

# Physicochemical and Sensory Quality of Probiotic Dahi Fortified With Moringa Leaf Powder

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## ABSTRACT

*Dahi, the set fermented milk of the Indian subcontinent, is a familiar vehicle for probiotic bacteria, and fortifying it with the dried leaf of Moringa oleifera is an appealing way to add protein, minerals and phenolic compounds to a food that people already eat. This narrative review asks what the published literature can and cannot say about the physicochemical and sensory quality of such a product, and it reports no new data. It draws together work on the fermentation and gel structure of dahi, the composition and anti-nutritional constituents of moringa leaf, the behaviour of probiotic strains in fortified fermented milks, and the methods used to judge texture and consumer acceptance. Fortification can improve the nutritional profile, but it may also change acidification, probiotic viability, firmness, water holding, colour and flavour, and the direction and size of each change depend on the dose, the particle size, the strain and the base milk. Sensory evidence is the weakest link: panels are usually small and untrained, scales are applied loosely, and acceptance of a green, slightly bitter product is rarely tested in the consumers who would buy it. The review concludes that low levels of leaf powder are plausible candidates for acceptable fortified dahi, that the evidence does not yet fix an optimum, and it sets out the measurements and panel designs a convincing study would need.*

**Keywords:** Probiotic dahi; Moringa oleifera; Fortification; Sensory quality; Texture; Anti-nutrients; Narrative review

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## 1. Introduction

Dahi is one of the most widely eaten fermented milks in South Asia. It is made at home and in dairies, eaten plain or sweetened, stirred into lassi, spooned over rice, and carried by habit from one generation to the next. A food with that reach is an obvious candidate for improvement, and two ideas have come together around it. The first is to make it a vehicle for probiotic bacteria, which has a long record in fermented milks generally [1, 2]. The second is to add a locally grown plant ingredient that raises its nutritional value, and the

dried leaf of the drumstick tree, Moringa oleifera, is among the most frequently suggested [3, 4].

The idea is attractive on paper. Moringa leaf is described as a source of protein, minerals and phenolic compounds [5, 6], and dahi is a food that people in the target population already accept. What is less clear is what the leaf powder does to the product once it is stirred into milk and left to ferment. Fortification can help nutrition, yet it may also change how well the probiotic strains survive, how firm and smooth the gel is, and how the finished dahi tastes. Any one of those changes can

undo the benefit of the others, because a dahi that nobody likes delivers no nutrients at all. The aim is a fair account of what is known and what is merely repeated.

This article is a narrative review. It draws on published work on the structure of fermented milk gels, the composition and anti-nutritional constituents of moringa leaf, the survival of probiotics in food matrices and the methods used to assess sensory quality, and it deliberately reports no new data. Where the literature on moringa-fortified dahi itself is thin, we say so, and we describe the evidence a convincing study would need to supply, instead of quoting figures we have not been able to check against their sources.

## 2. Literature Review

### 2.1 Dahi, Probiotics and the Fermented Milk Gel

Dahi is a set, acid-coagulated milk. Lactic acid bacteria ferment lactose, the pH falls, and the casein micelles lose their charge and aggregate into a continuous network that traps water, fat and bacteria [7, 8]. The texture that results depends on the milk base, the heat treatment given to it, the starter and the temperature and duration of incubation, and a change in any of these can matter as much as the choice of culture [9]. This is a point worth keeping in view, because a leaf powder added to such a system joins an arrangement that is already finely balanced.

A probiotic, in the consensus definition, is a live microorganism that confers a health benefit on the host when given in adequate amounts [10]. Fermented milks are a natural carrier, and yoghurt-type products have long been studied for that purpose [11, 12]. Probiotic dahi has been described with lactobacilli added to the usual starter, and animal work has examined biological effects of such products [13]. Two cautions run through the literature. A fermented food is not automatically a probiotic food, and the term should be reserved for products that carry a defined strain at a meaningful level through to the end of shelf life [10, 14]. This is why the same leaf powder can look excellent in one report and unremarkable in the next.

