

Review

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Review

Momordica balsamina L.: A Plant with Multiple Therapeutic and Nutritional Potential. A Review

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Abstract: This comprehensive review seeks to deepen our comprehension of the African plant *Momordica balsamina* L. by elucidating its therapeutically important molecules and micronutrient composition. Commonly referred to as the balsam apple, this plant species is extensively harnessed for its diverse therapeutic potentials across its various organs including leaves, fruits, roots, and stems. Numerous bioactive molecules have been isolated or identified within this plant, notably encompassing polyphenols, flavonoids, terpenes, and carotenoids. These compounds exhibit a wide array of biological activities, ranging from antioxidative, anti-inflammatory, anti-diabetic, anti-carcinogenic, to anti-malarial properties, among others. Furthermore, the leaves of *Momordica balsamina* L. stand out for their abundant micronutrients, proteins, and amino acids. This investigation aims to shed light not only on the botanical characteristics of the *Momordica balsamina* plant and its potential applications in traditional medicine, but also on its chemical composition, biological functionalities, and physicochemical attributes, thus accentuating its nutritional advantages. Nonetheless, an intriguing avenue presents itself for the exploration of strategies to conserve this species, delve deeper into its potential within the cosmetics industry, and innovate methodologies for the synthesis or biosynthesis of these bioactive molecules.

Keywords: *Momordica balsamina* L.; Phytotherapy; phytochemicals; biological properties; Nutritional values; cosmetic uses

1. Introduction

For millennia, humanity has drawn upon environmental resources to ensure survival and well-being. Even in contemporary times, plants remain invaluable sources of sustenance and medicinal properties [1,2]. Nevertheless, a scarcity of ethnobotanical and chemical investigations has obscured the full extent of their pharmacopoeia, nutritional value, and therapeutic potential.

In the present era, uncovering the botanical intricacies and therapeutic merits of plants presents a formidable challenge. Indeed, plants are fundamental and essential components in pharmaceutical research and production [1]. Consequently, delving into their chemical compositions and nutritional profiles emerges as a critical pursuit to enhance their application in medicine. Notably, plant-based derivatives constitute over 50% of the global medicinal repertoire [3]. These plants are frequently encountered in herbalists' domains, traditional healing practices, marketplaces, or their regions of origin. The leaves, barks, roots, and fruits of medicinal plants constitute the most utilized components for phytotherapeutic purposes, often administered through maceration, infusion, digestion, or decoction [4].

The Cucurbitaceae family, widely employed in traditional medicine, encompasses herbaceous vines with tendrils, and in some cases, shrubs. Certain of these species exhibit widespread distribution across tropical and subtropical regions [4,5]. Cucurbits notably hold a significant position in Africa, offering a range of edibles (such as squash, pumpkin, melon) and utilitarian items (like gourds and sponges). The fruits of numerous cucurbit species, rich in micronutrients, constitute dietary staples in Africa, sometimes consumed as juices to alleviate micronutrient deficiencies. Plants within the *Momordica* genus are of notable importance for their remedial attributes [6].

Momordica balsamina, commonly known as balsam apple or referred to as Mburbuf or Mborbof in the Wolof language (native to Senegal), belongs to the *Momordica* genus. Flourishing in arid expanses of tropical and subtropical Africa, *Momordica balsamina* serves a dual role, being both a dietary staple and a fundamental element of traditional African medicine. It finds application in alleviating diverse symptomatic manifestations, including those associated with diabetes and malaria [7].

The primary objective of this article is to provide a comprehensive botanical delineation of *Momordica balsamina*, followed by an exhaustive exploration of its numerous applications. Subsequently, a detailed synthesis of its chemical composition, biological activities, and nutritional potential is presented.

Momordica balsamina, with its numerous applications in the food sector, as a source of medicine, and potentially as a source for new cosmetic ingredients, truly deserve this review paper.

2. Botanical Description of *Momordica balsamina*

The genus *Momordica* comprises approximately fifty-nine herbaceous or perennial herbaceous species, occasionally manifesting as small shrub climbers. These plants belong to the cucurbit family and are indigenous to tropical and subtropical regions of Africa, Asia, and Australia [8].

