses in Vishwavallabh explaining the use of ingredients

Some important verses that describe important formulations related to manures/biopesticides have been considered and reviewed for their preparation, combinations and effects on soil and plants. The formulations and their ingredients used in the present study are summarized in (Table 1).

a) दुग्धोदकंतिन्दुकपादपानांप्रियालभस्मापिनालिकेर्या :|
आम्रादिकानांहितमम्बुशाले :||४||
-पौषणादिविधि:,विश्ववल्लभ:वृक्षायुर्वेद-

Meaning: Milk-water is beneficial to the Tinduka (*Diospyros tomentosa*) trees; the ash of the Priyala (*Buchanania lanzan*) tree is beneficial to the Coconut tree; and Rice water is beneficial to Mango and similar trees.

The above verse from Vishwavallabh describes the application of different ingredients on different plants for growth and development. It describes that Milk-water is beneficial for Tinduka trees. It is scientifically proven that milk is rich in nutrients and minerals. Cow's milk contains essential minerals such as calcium, potassium, magnesium, sodium, phosphorus, selenium, and zinc[5]. All these minerals are not only important for the human body but for the proper growth and development of plants, serving as an important part of cell walls[6]. Being a rich source of calcium, milk may have the potential to cure calcium-

Table 1 — Brief description of formulations and the ingredients used

Ingredients	Benefits for plants as per Vishwavallabh	Properties	Inference
Milk/milk-water	Beneficial for Tinduka; improves fruit sweetness in all trees	Rich in Ca, K, Mg, P, Zn, and Se; organic carbon andN[5]	Calcium supports cell walls; may address Ca-deficiency disorders; expired milk-based fertilizers improve growth[6]
Priyala (*Buchanania lanzan*) ash	Beneficial for Coconut trees	Mineral-rich: Ca and Fe[12]	Iron supports chlorophyll synthesis; no direct studies on ash application
Rice water	Beneficial for Mango and similar trees	Contains carbohydrates, amino acids, Ca; beneficial microbes[15]	Enhances soil biological activity; improves nutrient concentration; mitigates NPK-induced soil microbial loss[16]
Kulatha (Horse gram) boiled water	Stimulates growth of Pomegranate trees	Rich in phytochemicals, anthocyanins, Ca, Fe[19]	No direct studies; pulse flours in Jeevamrit improve growth & nutrient uptake[20]
Boiled cotton seeds water	Nourishment and development of Pomegranate	Rich in proteins, fats, carbohydrates, K[21]	Cotton seed cakes known as fertilizers; no study on boiled extract
Fermented black gram flour (Urad)	Enhances fruit development in Amla	High in proteins, Fe, and K; increased bioavailability after fermentation[22]	No direct studies; pulse flours part of Jeevamrit bioformulation systems
Vidanga (*Embelia ribes*)	Growth enhancer in seedlings; used in repair treatments	Contains embelin; anti-inflammatory, anti-parasitic	No studies on plant effects
Honey	Combined with sesame and vidanga for seedling growth	Rich in glucose and fructose; antioxidant properties[24]	Low doses boost plant antioxidant activity and growth[24]
Sesame/sesame cake	Growth promoter for young plants	Rich in Ca, Mg, Zn, and Fe[25]	Sesame cake fertilizer improves soil health, root growth, chloroplast structure, aroma precursors[26]
Ghee	Fumigation for seedlings; healing for damaged trees	Rich in fats and vitamins	Ghee-based dhoop reduces microbial load in air[28]; indirect agricultural uses
Barley (with milk)	Enhances seedling vigor	Rich in Mg, Se, Fe and Cu[29]	No studies on barley as fertilizer
Cow dung	Used in rejuvenation of damaged trees	Contains NPK (0.5–0.2–0.5%), beneficial microbes (*Rhizobium*, *Azotobacter*)	Enhances yield and gel content in *Aloe vera*[31]
Jaggery	Part of rejuvenation mixture	Rich in carbohydrates/sugars	Enhances microbial activity in soil when used in Jeevamrit[32]