Survival is the practical difficulty. Probiotic strains differ in their tolerance of acid, oxygen and cold storage, and they interact with the starter bacteria, which may help or hinder them [15, 16]. Reviews of probiotic foods repeat the same conclusion: viability in the food depends on the strain, the matrix, the processing and the storage conditions, and a count taken at manufacture says

little about the count a consumer will eat [17, 18]. Anything added to dahi that alters acidity, oxygen availability or the available nutrients can shift that balance.

### 2.2 Moringa Leaf as an Ingredient

Moringa oleifera is a fast-growing tree grown widely in warm regions, and its leaves are eaten fresh, cooked or dried and milled. Reviews describe leaves that contain protein, a range of minerals, vitamins and a long list of phenolic compounds and other secondary metabolites [4, 6, 19]. The protein fraction has been characterised chemically and is reported to contain a good spread of amino acids [20]. These descriptions explain the appeal of the leaf as a fortificant, though they say little about what happens to the nutrients once they are in a milk gel.

Composition is not fixed. It varies with cultivar, growing conditions, leaf age and especially with how the leaf is dried and ground, and the figure given for protein or iron in one paper cannot be carried over to the powder in another. A study that adds leaf powder to dahi without reporting the composition and particle size of that powder leaves the reader unable to tell what was added. We return to this point in the results, since it is the commonest reason that fortification studies cannot be compared with one another.

The same leaf also carries compounds that nutritionists regard with suspicion. Analyses of the leaf have reported phytate, tannins, saponins and other factors that can interfere with mineral absorption or digestion [21], and safety reviews note that although the leaf has a long history of food use, evidence on regular large intakes of concentrated preparations is limited [22]. Table 1 sets out what the leaf contributes and what it may cost, constituent by constituent.

### 2.3 Anti-Nutrients and Mineral Availability

Plant foods commonly contain compounds that bind minerals or inhibit enzymes, and these have been described at length in general reviews [23]. Phytate is the best known: it forms insoluble complexes with iron, zinc and calcium in the gut and can reduce how much of a mineral the body takes up from a meal [24]. Iron absorption in particular is affected by several dietary components, and a total iron figure on a label is a poor guide to what is absorbed [25].

**Table 1. Constituents of moringa leaf powder and their likely influence on probiotic dahi.**

| Constituent        | Nutritional interest                          | Possible effect on the product                               |
|--------------------|-----------------------------------------------|--------------------------------------------------------------|
| Protein            | Adds amino acids to a milk-based food [3, 20] | May bind water and firm the gel; may alter proteolysis       |
| Minerals           | Calcium, iron and others [3, 4]               | Availability may be reduced by phytate and oxalate [21, 24]  |
| Phenolic compounds | Antioxidant interest [6, 19]                  | Can interact with milk proteins and add astringency [27, 30] |
| Fibre              | Bulk and water binding                        | Can raise firmness or cause grittiness                       |
| Pigments           | Green colour                                  | Colour change; may be disliked in a white product            |
| Anti-nutrients     | Phytate, tannins, saponins reported [21, 22]  | Bitterness; possible reduced mineral uptake                  |

*Note: Qualitative summary from the cited literature. Content of each constituent varies with cultivar, season, leaf age and drying, so no figures are given.*

For fortified dahi this has two consequences. First, a mineral-rich leaf powder does not necessarily deliver a mineral-rich food in the nutritional sense, and a claim of improved iron or calcium supply needs bioavailability evidence, not just a proximate analysis. Second, fermentation itself may modify some of these compounds, because lactic acid bacteria and the acid environment can act on certain plant constituents, but the extent to which this happens in a short dahi fermentation is uncertain and is rarely measured in fortification studies [23, 26]. A culture that has been given time to settle behaves differently from one that has just been stirred in.

## 2.4 Phenolics, Proteins and the Probiotic Matrix

Phenolic compounds are among the chief reasons that plant powders are added to foods, and they interact with the surrounding matrix in complicated ways. They bind to proteins and carbohydrates, and the interactions depend on the compounds involved and on the pH [27]. In a milk gel, that can mean that some phenolics associate with casein and whey proteins, changing both the antioxidant activity that can be measured and the texture. Work on tea added to probiotic yoghurt illustrates the principle: antioxidant activity changed with the plant material and over storage, so plant additions cannot be assumed to behave alike [28].