Momordica balsamina (Figure 1) is an annual herbaceous, monoecious, climbing plant with glabrous or lightly hairy stems up to 4 to 5 m long, equipped with tendrils for attachment to nearby vegetation. It grows at altitudes of 0 to 1,293 m [3,4,9].

- The leaves of *Momordica balsamina* (see Figure 1a) exhibit a light green hue. They are alternate, waxy, simple, and lobed, featuring three to five distinct lobes covering up to half of the leaf blade. These leaves can reach a length of 12cm [4,9,10];
- The flowers (see Figure 1d) are pale yellow, monoecious, and solitary. They take on a rounded, trumpet-like form, characterized by a pedicel measuring up to 0.5 cm in length. The receptacle spans 0.5-1 mm, while the sepals are narrow and can grow up to 0.5 cm. Petals range from 0.5-1.5 cm in length, surrounding a unicellular lower ovary [3,4,10],
- The fruits of *Momordica balsamina* (see Figure 1b) adopt a spindle-shaped appearance, with colors shifting from orange to vibrant red. These fruits exhibit about 19 rows of regular or irregular, short, blunt, non-prickly, creamy, or yellowish spines. Upon ripening (when orange), the fruits, which measure 25-60 mm, spontaneously split into three coiled valves, revealing numerous seeds enshrouded by a vivid, extremely adhesive scarlet aril. This aril is edible and possesses a sweetness akin to watermelon. The seeds are encased within a crimson pulp. Oval and compressed, the seeds span 9 to 12 mm in length [3,4,10].

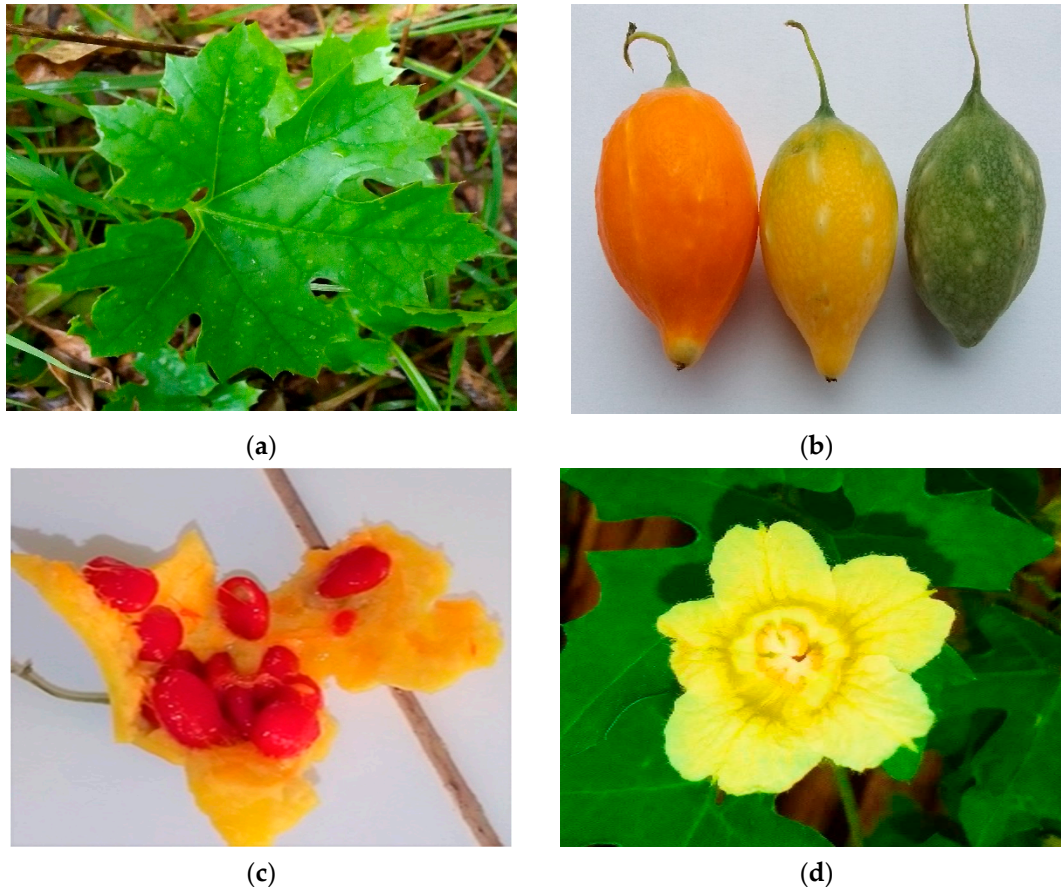


Figure 1. Different parts of the *Momordica balsamina* plant: (a) leaves, (b) fruit, (c) seed and (d) flower [Mareme THIAW, Ngoundiane (Thies- Senegal) 2022].

