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Edible plants in the *Basellaceae* family as potential supplemental functional feed ingredients for monogastric animals

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An integrative review of the existing literature surrounding plants in the *Basellaceae* family was conducted. The major cultivated species of this family, *Basella alba* (*B. alba*), *Ullucus tuberosus* (*U. tuberosus*), and *Anredera cordifolia* (*A. cordifolia*), were evaluated as potential functional feed ingredients that can diversify livestock feeding strategies and address production challenges within the Neotropics. Utilizing alternative plant species as functional feed supplements can remediate challenges to livestock production such as overreliance on imported feed ingredients, antibacterial resistance, and competition between human and animal food sources. As such, this review summarised the nutraceutical properties of the identified plant species and correlated these findings with their potential to advance Neotropical livestock production. Fifty-eight journal articles were reviewed in this paper. The results yielded a taxonomic outline of 19 plant species in the *Basellaceae* family, followed by a summary of the phytochemical and nutritional profiles of the three main species. The functional food attributes associated with the bioactive compounds of each species were also outlined. Finally, the potential of each species in monogastric animal feeding and nutrition was discussed at length, relating its application to current challenges of the livestock industry. The literature suggests that all species contain notable phytochemical and medicinal attributes. The feasibility of *B. alba* in regional livestock feeding is great; however, *U. tuberosus* is limited by its climatic condition requirements. *Anredera cordifolia* holds potential as an anti-inflammatory supplement. Species of the *Basellaceae* family provide several advantages for creating efficient, diverse, and sustainable livestock feeding strategies in the Neotropics.

KEYWORDS

Anredera cordifolia, *Basellaceae*, functional feed, Neotropical livestock nutrition, monogastric nutrition, supplemental feed, *Basella alba*, *Ullucus tuberosus*

1 Introduction

The demand for animal protein sources continues to increase in direct relation to rising global populations and consumer expectations (Ismail et al., 2020). This continued growth, coupled with contemporary issues facing animal agriculture, makes it difficult for producers to optimise their production strategies to maintain profitability and sustainability

(DSM, 2022). Feeding and nutrition in livestock production accounts for up to 70% of total input costs (Joseph and Hall, 2025). Therefore, research towards creating efficient animal feeding strategies, such as the diversification of animal feed resources, is vital.

Studies on non-conventional feedstuffs, including underutilised plant materials and agricultural by-products with great nutritional and functional potential, have emerged in response to the challenges facing the industry. Functional feed ingredients provide enhanced health and growth performance benefits due to their bioactive constituents, in addition to satisfying fundamental nutritional requirements (Lallès and Montoya, 2021; Abigarl et al., 2023). They contain basic nutrient components like protein, carbohydrates, and fats, as well as significant concentrations of vitamins, minerals, antioxidants, amino acids, immune stimulants, phytochemicals, probiotics, and prebiotics (Abigarl et al., 2023). Functional feed ingredients can be of plant, animal, or microbial origin (Abigarl et al., 2023). Plant-based supplements such as by-products and plant extracts are increasing in popularity amongst researchers and livestock scientists. They are particularly of interest for their high concentrations of secondary plant metabolites that offer nutritional, non-nutritional, antinutritional, and nutraceutical qualities. Several applications of plant-based functional feed supplements were found to improve growth performance, enhance feed conversion ratios, lower mortality rates, enhance animal immune response, and benefit gut microflora and nutrient digestion in monogastric livestock animals (Abdelsalam and Fathi, 2023; Abdelghani et al., 2024; Cascajosa-Lira et al., 2024; Badawy et al., 2025). Their supplementation also addresses critical production challenges that continue to plague producers. For example, functional feed additives serve as replacements to antibiotic administration and supplementation (Abigarl et al., 2023). The risk of antimicrobial resistance resulted in stringent restrictions and bans globally, facing producers with extreme losses from bacterial infections and outbreaks that could not be conventionally treated. The incorporation of these natural replacements has been found to relieve these production challenges (Abigarl et al., 2023).

The *Basellaceae* family is an underexplored and underutilised plant family that holds the potential being used as functional feed ingredients in livestock nutrition. Known for its nutritional and medicinal properties, this family comprises a variety of succulent herbaceous vine species, woody or erect species, and species that produce aerial and subterranean starchy tubers (Sperling, 1987). Plants of this family are native to tropical and subtropical regions of Asia, Africa, and the Americas (Sperling, 1987; Eriksson, 2007).

Basellaceae plants are highlighted for their diet-enhancing and medicinal properties in human applications, which are associated with their phytochemical and bioactive compounds (Omotoso et al., 2024). Despite these advances in human applications, its role in animal nutrition remains small. At the time of this review, plants of the *Basellaceae* family have only been incorporated into aquaculture feeding strategies, where *Basella alba* supplementation was successful in improving growth performance parameters of fishes (Oladipupo et al., 2018; Olusola et al., 2024). This identified research gap must be addressed since the evidence in the aquaculture settings shows the potential of this underutilised plant family in diversifying regional livestock feeding strategies.