Phenolics also act on the bacteria. Food phenolics and lactic acid bacteria influence each other, with

some strains able to metabolise certain phenolic compounds while others are inhibited by them [26]. The sign and size of the effect is strain-specific, which means a result obtained with one probiotic cannot be assumed for another. Protein breakdown during fermentation, which can release bioactive peptides, adds a further layer, and it too depends on strain and conditions [29].

## 2.5 Sensory Quality and Its Measurement

Sensory quality decides whether a fortified food succeeds. Plant powders add colour, a grassy or bitter flavour and sometimes an astringent feel, and polyphenols are among the compounds responsible for astringency and bitterness [30]. Bitterness is a particular obstacle for foods based on phytonutrient-rich plants, because the consumer response to bitter taste is strong and varies between individuals [31]. A pleasant balance at a low dose can give way to rejection a little higher up, and where that line falls is an empirical question.

The methods used to measure it matter as much as the results. Sensory science separates descriptive work, done by trained judges who rate defined attributes, from affective work, done by consumers who say how much they like a product [32]. Hedonic scales are the usual instrument for the second kind, and they carry well-documented difficulties, from how the words on a scale are interpreted to whether the numbers can be treated as equal intervals [33, 34]. Studies that ask a handful of colleagues to rate every attribute on a nine-point scale are mixing the two purposes and are weak at both.

## 2.6 Texture and Storage

Physical quality is usually reported as firmness, viscosity, whey separation and colour. Added particles may fill and reinforce the gel, bind water and raise firmness, or they may interrupt the protein network and weaken it, depending on their size, quantity and surface properties. Whey separation on storage is a consumer-visible defect, and it responds to the same factors [7, 9]. Stored dahi is a living system, and probiotic count, acidity and texture drift together during refrigerated storage [35, 36].

Storage is the dimension most often neglected. Probiotic viability should be reported at the end of the claimed shelf life, post-acidification can make a product that was pleasant on the day of manufacture sharp a week later, and the sensory effect of the added ingredient can change as flavour compounds migrate and bacteria continue to act. A report that tests only the fresh product

describes the first day of a longer story.

### 3. Materials and Methods

#### 3.1 Scope and Question

The review asks one question in two parts: how does the addition of moringa leaf powder to probiotic dahi plausibly affect its physical, chemical and microbiological quality, and how well does the available evidence show that the result is acceptable to the people who would eat it? The question was divided into the sub-questions that a fortification study would have to answer: what the powder was, how it was added, how fermentation and probiotic survival were followed, how texture was measured and how sensory quality was judged. None of these steps is difficult, but each one is easy to skip.

#### 3.2 Literature Assembly

The review draws on peer-reviewed work in four areas: the structure and fermentation of yoghurt-type milks; the composition, safety and anti-nutritional constituents of moringa leaf; the survival of probiotics in food matrices and during storage; and the methods of sensory evaluation. Sources were chosen for relevance, citation in the field and the clarity of their methods. Studies of other plant materials and other fermented milks are used for what they teach about mechanisms and limits, not as evidence of effects in moringa-fortified dahi.

We did not run a formal systematic search and we do not claim one. This is a narrative synthesis, and the choice of sources reflects the authors' judgement. The practical consequence is that the review is a better guide to what a good study should contain than to the exact size of any reported effect, and it avoids quoting figures from individual fortification studies that could not be checked against the primary papers for this article.

#### 3.3 Appraisal Framework

To judge how far a report can be trusted, we used a short framework with four questions. Is the added powder characterised, and is the control a matched unfortified dahi? Are the chemical and physical measurements described well enough to be repeated and made at more than one time point [7, 8]? Is probiotic viability counted with a method suited to the strain and followed through storage [16, 37]? And is sensory quality judged by a panel of suitable size and kind, with the scale and analysis stated [32, 38]? Table 2 lists the instrumental and chemical measurements we looked for.

## 4. Results

### 4.1 What Moringa Powder Offers Fermented Milk

The compositional literature describes a leaf that is rich in protein and minerals, with a measurable content of fibre and phenolic compounds [3, 4, 20]. In a milk base that already supplies protein, calcium and phosphorus, the contribution of a small quantity of leaf powder is therefore most noticeable for components milk lacks, such as phenolics and certain micronutrients, and least noticeable for protein. The nutritional case should be argued on that basis and not on the headline composition of the leaf alone.