Momordica balsamina is a prevalent vegetable within tropical and subtropical zones [6]. Originating in tropical Africa, it has proliferated across drier areas of South Africa and coastal regions of Australia. Its cultivation has extended to European gardens, as well as central American, Arabian, tropical Asian, and Indian regions. In India, it thrives naturally in forests during the rainy season. This species has been introduced to parts of the Neotropics, gaining naturalization in the United States and Pakistan [9,11]. It is found growing in the wild across southern African regions, including Botswana, Swaziland, Namibia, and South Africa. Within South Africa, it flourishes in the Eastern and Northern Cape, Limbo, and Kwazulu-Natal provinces [3].

3. Traditional Uses of *Momordica balsamina*

Momordica balsamina is an intriguing plant renowned for its potent medicinal properties. It finds application in treating a variety of conditions such as hypertension, digestive disorders, malaria, diabetes, and measles prevention [4].

Furthermore, *Momordica balsamina* is recommended for addressing dermatological ailments like pimples, skin spots, and edema. It serves as a remedy for wounds, eczema, allergies, and skin infections, while also functioning as a skin moisturizer.

The plant assumes the role of an anthelmintic when employing its fruits, seeds, and leaves. Leaves are used to combat fever and excessive uterine bleeding, while the whole plant is utilized to manage syphilis, rheumatism, hepatitis, and diverse skin conditions. It has applications as an abortifacient, aphrodisiac, galactogen, and diabetic treatment [4,12]. Diabetic patients consume leaf decoctions orally to regulate blood sugar levels. The plant is employed in various forms such as infusions, poultices, and herbal teas to address issues like liver problems, stomach cramps, and ulcers [4].

The utilization of *Momordica balsamina* in traditional medicine is both diverse and extensive, spanning various countries and cultures. This plant has found its way into the pharmacopeias of different regions, where its different parts are harnessed to address a multitude of health concerns. Below is an overview of its traditional medicinal applications: (refer to Table 1).

In Senegal, it is employed for treating dermatosis, stomachaches, rheumatism, hemorrhoids, painful menstruation, and other ailments. An aqueous extract of its leaves alleviates menstrual discomfort in young girls. It also finds utility in malaria and diabetes treatment through methods such as decoction, or infusion. The Wolof people (Senegal) utilize the fruits for purgative and deworming purposes [2,3]. In Nigeria, it addresses asthenia and digestive issues, while the Fulani people use it as a deworming agent and tranquilizer [13]. It is even integrated into prescriptions for mental health concerns. Additionally, a maceration of the entire plant acts as a galactagogue and is employed for chest massages to alleviate intercostal pain [3].

In Togo, a decoction of *Momordica balsamina*'s aerial parts, along with honey and *Zanthoxyloides fagara* root bark, functions as an oxytocic agent. Togolese people frequently utilize the leaves and stems [13]. Oral administration of calcined aerial parts powder is employed to treat hernias [13].

In different regions, the plant's fruits and leaves are used as hemostatic antiseptics for wound treatment. In Zambia, a decoction of the entire plant is used to treat conditions like syphilis, human immunodeficiency virus (HIV), acquired immunodeficiency syndrome (AIDS). The compound "Momordin" derived from the plant exhibits inhibitory properties against HIV and other viruses [3].

In Niger, crushed *Momordica balsamina* leaves are used as poultices for skin infections. Pounded leaves are recommended for hemorrhoids, diabetes, and fever. In combination with *Combretum micranthum*, it's utilized to treat malaria. Some women mix it with henna for abortion. The Hausa people (Mali) use the whole plant for embalming, drinking, and bathing to ward off malevolent spirits [13].