deficiency caused plant diseases like stunted growth and yellow tip[7]. Milk also contains good amount of potassium that provides turgidity to the plants and promotes robust root system; the deficiency of potassium causes thinning cell walls[8]. Milk also contains important minerals such as magnesium, which plays a vital role in sucrose translocation, nitrogen utilization, pollen development, plant–microbe interactions, and a wide range of other biological processes[9,10]. Perhaps, there has been no direct study that explores the effect of milk solution on plants. In one study, it was found that expired milk products were rich sources of organic carbon and nitrogen, and can be used for making organic fertilizers. The study found that the use of organic fertilizer derived from expired milk products, in combination with different urea forms, has been shown to influence ammonia emissions and improve the growth of Williams banana[11]. Further studies are needed to understand the direct effect of milk water on the Tinduka trees specifically.

The above verse also suggests that the ash of Priyala or Chironji (*Buchanania lanzan*) can be used as a growth agent for coconut trees. Though there have been no studies that describe the effect of Priyala or Chironji ash on trees/plants, specifically coconut, Chironji is rich in minerals like calcium[12] and iron, which the seeds can provide many important nutrients to plants. Iron is very important in plants for chlorophyll synthesis[13], the deficiency of which causes chlorosis in plants[14]. Studies need to be done to explore the effect of Priyala on plants.

The third ingredient is the rice water for mango and similar trees. Rice water is rich in a lot of nutrients like carbohydrates, amino acids, and calcium. Washed rice water contains nutrients and beneficial bacterial species that support plant growth. Detailed chemical and microbial assessments have shown that rice water waste can improve soil biological activity and promote plant development when applied appropriately[15]. The study also showed that the rice water has the potential to improve nutrient concentrations and beneficial soil biota.

Another study revealed that rice water has the potential to reduce the effect of chemical fertilizers. NPK fertilizers, which are known to exert negative effects on soil bacterial populations and overall microbial diversity, when applied at half the recommended rate and supplemented with a high concentration of fermented washed rice water, helped buffer the soil ecosystem and supported the recovery or protection of bacterial communities[16].

Although modern studies demonstrate that washed rice water contains essential nutrients, beneficial microbial populations, and can enhance soil biological activity and plant growth, and that fermented rice water can mitigate the negative impacts of NPK fertilisers on soil microbial diversity, further studies must be done to explore the potential of rice water on mango or similar fruit trees, as mentioned in the traditional verse.

b) सर्वदुमाणाम्कुणपस्यसकोहितोऽस्तिसश्वत्फलपुष्पवृद्धयै|
विशेषतोदाडिमपादपानांधूपोपिहिस्थूलफलाशुकारी||६||
-पौषणादिविधि:,विश्ववल्लभ:वृक्षायुर्वेद-

Meaning: The liquid (fertilizer) of Kuṇapa is beneficial for all trees for the increase of fruits and flowers. Especially for pomegranate trees, fumigation (or smoke treatment) is also a prompt producer of large fruits.

Kunapajala is a widely used bioformulation that finds its basis in ancient Indian texts like Vrikshayurveda (Verse 101-108). According to Nene[17], the Sanskrit word kunapa means "foul-smelling" or "having the odor of a decomposing body," an etymology that reflects its method of preparation. Kunapambu or Kunapajala (jala = water) is an ancient fermented manure prepared from animal remains, such as flesh, marrow, and other organic tissues, whose decomposition produces its characteristic odor. Lokopakara, compiled by the poet Chavundaraya in 1025 CE in Karnataka, also suggests the use of kunapajala in several contexts for tree growth acceleration, flowering, and fruiting. It has also been mentioned in Vishwavallabh. According to Vishwavallabah, it is beneficial for all the trees and increases the number of fruits and flowers.