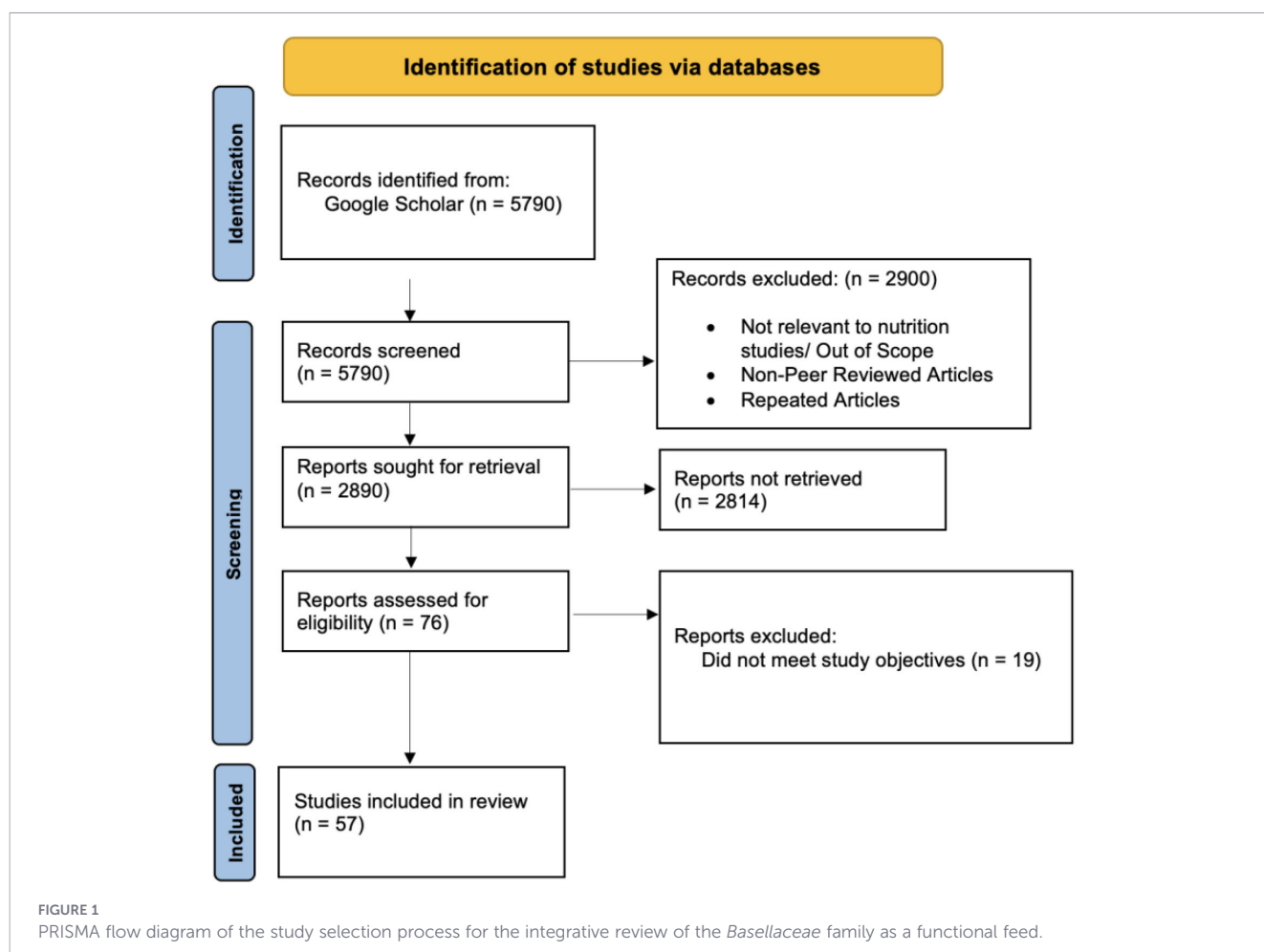
Utilising alternative feed sources to diversify animal feeding strategies can ultimately reduce the sector's reliance on imported feed ingredients, decrease production costs, address antibiotic restrictions, and improve overall profitability and sustainability (Jones et al., 2025). As such, this paper will review the three major species of the *Basellaceae* family, which are *B. alba*, *Ullucus tuberosus* (*U. tuberosus*), and *Anredera cordifolia* (*A. cordifolia*). This review will summarise the phytochemical profiles of each species and relate these findings to their potential functional feed attributes for monogastric animal feeding strategies. Furthermore, the findings of this review seek to address the following research questions: Can the established medicinal effects in human applications be adapted to enhance animal feeding strategies? How can this underutilised plant family remedy prominent challenges facing Neotropical livestock production systems? Are these plant species suited for livestock production in a tropical climatic setting? Finally, can these species serve as low-input, high-value ingredients for creating optimised, cost-effective animal feeding strategies? Overall, this review seeks to bridge the gap between primary biochemical data and preliminary studies and the enhancement of livestock feeding strategies.

2 Methodology

To fulfil the study objectives of evaluating the applicability of plants in the *Basellaceae* family for animal feeding and nutrition, an integrative literature review method was chosen. This is because an integrative review method involves the synthesis of new information based on the applicability of the findings (Souza et al., 2010). Due to its novelty, traditional feeding trial data, which examine the role of the identified plants in animal nutrition, are limited. An integrative literature review allows the combination of existing experimental data (*in vitro* studies and chemical analyses) and theoretical data (taxonomic and botanical studies) to understand the hypothesised nutritional benefits and safety for enhancing livestock production.

Google Scholar was utilised as the primary search engine for this integrative review. Google Scholar was used for its broad coverage and rigorous indexing of scientific journals, which ensures accurate and consistent data collection, enhancing the validity and reliability of the results obtained (Abusaada and Elshater, 2024). Furthermore, this database was chosen to ensure a comprehensive capture of literature from the primary geographical zones of the *Basellaceae* family including the Neotropics and Latin America, which are often excluded by Anglocentric databases like Scopus.