In Indonesia, bitter melon is not only known as a vegetable; it is also traditionally used as a laxative, a fever remedy, and an appetite stimulant. Additionally, bitter melon leaves are used to alleviate menstrual discomfort, heal burns, treat skin diseases, and act as a vermifuge [14].

Table 1. The utilization of *Momordica balsamina* in traditional medicine.

Country	Part of plant	Methods used	Use	References
Senegal	leaves, roots, stems, and pulp	Infusion Decoction	Hypertension, digestive disorders, malaria, diabetes, rheumatism, skin disorders, stomach aches, hemorrhoids, and painful periods	[2,3]
Nigeria	fruits and leaves	Infusion powder	Hypertension, digestive disorders, malaria, diabetes, rheumatism, skin disorders, stomach aches, hemorrhoids, painful menstruation, treatment of asthenia and hemostatic antiseptic	[3,12]
Syria	fruits and leaves	infusion powder	Treatment of asthenia, hemostatic, antiseptic	[3]
Togo	leaves and stem	Decoction	treat hernias, oxytocic	[13]
Zambia	fruits and leaves	Decoction	HIV, AIDS	[3]
Indonesia	leaves		Laxative, fever remedy, appetite stimulant, alleviate menstrual discomfort, heal burns, treat skin diseases, vermifuge	[14]
Other uses in Africa	fruits and leaves	Infusion, decoction	Galactagogue and to relieve intercostal pain, anthelmintics, purgatives and vermifuges, liver problems, stomach cramps and ulcers and prevention of measles	[3,4,10,13]

4. Biological properties of *Momordica balsamina*

Momordica balsamina leaves are employed as a vegetable, consumed as a decoction, or incorporated into various recipes in conjunction with other plants [15]. The leaves, fruits, seeds, and bark of this plant offer substantial medicinal benefits, including anti-HIV, anti-plasmodial, anti-diarrheal, antiseptic, antibacterial, antiviral, anti-inflammatory, antimicrobial, hypoglycemic, antioxidant, analgesic, and hepato-protective properties [3,16,17].

The plant *Momordica balsamina* exhibits highly interesting *in vitro* and *in vivo* antiplasmodial activities with very low toxicity. This could potentially explain its widespread use in traditional malaria treatment in Niger [18].

The antibacterial activity of this plant was investigated by Jigam et al. (2004) [19]. They reported that methanol (MeOH) extracts of various parts of the *Momordica balsamina* plant exhibited activity against *Staphylococcus aureus* and *Escherichia coli*. This finding aligns with the research conducted by Otimenyin et al. (2008) [20], who also demonstrated activity against *Bacillus subtilis*, *Proteus mirabilis*, and *Klebsiella pneumoniae* using extracts from the same plant.

Crude *Momordica balsamina* extracts also hold significant potential as antimicrobial agents and can be employed in the treatment of infectious diseases. These extracts have showcased the antibacterial and hypoglycemic properties, which may elucidate the plant's traditional use in managing diabetic sores [20].

Momordica balsamina extracts have been found to significantly inhibit the growth of *Bacillus subtilis*, *Streptococcus aureus*, *Klebsiella pneumoniae*, *Escherichia coli*, *Salmonella typhi*, *Proteus vulgaris*, and *Pseudomonas aeruginosa* to varying degrees [21].

The *Momordica balsamina* plant has demonstrated anti-HIV properties. Specifically, the plant protein MoMo30, isolated from *Momordica balsamina*, has been found to effectively inhibit HIV-1 at nanomolar levels while exhibiting minimal cellular toxicity at inhibitory levels [22], which agrees with the work of Coleman et al. (2022) [23].

Khumalo et al (2023) demonstrated that oral administration of *Momordica balsamina* to pre-diabetic rats attenuated diabetes-associated renal function abnormalities by reducing damage and restoring renal function. [24,25].

Kgopa et al. (2020) [26], uncovered that both the relatively non-polar extracts from *Momordica balsamina* fruits, such as hexane and ethyl acetate extracts, have the ability to increase glucose uptake by RIN-m5F β -cells, and this effect is dependent on the dosage of the extract.

Ampitan et al. (2023) [27], demonstrated the effectiveness of *Momordica balsamina* extract against avian paramyxovirus-1 infection in broiler chickens.