Many studies have been conducted to understand the effects of Kunapajala on plants and soil. In a recent study, which assessed its effect on the cultivation of chamomile, an essential oil–bearing plant, a field experiment was conducted using three doses of three types of herbal Kunapajala at the Medicinal Plant Research and Development Centre, Pantnagar. Applications of Kunapajala significantly influenced some floral traits; like early bud formation, enlargement of flower size, essential oil content (0.27%) and number of bioactive compounds, showing herbal Kunapajala acts as a promising alternative to synthetic inorganic fertilizers for improving flower size and yield besides essential oil quality in chamomile[18].

Existing studies, such as those conducted on chamomile, demonstrate promising growth and quality improvements, but there is an absence of empirical evidence testing Kunapajala on fruit trees or pomegranate, as mentioned in traditional literature.

c) कुलत्थंचूर्णक्वथिताम्बुसेकोवृद्धिकरोदाडिमपादपानाम्|
कार्पासबीजंक्वथिताम्बुसेकामृत्सैरभेयीसकृतश्चदानात्||८||
-पौषणादिविधिः,विश्ववल्लभः वृक्षायुर्वेद-

Meaning: Water prepared by boiling the powder of horse gram, Kulatha, is propitious for growth when applied to the pomegranate trees. Similarly, water prepared by boiling cotton seeds is used on the soil where the plant is located, for its nourishment and development.

The above-mentioned verse describes the positive effect of boiled water solution of Kulatha (Horse gram, *Macrotyloma uniflorum*) powder on growth of pomegranate tree. The horse gram flour contains phytochemicals, anthocyanin and rich source of calcium and iron[19]. Several studies have been conducted on different pulse flours like gram flour as one of the ingredients of Jeevamruthan on its effects on plants and soil. A study showed that treatments containing Jeevamritam-especially when combined with vermicompost and *Rhizobium*-significantly improved mung bean growth, yield, and nutrient uptake compared to individual applications[20]. There has been no study done so far focusing on the individual effect of pulse flour, specifically horse gram flour solution on plants like pomegranate.

The verse also states that cotton seeds boiled in water will help in plant nourishment and development. In many places, cottonseed oil cakes are used as fertilizers and poultry feed, which contain a lot of amino acids and nutrients. Cotton seeds are rich in potassium, proteins, fats, and carbohydrates[21]. There have been no studies showing the effect of boiled cottonseed water on plants.

d)श्विन्नाश्चमाषाःसजलाःनिरुक्तावृद्धयैफलानांजरठामलक्याः।
दुग्धस्यसेकात्सकलद्रुमाणांफलंसुमिष्टंभवतीतिपक्वम्॥९॥
-पौषणादिविधिः,विश्ववल्लभः वृक्षायुर्वेद-

Meaning: Fermented black gram flour helps in the development of fruits, specifically in Amla. A spray of milk mixed with water improves the fruit's sweetness and overall quality.

The above verse suggests the application of fermented black gram flour. Black gram is rich in proteins, potassium, and iron. Studies have shown that fermentation increases the nutritional profile and bioavailability of nutrients in black gram[22]. Though there have been no studies that focus on its effects on plants or soil. In many traditional agricultural practices, like Natural farming, Jeevamritam is used as a liquid bioformulation, which is prepared by mixing gram flour with other ingredients like jaggery, cow dung, cow urine, etc, as discussed earlier. In some methods, the gram flour is sometimes replaced with other types of pulse flour. Though individual effects of these pulse flours have not been studied, the Jeevamritam solution has been studied widely for its effects on plants and soil.