As of 24 March 2026, a preliminary search was conducted using the Google Scholar platform, with no restrictions on the year of publication. English was the primary language used for the scientific literature search strategy in this review. Using the search 'Basellaceae family edible plants', initial results yielded 5,790 results comprising of journal articles that assess traditional and non-traditional uses of *Basellaceae* species. This search was narrowed down using keywords such as 'edible plants', 'functional feed', 'phytochemical compounds', '*Basella alba*', '*Ullucus tuberosus*',



and '*Anredera cordifolia*', to filter results to suit the review objectives. This was then followed by further title and abstract screening. Supplementary to this preliminary search, relevant articles were obtained via the reference chaining/snowballing strategy, where applicable citations from the primary articles were extracted. At the end of the collection and screening process, 58 articles met the final inclusion criteria as applicable literature on *Basellaceae* plants used as functional feed ingredients for human and animal applications. **Figure 1** is a flow diagram based on the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) format (Page et al., 2021), which provides a visual representation of the selection process for applicable sources.

A percentage distribution of publishers was generated using the 58 cited references in this review. This calculation further strengthens the rigor of this review by confirming that the foundational data were sourced from high-impact publishers. Approximately 41.4% of the cited studies were sourced from major publishers, including Elsevier, Springer, Frontiers, and MDPI. However, a significant proportion of the results (58.6%) was sourced from specialised and/or regional journals. This indicates that the foundational research on plants within the *Basellaceae* plant family is grounded within its tropical native regions. **Table 1** details the percentage distribution calculations.

Themes and concepts from the literature were analysed using a synthesis matrix. The synthesis matrix focussed on thematic

applications of the results and findings that were used to compare and contrast plants in the *Basellaceae* family. The matrix utilised the headers 'Bioactive compound content', 'Evidence and justification', and 'Constraints and sustainability' to analyse the functional feed potential of each of the *Basellaceae* plant species. The synthesis matrix is summarised in **Table 2** below.

TABLE 1 Percentage distribution of published representation for the included studies.

Publisher group	Count	Percentage (%)
Elsevier	8	13.8%
Springer Nature	4	6.9%
Frontiers	4	6.9%
MDPI	3	5.2%
Taylor & Francis	2	3.4%
Wiley-Blackwell	1	1.7%
Cambridge University Press	1	1.7%
American Chemical Society (ACS)	1	1.7%
Regional/specialised	34	58.6%
Total	58	100%

TABLE 2 Synthesis matrix for thematic analysis of the results and findings.

Functional feed potential	Plant species	Bioactive compound content	Evidence and justification	Constraints and sustainability
Alternative antibiotic growth promoter	<i>Basella alba</i>	Phenolic compound content	Study results (Oladipupo et al., 2018; Olusola et al., 2024) are comparable to feed-supplemented antibiotic growth enhancement in monogastrics (Xu and Yu, 2021; Iqbal et al., 2024)	Antinutritional factors (ANF), e.g., high tannin content (Adenegan-Alakinde and Ojo, 2018) requires caution and field trials Climate adaptability and invasive nature create suitable sustainable utilisation in animal feeding (Vélez-Gavilán, 2022)
Vegetable by-product	<i>Ullucus tuberosus</i>	Skin concentrated phenolic compounds	Concentrated bioactive contents in skin (Svenson et al., 2008)	Competition between human and animal feed resources (Xu and Yu, 2021) Sustainable implementation by utilising skin waste/vegetable by-product (Xu and Yu, 2021)
Functional antimicrobial	<i>Anredera cordifolia</i>	Phenolic compound content	Comparable bioactive compound content to medicinal plants (Fachriyah et al., 2019; Alba et al., 2020; Kumar et al., 2021; Pratiwi et al., 2024)	Not currently established in animal feeding and nutrition Safe incorporation as animal feedstuff based on toxicology studies (Suryawati et al., 2022)

3 Results

3.1 Taxonomic overview and cultivation characteristics of the *Basellaceae* family

The relatively small family of the *Basellaceae* contains 19 species which are divided into four genera, namely, *Anredera*, *Basella*, *Tourneria*, and *Ullucus*. Table 3, adapted from Eriksson (2007), categorises each species under its respective genera.

Three of these species, *Anredera*, *Tourneria*, and *Ullucus*, are native to the Neotropics, mainly in the Andean regions of South America (Eriksson, 2007). Meanwhile, the genus *Basella* is native to South and East Africa and Madagascar (Sperling, 1987; Eriksson, 2007). The species *B. alba* L. is found in the tropics (Sperling, 1987; Eriksson, 2007), with later research confirming its origins from South Asia, including India and Indonesia, and its naturalisation in Tropical Asia and Africa (Page et al., 2021). Plants of this family are

generally succulent, herbaceous vines, containing fleshy vines and broad mucilaginous leaves, and are primarily taxonomised by their reproductive features (Sperling, 1987; Eriksson, 2007).

However, of the 19 known species within the family, two are of major commercial value (*B. alba* and *U. tuberosus*) and one is a known medicinal plant (*A. cordifolia*). *Basella alba* is largely cultivated in the eastern tropics as a leafy vegetable, and *U. tuberosus* is a significant tuber crop cultivated in the Andean region (Eriksson, 2007). Some species of the *Anredera* genus are cultivated as ornamental crops; however, they are mainly known for their healing and ethnomedicinal properties (Eriksson, 2007).

Edible plants of the *Basellaceae* family have attracted the interest of researchers over recent years because of their nutritional and health benefits. Figure 2 outlines a trend graph of scientific productivity that was generated using a systematic search method via the Google Scholar database. Four key search terms—‘*Basellaceae* family edible plants’, ‘*Basella alba* AND nutrition’, ‘*Ullucus tuberosus* AND nutrition’, and ‘*Anredera cordifolia* AND nutrition’—were entered into the database and filtered by year to measure the trend in results generated over time. The data presented in the graph illustrated a prominent exponential increase in research interest surrounding the search terms, particularly within the last decade. The search for ‘*Basella alba* AND nutrition’ showed the steepest growth curve surpassing 5,000 results by 2026. The search for *A. cordifolia* also showed a significant jump from 2020 to 2026.