The results of research of A.T. Samaila's [28], reveal that *Momordica balsamina* leaf and root extracts have the potential to generate drugs and compounds with antifungal properties, effectively targeting pathogenic fungi.

5. Cosmetic use

In the realm of cosmetics, *Momordica balsamina* finds extensive application in addressing dermatological concerns. Notably, the juice extracted from the leaves of *Momordica balsamina* has been employed as a natural soap [12]. This unique formulation, often referred to as "pimples natural soap," harnesses the properties of *Momordica balsamina* to combat pimples, skin spots, and edema. When mixed with water, it produces a mildly soapy solution. The plant's soothing attributes extend to the treatment of wounds, eczema, pimples, allergies, and skin infections. Additionally, *Momordica balsamina* serves as a highly effective skin moisturizer [10,12].

6. Other Uses of *Momordica balsamina*

The versatility of the *Momordica balsamina* plant transcends beyond therapy and encompasses various other domains: The whole plant extract demonstrates insecticidal properties, making it a valuable tool in pest control. The seeds of the plant are often utilized as arrow poison. The plant contributes to mitigating micronutrient deficiencies within the soil, aiding in soil health and fertility

enhancement [3]. Extracts from the leaves of *Momordica balsamina* serve as effective metal cleaners [12]. Additionally, the ethanolic extract of *Momordica balsamina* leaves has been studied for its potential to safeguard copper from corrosion within acidic environments [29]. In the Hausa regions of Nigeria and the Niger Republic, the leaves are incorporated into green vegetable soups consumed by nursing mothers. It is believed that these soups aid in post-labor blood regeneration and the purification of breast milk [30]. Among farmers, the plant is harnessed to augment milk production in cows [13]. The multifaceted applications of *Momordica balsamina* highlight its valuable contributions across diverse sectors, ranging from cosmetics, therapy to agriculture and beyond.

7. Chemical Composition of *Momordica balsamina*

Momordica balsamina is revered in traditional medicine for its diverse chemical composition, contributing to its efficacy in treating a multitude of diseases. Each part of the plant is utilized in accordance with its distinct chemical composition and the specific ailment to be addressed.

The plant's leaves, fruits, stems, seeds, and bark collectively contain a spectrum of compounds, including resins, alkaloids, flavonoids, glycosides, steroids, terpenes, cardiac glycosides, and saponins, among others (refer to Table 2). The fruit of *Momordica balsamina* notably boasts a significant quantity of saponins, steroid rings, and carbohydrates. Alkaloids, tannins, flavonoids, glycosides, steroids, and terpenes are also present, albeit in smaller amounts [2,31–33]. Furthermore, aerial parts of the plant encompass mucilage and reducing compounds [31].

Based on findings from ethnopharmacology surveys, phytochemical screenings, and extract fractionation through chromatography, a range of biological tests can be conducted. These include assessments of antioxidant, antibacterial, antidiabetic, anti-inflammatory, antimalarial, antiviral, and anti-HIV properties, among others [34–37]. The observed biological activities can be attributed to the presence of identified or isolated metabolites within *Momordica balsamina* extracts, including flavonoids, terpenes, phenolic acids, carotenoids, and more (refer to Table 3).

Numerous phenolic acids, such as quinic acid and various chlorogenic acids, have been identified within the plant [35,36]. Unique compounds, including pseudolaroside A acid and isocitric feruloyl acid, have been reported for the first time in relation to *Momordica balsamina* [29]. Common flavonoids, including kaempferol, quercetin, and isorhamnetin, have been identified, each exhibiting distinct glycoside forms [35,36]. Notably, certain flavonoids demonstrate an array of biological activities, such as anti-inflammatory, antioxidant, and antidiabetic effects [35,36].

Cucurbitane triterpenoids, encompassing balsaminols, balsaminosides, balsaminagenins, karavilagenins, and cucurbalsaminols, have been extensively investigated for their diverse bioactivities, including antidiabetic, antimalarial, antiplasmodial, anticancer, antibacterial, and P-gp inhibitory effects [37]. Carotenoids, including zeaxanthin, lutein, and β -carotene, renowned for their antioxidative, anti-inflammatory, and anti-aging properties, have also been identified within the plant [36].