**Table 2. Instrumental and chemical measurements for fortified dahi and what each one answers.**

| Measurement                | What it shows                        | Common pitfall                                        |
|----------------------------|--------------------------------------|-------------------------------------------------------|
| pH and titratable acidity  | Pace and extent of acidification [7] | Reading only at the end of fermentation               |
| Viable probiotic count     | Survival through storage [16, 37]    | Selective media not validated for the strain          |
| Firmness and viscosity     | Gel strength and mouthfeel [8, 9]    | Sample temperature and shear history not standardised |
| Syneresis or water holding | Whey separation on storage [7]       | Method differs between reports                        |
| Colour                     | Visible effect of the green powder   | Instrument colour not tied to liking                  |
| Proximate composition      | Real nutritional gain                | Powder composition not reported                       |

*Note: The last column gives the question the measurement addresses; it is not a prescribed protocol.*

A second point is that fortification is a matter of dose. A level high enough to change the nutritional profile in a meaningful way is also a level likely to change the colour, texture and taste, while a level that goes unnoticed on the tongue may be too low to matter nutritionally. The two constraints pull in opposite directions, and the literature we drew on does not locate a dose that satisfies both. This is a central tension of the topic, not an oversight of any one report. Such differences are small individually, but they add up over a shelf life.

### 4.2 Plausible Effects on Fermentation and Probiotic Viability

Several routes by which leaf powder could alter fermentation and survival are plausible (Figure 1). Leaf-derived nutrients, such as peptides, minerals and fermentable sugars, could stimulate growth of the lactic acid bacteria and speed acidification. Phenolic compounds could slow growth of some strains while being tolerated by others [26]. The

powder may also change the buffering capacity of the milk, and with it the pace at which the pH falls [7]. And particles could offer surfaces or microenvironments that affect how cells survive in storage.

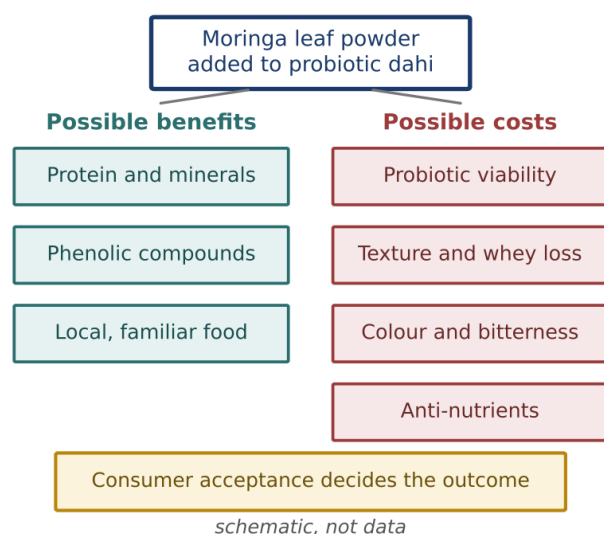


Figure 1. Balance of benefits and risks when moringa leaf powder is added to probiotic dahi (schematic, not data).

Each route predicts something different. Nutrient stimulation should shorten the time to a target pH and, if post-acidification follows, may reduce survival of acid-sensitive strains in storage. Inhibition by phenolics should lengthen fermentation and perhaps favour tolerant strains over sensitive ones. Buffering should show as a changed titratable acidity at the same pH. A study that reports only the final plate count cannot say which route was at work, and so cannot say whether its result would hold for another strain or another leaf batch [18, 39]. Read this way, a failure to find a difference in a small panel is not evidence that none exists.

The dose dependence of the response is also uncertain. In general terms one expects little effect at very low levels, a possible mild stimulation at moderate levels and increasing interference at high levels, as sketched in Figure 2; the figure is a qualitative matrix of that expectation, not a plot of data. Most reports test only one or two levels of powder, which cannot reveal where, or whether, the shifts occur.