3.1.1 *Basella alba*

Basella alba, also known as ‘Malabar spinach’ or ‘Poi/Poui Bhaji’, occurs in two forms: *B. alba*, which is the green- or white-stemmed, succulent twining vine, and its synonymous subspecies *B. rubra*, which is the red-stemmed variety differentiated by stem and fruit colour and has smaller stems and leaves in comparison to the green-stemmed variety (Sperling, 1987; Deshmukh and Gaikwad, 2014). This plant, described as ‘wildly cultivated’ in parts of India, is a leafy vegetable, commonly referred to as ‘Poi’ in this region (Chaurasiya et al., 2021). It is a heat-tolerant, fast-growing vining plant that is highly prolific in nature, which can become quite

TABLE 3 A total of 19 documented species of *Basellaceae* categorised by genera.

<i>Anredera</i> (12 species)	<i>Basella</i> (5 species)	<i>Tourneria</i> (1 species)	<i>Ullucus</i> (1 species)
<i>A. aspera</i>	<i>B. alba</i>	<i>T. hookeriana</i>	<i>U. tuberosus</i>
<i>A. baselloides</i>	<i>B. excavate</i>		
<i>A. brachystachys</i>	<i>B. leandriana</i>		
<i>A. cordifolia</i>	<i>B. madagascariensis</i>		
<i>A. densiflora</i>	<i>B. paniculata</i>		
<i>A. diffusa</i>			
<i>A. floribunda</i>			
<i>A. krapovickasii</i>			
<i>A. marginata</i>			
<i>A. tucumanensis</i>			
<i>A. vesicaria</i>			
<i>A. ramosa</i>			

The table was adapted from Eriksson (Lallès and Montoya, 2021).

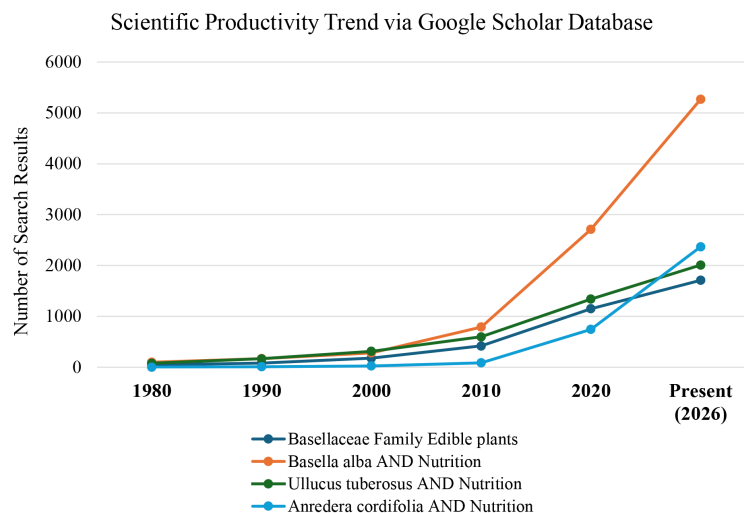


FIGURE 2
Scientific productivity trend graph of the literature on the *Basellaceae* plant family.

invasive if left unmanaged (Vélez-Gavilán, 2022). It is particularly of interest due to its prominent nutritional and medicinal value, being widely studied by researchers in India (Chaurasiya et al., 2021). Its high phytochemical and bioactive content offers a range of nutraceutical applications in human nutrition (Chaurasiya et al., 2021). Other uses of *B. alba* and *B. rubra* include its cultivation as an ornamental pot plant in some places of India (Chaurasiya et al., 2021) and its application as a food-grade dye, ink, and cosmetic colouring produced by the purple-coloured fruit (Eriksson, 2007).

3.1.2 Ullucus tuberosus

Ullucus tuberosus, also known as ‘Ulluco’ in its native region or by its Spanish name ‘Papalisa’, is an edible Andean tuber crop, native to the Neotropics, and is naturalised in countries along the Andes Mountains including Colombia, Peru, Ecuador, Northern Argentina, Bolivia, and Venezuela (Rodríguez et al., 2024). It is a starchy, potato-like tuber that comes in a variety of colours ranging between pink, red, magenta, purple, and orange and grows in heights of up to 3,500 m in altitude (Rodríguez et al., 2024; Patricia et al., 2025). Patricia et al (2025) stated that *U. tuberosus* is the second most economically significant Andean tuber crop, being surpassed only by potatoes, indicating its significant commercial value its native region (Patricia et al., 2025). Like *B. alba*, it is widely known for its nutritional content and medicinal healing properties, due to its concentration of antioxidants and bioactive and phenolic compounds (Rodríguez et al., 2024; Patricia et al., 2025). Additionally, the starchy nature of its tubers makes *U. tuberosus* useful in the cooking industry, with successful applications as cooking flour and cooking starch used as a food-gelling agent in jams and jellies. These applications further highlight the untapped potential of this *Basellaceae* species as a functional food in the food industry (Patricia et al., 2025).

3.1.3 Anredera cordifolia

Anredera cordifolia comes from the largest genus of the *Basellaceae* family, of which its species are distributed pan-tropically. It is characterised by its unique, fragrant inflorescence (Eriksson, 2007). It is commonly called ‘Madeira vine’ or ‘Banahong’ (Eriksson, 2007; Alba et al., 2020; Pratiwi et al., 2024). In Latin America and Indonesia, it is a well-known ethnomedicinal plant, which claims to be effective in wound healing and as an antifungal, anti-inflammatory, and antimicrobial agent (Alba et al., 2020; Pratiwi et al., 2024).