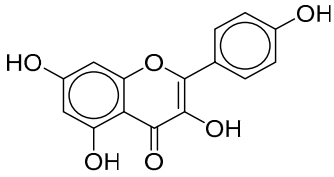
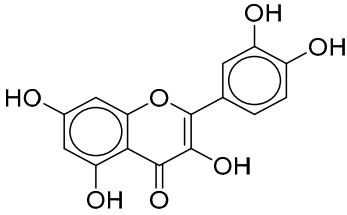
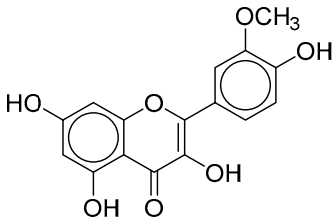
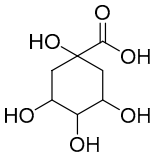
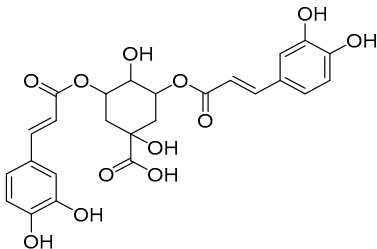
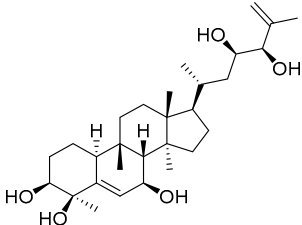
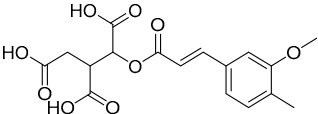
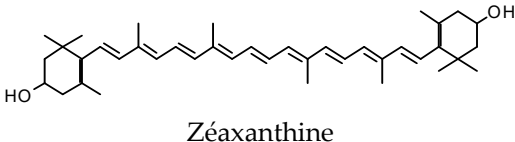
It exerts ribosomal inactivation (RIP) [11], and allows inhibition of HIV-1 replication at the translation stage [11,38]. Moreover, a broad-spectrum antibacterial activity has been documented [37].

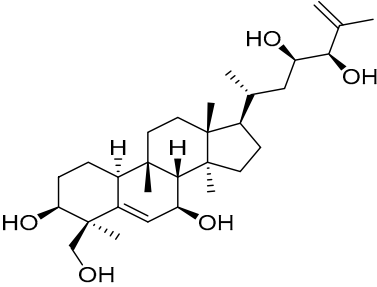
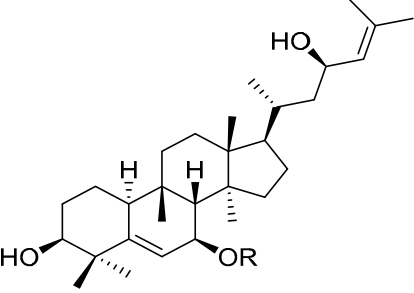
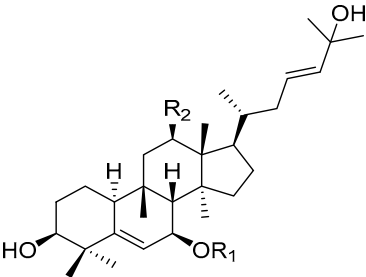
This rich chemical profile contributes to the plant's versatility and potent therapeutic properties, making it a valuable resource in traditional medicine and beyond.

Table 2. Chemical Composition of *Momordica balsamina*.

Part of <i>Momordica balsamina</i>	Chemical composition	References
Aerial part	Alkaloids, flavonoids, terpenes, and steroids, saponins, tannins and anthocyanins, mucilage	[3,31,32]
Fruits	Saponins, alkaloids, tannins, flavonoids, steroids, and terpenes	[3]

Table 3. metabolites of *Momordica balsamina* and their biological activities.