Milk water has been again recommended in this verse. The studies and limitations of the studies related to milk solution have already been discussed earlier.

e) विडङ्गमाक्षीकतिलैःप्रलेपोधूमोघृतस्यापिमृदालवाले।
सेकोयवक्षीरजलैस्तरूणांवृद्धिकरःस्यात्कुणपैःशिशूनाम्॥३३॥
-पौषणादिविधिः,विश्ववल्लभः वृक्षायुर्वेद-

Meaning: A mixture of Vidanga (*Embelia ribes*), honey, and sesame is considered good for the growth of young plants. Fumigation with ghee is also beneficial for seedlings as it strengthens the plants. Spraying with a fermented mix of barley, milk, and water enhances seedling vigor.

Vidanga (*Embleia ribes)* is rich in embelin, having anti-inflammatory and anti-parasitic properties as per Ayurveda. According to Sharma *et al.*[23], Vidanga contains several bioactive compounds and oils, including viangin, a derivative of embelin, which exhibits cytotoxic effects against cancer cells, antibacterial properties, and quinones that serve as precursors for the development of therapeutic drugs. There have been no studies done so far that focus on the effect of Vidanga on plants. Honey, another ingredient mentioned in the verse, is rich in glucose and fructose. According to Sadou *et al.*[24], honey acts as an effective soil amendment and enhances the growth of basil (*Ocimum basilicum*).While higher honey concentrations inhibited plant height, lower doses significantly boosted antioxidant compounds and activity, highlighting honey's potential as an eco-friendly bioformulation for improving plant resilience.

Sesame (*Sesamum indicum*) is another ingredient mentioned in the formulation. Sesame seeds are rich in calcium, iron, magnesium, and zinc. Sesame also contains high amounts of proteins, oils and lignans etc[25]. Sesame seed cake has been used as fertilizer. A recent study shows that Sesame cake fertilizer significantly improves soil health, stimulates robust tobacco root growth, enhances chloroplast

ultrastructure, and increases glandular trichome activity-ultimately enriching aroma precursors and elevating sensory quality[26]. More studies should focus on its effect when fermented in combination with other ingredients, as mentioned in the verse.

Fumigation with ghee is another step mentioned in the verse. Ghee is rich in vitamins and fats. It has been mentioned in various Ayurvedic texts. The use of medicinal smoke (dhūpa) in traditional Indian knowledge systems has also received scientific attention[27]. Nene reported that medicinal smoke generated from herbal ingredients significantly reduced airborne pathogenic bacterial populations and contributed to environmental sanitization. Such findings provide a possible scientific basis for the fumigation practices described in *Vishwavallabh*. However, the direct effects of such fumigation on plant physiology, pest management, or fruit development remain largely unexplored and require systematic experimental investigation. A recent study reveals that fumigation with dhoop with ghee being one of the ingredients, purifies the air quality and decreases the bacterial growth[28]. Though there have been no direct studies that explain the effects of fumigation with ghee specifically on plants, it has been found that ghee has been in use in various practices like Homa, Panchagavya, etc., which are directly or indirectly used as manures in agriculture.

Another ingredient is barley, which should be mixed with milk. Barley is one of the most grown cereals globally, rich in magnesium, selenium, iron, copper, etc.[29]. It has never been applied and tested as a fertilizer for crops. Barley malt is rich in these nutrients and is often consumed with milk. Studies should be done to test the effects of barley on crops.

f) सेकोजलैर्मूर्ध्निचगोमयंस्याद्गोविण्मृदःपूरणमालवाले।
विडङ्गमध्वाज्यगुडैःसदुग्धैःप्ररोहकृच्छिन्नतरोःप्रलेपः || ४६||
-पौषणादिविधिः,विश्ववल्लभःवृक्षायुर्वेद-

The treatment method for a damaged tree involves irrigation with water and cow dung on the head of the tree. Application of a mixture of desi cow dung, water, vidanga, honey, ghee, jaggery, and milk near the roots of the tree is believed to stimulate new green growth in plants.

In the above verse, the following ingredients are mentioned: Vidanga, honey and milk, cow dung, ghee and jaggery have been mentioned. In the previous section, vidanga, honey, ghee and milk have been discussed.