#### 4.3 Texture, Colour and Physical Stability

The effect of added plant particles on gel structure is not uniform. Fine, well-dispersed particles can strengthen a gel by acting as fillers and holding water, whereas coarse or poorly hydrated particles can disturb the network and give a gritty mouthfeel and more whey separation [7, 9]. The

direction therefore depends on particle size, the way the powder is added, the heat treatment and the solids content of the base milk, and the same dose can yield a firmer product in one study and a weaker one in another. This is why the same plant can look excellent in one report and unremarkable in the next.

|                         | Low dose  | Moderate  | High dose  |
|-------------------------|-----------|-----------|------------|
| Green colour            | faint     | visible   | strong     |
| Bitterness / grassiness | none      | slight    | marked     |
| Firmness / gel          | little    | may rise  | may weaken |
| Probiotic survival      | unchanged | uncertain | may fall   |
| Nutritional gain        | small     | some      | larger     |

expected pattern, qualitative; not data

Figure 2. Qualitative matrix of how dose is expected to affect quality attributes (schematic, not data).

Colour is the most immediate change. A white or cream-coloured dahi turns green, and the intensity of the colour tracks the dose. Instrumental colour readings quantify this but do not show whether consumers like it, and a green dahi may suit a health-oriented market while putting off a traditional one. The question is a sensory one, and it can only be settled by asking the right people.

Physical stability across the shelf life deserves separate mention. Whey separation, loss of viscosity and changes in appearance appear gradually and may track the continuing activity of the culture [8, 35]. Reporting only the fresh product misses these changes. Equally, comparisons between studies need the same methods for firmness and water holding, since different probes, speeds and temperatures give numbers that cannot be set side by side.

Because the physical and chemical effects arise from several interacting causes, a fair analysis presents the full pattern instead of a single measurement. A best case might show an improved firmness with unchanged viability, a base case slight softening with a modest loss of viable cells, and a worst case visible whey separation with poor survival in storage. A formulation that holds up across such scenarios is robust, and one that works only in the best case is not. Presenting the full set costs the authors of a study little and gives the reader what is needed to judge transfer to another milk or another strain.

#### 4.4 Quality of the Sensory Evidence

Reports on sensory acceptance of fortified fermented milks commonly share a set of design limitations (Table 3). Panels are small, often drawn from the staff and students of the institution that ran the study, judges are asked to rate many attributes without training, and the product is tasted once, fresh, in a booth [38, 40]. These conditions are practical and understandable, but they limit what can be concluded. A small panel yields unstable estimates of mean liking, and the result for a sample of colleagues may differ from the result for the consumers who would buy the product.

Methodological problems compound this. Hedonic scores are often analysed as though the intervals between scale points were equal, and results are reported as significant or not without an indication of effect size [33, 34]. Ranking methods, preference tests and acceptance tests answer different questions and can give different answers about the same samples [40]. Where several attributes are compared and only the favourable ones are discussed, the risk of a misleading impression rises.

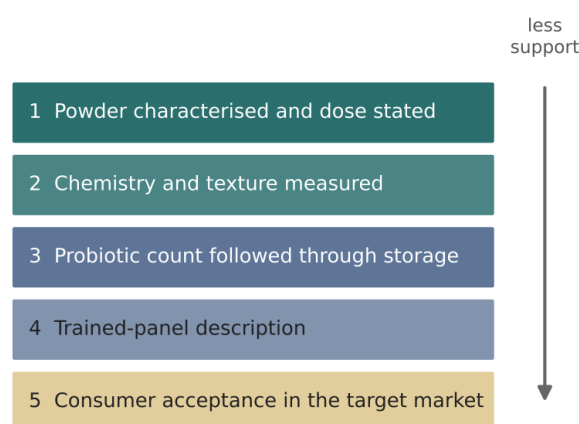
**Table 3. Common weaknesses of sensory evaluation of fortified dairy foods and what follows from them.**

| Weakness                              | Consequence                                              | Remedy                                                  |
|---------------------------------------|----------------------------------------------------------|---------------------------------------------------------|
| Small panel                           | Unstable preference estimates [38]                       | Recruit enough consumers; report intervals              |
| Untrained judges asked for attributes | Attribute scores unreliable [32]                         | Train a panel for description; use consumers for liking |
| Hedonic scale used loosely            | Scale treated as interval data without checking [33, 34] | Justify the analysis; consider ranking                  |
| Single tasting at one storage age     | Misses change over shelf life [35]                       | Test across the storage period                          |
| No unfortified control served         | No reference point                                       | Include a matched control                               |
| Product not served in a usual context | Acceptance may not carry over [40]                       | Test as the product is normally eaten                   |