3.2 Phytochemical composition and medicinal potential of *Basellaceae*

3.2.1 The function of flavonoids in *Basella alba*

The chemical composition of *B. alba* was quantified via proximate analysis by Olusola and Olaifa (2018), who examined a group of edible leaves with potential as feedstuff in aquaculture. The results confirmed its notable chemical fractions on a dry matter basis, with 21.1% crude protein, 10.35% crude fibre, and 3.8% ether extract (crude fat) (Olusola and Olaifa, 2018) (see Table 4). Similar works by Killur et al. quantified 36.9% oils, 50.3% fatty acids, 49.1% linoleic acid, and 23.1% protein within the composition of *B. alba* seeds (Killur et al., 1983). The carbohydrate content of dried *B. alba* leaves was quantified by Agbede et al (2012) as 32.9% (see Table 4). This study also confirmed the proximate analyses results of Olusola and Olaifa (2018), by presenting similar percentages including 25.28% crude protein and 9.23% fibre; however, this study recorded a higher crude fat percentage of 8.57% (Agbede et al., 2012). The amino acid profile of this plant was quantified by Khare, who confirmed the presence of the essential amino acids isoleucine, lysine, leucine, arginine, tryptophan, and threonine (Khare, 2007).

TABLE 4 Chemical and mineral composition of *Ullucus tuberosus*, *Basella alba*, and *Anredera cordifolia*.

Proximate composition			
Chemical Composition	<i>Ullucus tuberosus</i>	<i>Basella alba</i>	<i>Anredera cordifolia</i>
Carbohydrates (%)	67 Source (Sanchez-Portillo et al., 2024):	32.9 Source (Agbede et al., 2012):	N/A
Crude fibre (%)	14	10.35	
Crude Protein (%)	6.28	21.1	
Crude fat (%)	0.25	3.8	
	Source (Sanchez-Portillo et al., 2024):	Source (Olusola and Olaifa, 2018):	
Mineral composition			
Potassium (%)	4.12	N/A	N/A
Magnesium (%)	1.22	N/A	
	Source (Sanchez-Portillo et al., 2024):		

N/A, not available.

The medicinal properties of *B. alba* are largely credited in the literature by its antioxidant and phenolic compound concentrations. Plant extracts of *B. alba*, *B. rubra*, and the landrace variety *B. cordifolia* were confirmed with substantial phenolic compound concentrations (Adenegan-Alakinde and Ojo, 2018). Studies confirm *B. alba* as an excellent source of vitamins A, C, and B₉ (folic acid) as well as minerals including iron, calcium, and magnesium (Deshmukh and Gaikwad, 2014). *Basella alba* was recorded to contain multiple forms of flavonoids (Bose et al., 2023), as well as a compound known as basellasaponins (Sen et al., 2016), which is a saponin-type bioactive compound known for its soaping properties and medicinal herbal role (Bose et al., 2023). Adenegan-Alakinde and Ojo (2018) quantified the largest concentration of phenol and vitamins A and C in *B. alba*, the highest concentrations of alkaloids and tannins in *B. rubra*, and the highest flavonoid and saponin concentrations in *B. cordifolia*.

A review article by Chaurasiya et al. (2021) (Chaurasiya et al., 2021) listed a multitude of medicinal and human health benefits of *B. alba*, all associated with its phenolic compound content. This plant has been confirmed to have anti-ulcer, anti-inflammatory, antihypoglycaemic, antiproliferative, wound and scar healing, and antimicrobial properties. They also noted that *B. alba* leaf juice has been successful in the treatment of urinary diseases and can work as a mild laxative for children (Chaurasiya et al., 2021).

A similar study by Omotoso et al (2024) confirmed the findings of Chaurasiya et al (2021) by also reporting anticancer, antimicrobial, antiproliferative, anti-inflammatory, and neuroprotective effects of *B. alba* for human health (Omotoso et al., 2024). A review article by Bose et al. compiled multiple studies that correlated these medicinal claims with their associated phytochemical compounds that are present in *B. alba* (Bose et al., 2023). Flavonoids such as acecetin and kaempferol were credited for their anticancer, antimutagenic, and chemotherapeutic claims (Hebbar et al., 2004; Bose et al., 2023). β-Sitosterol, which is a naturally occurring cholesterol, is claimed to lower cholesterol, in addition to showing anticancer, antioxidant, anti-inflammatory, immunomodulatory, and anti-infective effects (Salimi and Pourahmad, 2018). β-Carotene has cancer-protective qualities and shows antioxidant

qualities of neutralising and stabilising free radicals and reactive oxygen species (ROS) (Hussain et al., 2018). Basellasaponins show anti-inflammatory properties and are effective in treating constipation (Uhegbu et al., 2011; Murakami et al., 2001; Saroj et al., 2025).

Furthermore, the review article by Bose et al. outlined several *in vitro* and *in vivo* studies that confirmed the anti-ulcer, anti-inflammatory, and antimicrobial claims of *B. alba* (Bose et al., 2023). *Basella alba* exhibited anti-ulcer properties in a study, where lab rats were induced with gastric ulcers using pylorus ligation and ethanol-induced ulcers and were treated with two forms of *B. alba* extract (aqueous and ethanolic). The treatment resulted in ‘dose-dependent’ effects, where gastric mucosal protection and a decrease in gastric acidity were observed in the treated animals (Kumar et al., 2012). *Basella alba* leaf extract showed ‘concentration-dependent’ anti-inflammatory properties in an *in vitro* study where human blood samples were utilised. The treatment resulted in a membrane stabilisation effect which is an important mechanism for reducing inflammatory response (Kumar et al., 2011). Another *in vitro* study by Deka et al. presented significant antimicrobial activity of ethanolic *B. alba* extract against gram-positive *Staphylococcus aureus*, gram-negative *Escherichia coli*, and fungal strains including *Candida albicans* and *Trichophyton rubrum* (Deka et al., 2017). Table 5 summarizes the phytochemical profiles of the *Basellaceae* species that is presented in the literature.