Cow dung is an important ingredient and has been used in many types of manure. Cow dung contains about 0.5% Nitrogen, 0.2% Phosphorus, and 0.5% Potassium, along with beneficial microbes like *Rhizobium*, *Azotobacter*, etc. According to Sagar *et al*.[30], cow dung contains many types of plant growth promoting bacteria like *Bacillus* sp., *Pseudomonas* sp., *Azotobacter* sp., and *Rhizobium* sp. which help in nitrogen fixation, solubilization of insoluble phosphorus, potassium solubilization, zinc solubilisation etc. Recent studies reveal that cow dung enhances leaf yield and gel content in *Aloe vera* when applied as manure[31].

Jaggery is another ingredient used in this formulation. Jaggery has been used as an important ingredient in Jeevamruthan/Jeevamrit, a liquid natural fertiliser. Jaggery acts as an important carbohydrate/sugar supplement that attracts microbes in soil when applied in combination with other ingredients as Jeevamrutam. This increases crop yield[32].

Discussion

The review reveals that many ingredients described in Vishwavallabh possess properties that align closely with contemporary concepts of agricultural bioformulations. A recurring pattern observed across the formulations is the use of nutrient-rich organic materials such as milk, cow dung, sesame, cereals, pulses, and fermented products, which may contribute to plant growth through nutrient supplementation, enhancement of soil microbial activity, and stimulation of plant physiological processes.

Another notable feature is the integration of multiple ingredients within a single formulation. Such combinations may generate synergistic effects through interactions among nutrients, microbial populations, and bioactive compounds. Similar principles are recognized in modern bioformulation formulations that combine organic substrates, microbial inoculants, and nutrient sources to improve crop performance.

The review also highlights substantial research gaps. While ingredients such as rice water, cow dung, sesame cake, and Kunapajala have received increasing scientific attention, many components mentioned in Vishwavallabh-including Priyala ash, Vidanga, fermented black gram preparations, boiled cotton seed extracts, and barley-milk formulations-remain largely non-investigated in agricultural contexts. Furthermore, most available studies focus on annual crops, whereas the original text frequently

recommends these formulations for fruit trees and perennial species.

Future research should focus on experimentally validating both individual ingredients and complete formulations under controlled and field conditions. Investigations into their biochemical composition, microbial dynamics, effects on nutrient-use efficiency, stress tolerance, fruit quality, and soil health would contribute significantly to their scientific validation and practical application in sustainable agriculture.

Conclusion

Ancient Indian texts such as Vishwavallabh preserve a remarkable repository of plant-nourishing formulations that function as bioformulations and organic fertilizers. These traditional bioformulations-rich in botanicals, animal-based preparations, cereals, pulses, and natural by-products-reflect a deep ecological understanding of soil health, plant nutrition, and sustainable agriculture. While modern studies increasingly validate the scientific potential of several ingredients, many formulations remain unexplored. Therefore, systematic research is essential to evaluate their biochemical properties, assess their agronomic effects, and integrate their benefits into contemporary sustainable farming practices.

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Author Contributions

GK contributed to the conceptualization of the study, literature review, manuscript drafting, and interpretation of traditional sources. GNY contributed to scientific analysis of the ingredients and revision. SV and SB contributed to supervision and guidance. All authors read and approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics Statement

This article is a review of published literature and traditional textual sources. No human participants, animals, or biological samples were involved in the study. Therefore, ethical approval was not required.

Informed Consent

Not applicable, as this study did not involve human participants.

Use of Artificial Intelligence (AI)

Artificial intelligence (AI) tools were used only for editing assistance and formatting support (using ChatGPT). All scientific interpretations, literature analysis, conclusions, and manuscript content were critically reviewed and verified by the authors, who take full responsibility for the final manuscript.

Data Availability

No new datasets were generated or analyzed during this study. All information discussed in this review is derived from published literature and cited sources.

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