*Note: Weaknesses are those discussed in the cited sensory-science literature; they are not attributed to any single study.*

Training is an underrated issue. Untrained judges can say whether they like a dahi, but they are poor at describing exactly what it is about the texture or taste that they like or dislike, and attribute ratings from such panels should be read as impressions. Descriptive analysis needs a trained panel, and affective testing needs consumers in adequate numbers [32]. Figure 3 sketches how the

evidence thins as one moves from formulation to demonstrated consumer acceptance.



*Schematic of the evidence chain; fading shade, not counts*

*Figure 3. Schematic of the evidence chain from formulation to consumer acceptance; stage heights are not counts.*

Put plainly, the literature supports only a cautious statement. Moringa leaf powder is a nutrient-bearing ingredient with real compositional appeal, the case for acceptable quality at low levels is plausible, and the case for any particular optimum is not established. The size and direction of effects on viability, texture and flavour depend on the dose, the powder, the strain and the base milk, and the best summary is that low levels are likely to be tolerated, higher levels are uncertain, and acceptability needs to be shown in consumers. That is a modest claim, and it is the one the evidence will currently bear.

#### 4.5 Reading a Claim of Benefit

A reader meeting a claim that moringa-fortified dahi is nutritious and well accepted can ask a short sequence of questions. What was the powder, and how much was added, on what basis? Was there a matched control dahi, and was it served in the same session? How many judges tasted it, who were they, and how was liking measured and analysed [33, 38]? Were viable counts reported for the probiotic strain at the end of the shelf life [16, 17]? A report that answers all four is rare, and one that answers none should be read as an observation, not as evidence of benefit.

Health claims need the same scrutiny. A probiotic benefit belongs to a defined strain at a defined dose, and fermented foods are not all probiotic foods [10, 14]. Likewise, antioxidant activity measured in a test tube is a property of a chemical assay, not a demonstrated effect in people, and the nutritional value of added minerals depends on whether they are absorbed [24, 25]. Statements that fortified dahi is healthier are best replaced by

measured composition, measured viability and, where possible, evidence from human studies of the same product.

Finally, products differ in region, season and consumer habit, and an acceptable formulation in one market is not automatically acceptable in another. Studies with consumers in the intended market, using the product as it is normally eaten, are more informative than laboratory tastings [32, 40]. For moringa dahi, where people may already know the leaf as a cooked vegetable, expectations about flavour may be strong, and they can shape acceptance in either direction.

## 5. Discussion

### 5.1 Interpretation and Practical Reading

The main finding of this review is a conditional one. Moringa leaf powder is most likely to give an acceptable fortified dahi at low levels of addition, in a well-dispersed fine form, with a robust probiotic strain and a good base milk, and least likely to do so when the dose is raised to make a visible nutritional difference. That fits what is known about plant additions to fermented milks in general [2, 39], and it implies that the question for a producer is not whether moringa works but at what dose, in what form and for which consumers.

The second conditional is nutritional. Whether fortified dahi is meaningfully better than ordinary dahi depends on how much leaf is added, what it contains and whether the nutrients can be absorbed. A product that adds trace amounts of leaf for colour and a health label may do little for nutrition, while one that adds enough to matter may cost acceptance. The same compositional claim can mean quite different things at different doses, which is why a single study on a single formulation can mislead readers on both sides of the argument.

A third point concerns anti-nutrients and safety. The leaf contains compounds that can interfere with mineral uptake [21, 23] and, as with any botanical ingredient, supplies of leaf powder should be of known origin and quality [22]. These do not argue against the practice. They are the routine checks any new ingredient should pass, and they are inexpensive compared with the cost of a product that proves unacceptable or unsafe in the market. These points apply with equal force to any plant powder added to a fermented milk, not only to moringa.