3.2.2 Chemical profile and wound-healing effects of *Ullucus tuberosus*

A study by Sanchez-Portillo et al (2024) outlined the chemical fractions of two Andean tuber crops via proximate analysis, with *U. tuberosus* amongst the subject tubers. Its composition was confirmed to have 67% carbohydrates, 14% fibre, 6.28% protein, and 0.25% fat. Its mineral content was also quantified, having 4.12% potassium and 1.22% magnesium (Sanchez-Portillo et al., 2024) (see Table 4). Furthermore, the researchers used high-performance liquid chromatography-mass spectrometry analysis to quantify the phenolic compound in the skin and pulp. This test confirmed the presence of caffeic acid 4-O-glucoside, p-coumaroyl glucose,

and 3,7-dimethylquercetin (Sanchez-Portillo et al., 2024). The literature also attributed its notable phenolic compound content to the betalains present in its uniquely coloured tuber skin (Svenson et al., 2008).

The aqueous extract of *U. tuberosus* was confirmed of having wound-healing properties by the research conducted by Heil et al (Heil et al., 2017). The study quantified a 12% increase in collagenase activity, the presence of dermal fibroblasts, and the production of pro-collagen in *U. tuberosus* extract, which is responsible its effective application in scar and wound-healing treatments. The study proved this crop to be effective in scarless tissue regeneration (Heil et al., 2017).

3.2.3 Anti-inflammatory and wound-healing effects of *Anredera cordifolia* in human applications

The characterisation of the bioactive compounds of *A. cordifolia* revealed concentrations of flavonoids, saponins, tannins, alkaloids, ascorbic acid, steroids, and triterpenoids (Alba et al., 2020; Pratiwi et al., 2024). Fachriyah et al (2019) characterised and isolated the phenolic compounds of *A. cordifolia* ethanolic extract. The authors found a significant amount of *p*-coumaric acid in their isolation analysis (Fachriyah et al., 2019). The wound-healing and anti-inflammatory claims of this medicinal plant are supported by these compounds, which were outlined in a review article by Pratiwi et al (Pratiwi et al., 2024). The wound=healing claims of *A. cordifolia* were tested by Kaur et al (2014) and Istyastono and Yuliani (2016). Kaur et al. evaluated the application of *A. cordifolia* leaf paste as a topical application for wound healing in mice. This study found that the leaf paste performed better than sodium chloride and providone iodone in the wound-healing process of the test mice (Kaur et al., 2014). Istyastono and Yuliani examined the success rate of *A. cordifolia* leaf extract in promoting scarless wound healing. They found that combining the leaf extract with an

enzyme inhibitor (cyclooxygenase-2 inhibitor) resulted in wound healing with reduced scar tissue formation (Istyastono and Yuliani, 2016).

Laksmitawati et al. confirmed the anti-inflammatory properties of *A. cordifolia* after the plant extract exhibited inhibitory activities to inflammatory mediators in their study (Laksmitawati et al., 2017). Similarly, Syahfery et al. confirmed the anti-inflammatory properties of *A. cordifolia* in a clinical setting. In their study, the leaves were used in the form of a ‘subgingival gel’ at 3%, and it was successful in reducing the effects of pro-inflammatory compounds associated with a tooth-infection condition known as chronic periodontitis (Syahfery et al., 2020). In highlighting these findings, Pratiwi et al. did not record either studies to claim specific compounds of *A. cordifolia* as responsible for their anti-inflammatory effects (Pratiwi et al., 2024). However, the work by Serafini et al. credited flavonoid compounds for their ability to inhibit pro-inflammatory compounds (Serafini et al., 2010).

4 Discussion

4.1 The *Basellaceae* species as functional feed ingredients for monogastric animals

The interest in the *Basellaceae* plant family has increased in recent years because of its effective applications as an ethnomedicinal plant with nutritional and high antioxidant properties. Figure 2 outlines a scientific productivity trend graph, showcasing a notable surge in the results produced via the Google Scholar database. The increase in primary research studies outlines the recent shift towards the exploration of alternative plant species with medicinal nutritional benefits. While the increasing number of primary studies justifies the relevance of exploring novel alternative nutritional and medicinal plant sources, it also underscores the need

TABLE 5 Phytochemical profiles of *Basella alba*, *Ullucus tuberosus*, and *Anredera cordifolia*.

Phytochemical profile		
<i>Basella alba</i>	<i>Ullucus tuberosus</i>	<i>Anredera cordifolia</i>
Vitamins A, C, and B ₉ (folic acid) (Page et al., 2021)	Caffeic acid 4-O-glucoside p-Coumaroyl glucose 3,7-Dimethylquercetin (Kumar et al., 2011)	Flavonoids Saponins Tannins Alkaloids Ascorbic acid Steroids Triterpenoids (Rodríguez et al., 2024; Patricia et al., 2025)
Flavonoids (Khare, 2007)	Betalains (Deka et al., 2017)	<i>p</i> -Coumaric acid (Svenson et al., 2008)
Basellasaponins (Adenegan-Alakinde and Ojo, 2018)		
Phenols Vitamins A and C Alkaloids Tannins Flavonoid Saponin (Killur et al., 1983)		

for implementing information synthesis research for novel applications. Integrative review methodologies that analyse and translate existing primary data into alternative sustainable applications, such as in livestock and animal feeding, aim to bridge the gap between the existing raw data and applied science. The current review not only summarises the nutritional and chemical contents of plants in the *Basellaceae* family but also proposes hypothesised functional feeding strategies that can potentially boost tropical livestock productivity and sustainability.