### 5.2 Limitations of the Evidence and of This Review

The limits of this review are those of narrative synthesis. It was not a systematic search, it may favour sources known to the authors, and it did not extract data from individual fortification trials. We have deliberately avoided quoting numerical results from single studies, on the ground that a number repeated without checking against its source is more dangerous than a qualitative statement. The consequence is that the review cannot rank formulations, nor say what dose is best.

The limits of the underlying evidence are more serious. Leaf powder is rarely characterised, probiotic strains vary between studies, storage periods are short, panels are small and untrained, and the nutritional claims seldom extend to bioavailability. Many of the studies that exist are single-site and short, and publication of positive results is more likely than of null ones. Evidence of this kind can be suggestive but cannot, on its own, settle questions of dose or consumer acceptance [32, 38].

### 5.3 What a Decisive Study Would Contain

Three findings would change this reading. A study that characterised the leaf powder, tested several graded doses against a matched control and followed a defined probiotic strain through the full shelf life would show the shape of the response and whether any dose preserves viability. A sensory study that combined a trained panel for description with an adequately sized consumer test in the intended market would show whether the product is liked and why [32, 40]. And bioavailability work would show whether the added minerals reach the consumer in a usable form [24, 25].

The design would hold the milk base, heat treatment, starter and probiotic strain constant, describe the powder and its particle size, report acidification curves and viable counts at several storage times, and measure firmness, syneresis and colour with standardised methods [7, 9]. Reporting results with interval estimates instead of significance statements alone would let readers judge precision. These requirements are demanding, but they are the ones that distinguish a result a producer can use from one that only supports a hunch.

### 5.4 Directions for Future Work

Three needs stand out. First, a formal systematic review with a transparent search and quality appraisal of studies on plant-fortified fermented

milks. Second, well-designed formulation studies with characterised powder, graded doses and storage follow-up, together with consumer testing in the target population. Third, work on the effect of fermentation on anti-nutrients and mineral availability in leaf-fortified dairy products, which is a gap that few reports address [23, 26].

### 5.5 Practical Reading for Producers and Small Dairies

For a small dairy, the sensible position is neither to dismiss moringa dahi nor to promise results. A producer who wishes to try it can do so as a small, recorded pilot: a batch with a small amount of finely milled powder alongside an unfortified batch made on the same day with the same milk and culture, with acidity, texture and taste noted in the same way for both. Records of the powder source, the amount added and the storage conditions are as important as the tasting notes, because the outcome depends on them [18, 35].

Such a pilot is not a substitute for a study, and it should not be reported as one. It can nonetheless tell a dairy whether the product is workable in its own setting, whether customers notice and like it, and whether the colour and flavour are tolerable in the market it serves. Its value lies in local decision-making, and the broader question of the best dose will be settled by designed studies and by careful synthesis of their results [11, 17].

### 6. Conclusion

Moringa leaf powder is a plausible fortificant for probiotic dahi, rich in protein, minerals and phenolic compounds and easy to add. The evidence, as we can responsibly summarise it, does not yet establish what dose gives a nutritionally meaningful and sensorially acceptable product, or how much the powder alters probiotic survival, texture and flavour over shelf life. What the literature does show is where the risks lie, what a fair study would contain, and why small untrained panels cannot carry the weight of a claim of consumer acceptance. Readers should treat claims of both health benefit and good acceptance with caution until they meet those standards.

For the practitioner the message is practical rather than discouraging. Moringa dahi can be tried, provided the powder is characterised, the dose is kept modest, the probiotic count is followed through storage and the product is tasted by the people who would buy it. For the researcher, the opportunity is a set of well-controlled formulation and consumer studies

that turn a plausible idea into a measured result that producers and consumers can rely on.

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### 9. Conflict of Interest

The authors declare no conflict of interest.

### 10. Author Contributions

C.T. conceived the review and wrote the sections on dairy technology and product quality. A.K. wrote the sections on probiotic microbiology and fermentation. R.F. wrote the sections on moringa composition, anti-nutrients and sensory evaluation. All authors revised the manuscript and approved the final version.

### 11. Ethics Statement

This is a review of published literature. No human participants or animals were used and no ethical approval was required.

### 12. Data Availability

No new data were generated. All sources are cited in the reference list.

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