4.2 *Basella alba* as a potential antibiotic substitute

To date, the application of *B. alba* in animal nutrition remains limited to aquatic cultivation. A feeding trial by Oladipupo et al (2018) observed the effects of *B. alba* leaf meal inclusion in the diets of Nile tilapia (*Oreochromis niloticus*) in aquaculture. The authors found improved weight gain and specific growth rate, feed intake, and feed conversion ratio amongst the fishes at an optimum inclusion percentage of 2.0% (Oladipupo et al., 2018). A similar trial by Olusola, Olusola, and Abbah (Olusola et al., 2024) observed the dietary inclusion of *B. alba* extract in juvenile African sharp-tooth catfish (*Clarias gariepinus*). The results found increases in weight gain, specific growth rate, protein productive value, and survival rate at a 2% inclusion rate of the extract (Olusola et al., 2024).

Its phytochemical and nutritional content, along with its efficacy in fish growth performance, evokes the thought of its application in other livestock species to address challenges like antimicrobial resistance. Low dosages of antibiotics have commonly been used as animal feed additives in poultry and pigs for improving growth performance and overall productivity (Hao et al., 2014; You and Silbergeld, 2014; Manyi-Loh et al., 2018). However, the detriments of antibacterial resistance caused by the overuse of antibiotics in animal nutrition led to restrictions and, in some countries, bans surrounding the administration of antibiotics in livestock production (Manyi-Loh et al., 2018; Xu and Yu, 2021). The exploration of functional feed ingredients, like medicinal plants and agricultural by-products that are high in phytochemical compounds and antioxidants, has emerged as a substitute to antibiotic feed supplementation with equivalent effects (Xu and Yu, 2021; Iqbal et al., 2024). These functional attributes are confirmed by the improved growth effects that occurred in the Nile tilapia and African sharp-tooth catfish after *B. alba* dietary supplementation (Oladipupo et al., 2018; Olusola et al., 2024). These observations invite further research into *B. alba* as functional feed additives for other livestock species which can replace the use of antibiotics for enhancing growth performance.

On the other hand, the literature also noted its high tannin concentration particularly in *B. rubra* (Adenegan-Alakinde and Ojo, 2018). Tannins are polyphenolic compounds in plants that act as their defence mechanism by exhibiting protein-binding qualities, which reduce protein digestion in herbivores (Yacout, 2016; Sommerauer et al., 2019). This exhibits antinutritional qualities particularly in monogastric digestion, which binds to proteins making it difficult to digest (Tong et al., 2022). As such, methods of

safely incorporating medicinal plants as functional feed ingredients must be carefully evaluated. For example, with higher inclusion percentages (above 2.0%) in the Nile tilapia, researchers observed a decline in growth performance and productivity of the fishes (Oladipupo et al., 2018). The cause of this decline in productivity was not identified in the study; however, confirmation of the high tannin concentration implies that antinutritional factors take effect at higher inclusion percentages. This highlights the importance of continued research on determining optimal inclusion levels of *B. alba* in other livestock species, to harness its productive benefits. It should be noted, however, that tannins have beneficial applications in ruminant digestion, where their protein-binding quality is used for encapsulating by-pass proteins for efficient ruminant protein digestion (Xu and Yu, 2021; Tong et al., 2022). In such cases, polyphenols of *B. alba* can be used to improve meat and milk production in ruminants (Tong et al., 2022).

In terms of its regional adaptability to the Neotropics, *B. alba* is well suited to tropical climates. It is drought-tolerant and prolific in nature (Vélez-Gavilán, 2022) and has been naturalised in several Caribbean islands like Trinidad. However, currently, its main form of utilisation is as a human food source (Chaurasiya et al., 2021). This creates concerns of competition between human and livestock feed resources. Yet, when considering its growing habits and adaptability to tropical climate, the literature also confirms that *B. alba* is invasive in nature. It is considered a potential weed in Australia; a sugarcane field weed on Iriomote Island, Japan; and classified as an invasive species in several countries, including China, the Philippines, Cuba, and Hawaii (Vélez-Gavilán, 2022). Therefore, its invasive nature makes it important to evaluate its productive uses. Its application in animal feeding can make the most of its beneficial properties and reduces its risks of becoming an invasive weed.

4.3 *Ullucus tuberosus* as a vegetable by-product functional feed ingredient

Studies on the application of *U. tuberosus* in animal feeding and nutrition is currently unavailable, yet its potential for use in this area cannot be disregarded. Its high carbohydrate, protein, mineral, antioxidant, and polyphenolic compound contents make it suitable to serve as an energy-dense feeding supplement, similar to starchy tubers with comparable biochemical compositions, such as cassava. A review by Ogbuewu and Mbajorgu (2022) concluded that the inclusion of cassava in broiler chicken diets resulted in improved growth performance traits. The nutritional composition of *U. tuberosus* invites future research on its viability as a sustainable feed ingredient for livestock production systems.

However, like *B. alba*, the major application of this tuber crop is currently for human consumption (Patricia et al., 2025). This raises similar concerns of competition between human and livestock feed resources. Considering that the literature highlights the source of its high antioxidant content being from its unique skin colour pigmentation (Svenson et al., 2008), using its skin as a supplementary feed by-product for its functional attributes may be more applicable for harnessing its medicinal benefits. Potato skin is a common

functional feed ingredient in the form of a vegetable by-product, which contributes to sustainable food systems and waste reduction (Xu and Yu, 2021). Therefore, utilizing *U. tuberosus* for livestock feed supplementation, a similar approach can promote sustainability and cyclical food production systems.

It is important to note the limitations affecting its feasibility for application in regional livestock production systems. As a crop that originates in the Neotropics, its regional application is greatly limited by its growing conditions. Unlike *Basella alba* which has been naturalised in Caribbean islands with warmer climates (Vélez-Gavilán, 2022), this tuber crop requires cool conditions of high-altitude regions such as the Andes mountains (Rodríguez et al., 2024). Because of this, it cannot be found in regions such as the low-lying Caribbean islands, which limits its adaptability to the larger tropical region. Therefore, its application for use in livestock feeding strategies is currently limited to its native Andean region of the Neotropics.

4.4 *Anredera cordifolia* as an anti-inflammatory supplement for human health

The application of *A. cordifolia* as an animal food source has not yet been researched. At the time of this review, it has only been used in lab rats to test and confirm medicinal claims (Suryawati et al., 2022). However, this plant bears similar phytochemical constituents and nutraceutical associations to its related taxa, *B. alba* and *U. tuberosus* (Fachriyah et al., 2019; Alba et al., 2020; Pratiwi et al., 2024). Furthermore, toxicity studies by Suryawati et al. claim that *A. cordifolia* is non-toxic to Wistar rats (Suryawati et al., 2022). Therefore, its application as a functional feed ingredient in monogastric livestock production is possible, and it can seek to address challenges such as antimicrobial resistance and disease treatment.

Anredera cordifolia can be used as a functional feed ingredient similar to guava leaf extract (GLE) which has been used in growing rabbits. Kumar et al. characterised the phenolic compounds of GLE and listed the presence of quercetin, avicularin, apigenin, guaijaverin, kaempferol, hyperin, myricetin, gallic acid, catechin, epicatechin, chlorogenic acid, epigallocatechin gallate, and caffeic acid (Kumar et al., 2021). These compounds were credited for the extract's prominent medicinal properties, many of which overlap with the reported medicinal effects of *A. cordifolia* (including antimicrobial, anti-inflammatory, and antioxidant), which also contains a similar phenolic compound profile (Alba et al., 2020; Pratiwi et al., 2024). GLE was supplemented into rabbit diets on the basis of these nutraceutical claims and its potential for acting as an antimicrobial feed supplement replacement (Kumar et al., 2021). This supplementation was found to improve weight gain and feed intake, reduce lipid contents (triglycerides, total cholesterol, LDL, HDL, and VLDL), and improve immunoglobulins and antioxidant indicators in the treated rabbits (Kumar et al., 2021). These results from this study indicate an overall improvement in the production of these animals. The similarities between the phenolic compounds and nutraceutical claims of GLE and *A. cordifolia* both suggest that its application as a functional feed ingredient in monogastric animals can yield favourable production improvements.

4.5 Strengths, limitations, and future research

This review provides a synthesis of data surrounding the potential of edible plants in the *Basellaceae* family in animal nutrition. The integrative review methodology allowed a comprehensive synthesis of various types of data, including botanical descriptions, *in vitro* studies, experimental trials, and chemical analyses, to establish the novel theoretical framework for utilising *Basellaceae* plant species as functional feed ingredients for animal feeding. However, to appropriately establish the importance of this fundamental work, the limitations of this review must be acknowledged.

At the time of this review, the existing literature of plants of the *Basellaceae* family is concentrated in the global south, including the Neotropics, Latin America, and Eastern Tropics. As such, a significant portion of the published literature is indexed in regional repositories rather than high impact databases like Scopus or Web of Science. While Google Scholar was successful in capturing this range of regional literature, the cited sources may pose accessibility restrictions to the wider international scientific communities.

Additionally, the *Basellaceae* family remains largely underexplored in the context of animal nutrition and livestock feeding. Most of the available literature comprises studies that examine ethnomedicinal applications of these plants in human applications or health benefits in human consumption. In this regard, the synthesis of information in this review relies greatly on the extrapolation of the nutritional compositions and phytochemical characterisations to hypothesise the potential nutritional benefits for animal feeding.

Furthermore, while there are 19 known species of this plant family, the available literature remains restricted to the three main commercialised/edible species that were discussed in this review. The existing scope of published data does not include nutritional profiles for the remaining 16 wild species. Therefore, the suitability of these species for animal feeding remains speculative, until the appropriate analyses and testing are done.

In order to maximise the practicality of these review findings, future studies must prioritise experimental feeding trials to determine the safety and efficacy of these plants as functional feed ingredients for animal nutrition.

5 Conclusion

The three major species of the *Basellaceae* family, *B. alba*, *U. tuberosus*, and *Anredera cordifolia*, are greatly recognised in their native regions for their healing and ethnomedicinal properties. Research on the application of *B. alba* in animal nutrition has been published; however, it is limited to only one animal species, i.e., fishes. The production improvements in the aquaculture setting suggest beneficial applications in other monogastric livestock species. *Ullucus tuberosus* has not yet been recognised in animal nutrition, but its potential as a vegetable by-product functional feed ingredient is substantial. However, this tuber crop is limited by its growing conditions and can only be utilised in high-altitude tropical regions. Similarly, *A. cordifolia* has not been applied in

animal nutrition; however, it can potentially act as an anti-inflammatory feed supplement. With the increasing demands for more sustainable animal feeding and nutrition systems, commercial crops of the *Basellaceae* family can play an important role in the diversification of feed sources.

Author contributions

AJ: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. KJ: Conceptualization, Formal Analysis, Supervision, Validation, Writing – original draft, Writing – review & editing.

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