Compounds	Structures	Biological activity	References
Kaempferol		Antioxidant, managing cancer-associated ailments	[35,36]
Quercetin		Anti-inflammatory activity, protection of liver cells, suppression of hemoglobin oxidation	[35,36]
Isorhamnétine		Anti-inflammatory activity	[35,36]
Quinic acid		Anti-inflammatory, anti-diabetic	[35,36]
Dicafeoylquinic acid		Anti-inflammatory, anti-diabetic	[35,36]
Pseudolaroside A acid		Antioxidant	[35,36]
Feruloyl isocitric acid		Antioxidant	[35,36]
Zéaxanthine, Lutéine, β-carotène	 Zéaxanthine	Antioxidants, anti-inflammatory and anti-aging	[36]

Balsaminapentaol A,		Anti-diabetic, anti-malarial, anti-plasmodial, anti-cancer, antibacterial, P-gp inhibitors and others	[36,37]
Balsaminol balsaminoside, balsaminagenine, 8aravilagénine	 <p data-bbox="517 846 794 909">R= H :Balsaminol A R= CH₃ : Balsaminol B</p>	Anti-diabetic, anti-malarial, anti-plasmodial, anti-cancer, antibacterial, P-gp inhibitors and others	[36,37]
Cucurbalsaminol	 <p data-bbox="517 1283 927 1346">R₁ = H, R₂ = OH :Cucurbalsaminol A R₁ = CH₃, R₂ = OH : Cucurbalsaminol B</p>	Anti-diabetic, anti-malarial, anti-plasmodial, anti-cancer, antibacterial, P-gp inhibitors and others	[36,37]

8. Nutritional Value

Momordica balsamina stands as a plant rich in vital micronutrients and holds a significant place in African cuisine [39]. The leaves of *Momordica balsamina*, deemed a significant green leaf vegetable, possess a multifaceted nutritional potential. It offers a source of nutrients that complements major dietary components [9]. Table 4 highlights the micronutrient composition, encompassing protein, fiber, fat, minerals, and caloric value of *Momordica balsamina*. Notably, the protein content of this wild vegetable is remarkably high (287.7 ± 1.8 g/Kg or 28.77%), surpassing that of numerous other vegetables [9]. This elevated protein content positions it as a promising protein supplement or meat substitute, especially for resource-scarce rural communities [9]. In line with recommended daily protein allowances, a mere 3g of *Momordica balsamina* leaves could significantly contribute to daily protein requirements.

With its relatively low crude fiber content (37.2 ± 7.9), *Momordica balsamina* leaves contribute substantially to dietary fiber intake, an essential component in human nutrition [9]. Characteristic of most green leafy vegetables, *Momordica balsamina* boasts a modest caloric value (1892.2 kcal/kg), making it a favorable dietary addition for those aiming to manage caloric intake [30]

Impressively high ash content (12.7 ± 17.0 g/100g) establishes *Momordica balsamina* as a dependable source of essential minerals [9]. Notably, potassium and calcium dominate the mineral composition (27.05 and 22.2 g/kg, respectively). Even a modest consumption of 4g for children and 6g for adults of *Momordica balsamina* can fulfill a part of daily calcium needs, alongside potassium

requirements ranging from 1.5g to 17g [9]. The elevated potassium content suggests its potential as a dietary addition to mitigate hypertension, stroke, cardiac disorders, kidney damage, and osteoporosis, particularly in conjunction with low sodium diets [9]. In contrast, the levels of sodium, magnesium, zinc, and iron remain relatively low, underscoring the need for alternative sources for these micronutrients.

While *Momordica balsamina* leaves are found to be low in vegetable lipids, aligning with the characteristic low-fat nature of leafy greens, the results substantiate its role in promoting health and preventing obesity [30].

Table 5 delves into the amino acid composition of *Momordica balsamina*, revealing a preponderance of non-essential amino acids, primarily glutamic acid and aspartic acid, comprising 12, 38, and 8.21 mg/100g of protein, respectively [30]. However, it is noteworthy that while these proteins, including balsamin, are rich in certain amino acids, their profile lacks balanced proportions of the eight essential amino acids, including isoleucine, leucine, lysine, methionine, phenylalanine, threonine, valine, and histidine.

The nutritional richness of *Momordica balsamina* establishes its potential as a pivotal dietary component, contributing to dietary diversity, health management, and nutrient supplementation for various populations.

Nutritional data for *Momordica balsamina* fruits reveals that they are among the most diverse and promising vegetable crops for inclusion in the human diet[40].

Table 4. Nutritional composition of *Momordica balsamina* leaves.

Nutriments [22].	Composition (mean ± standard deviation, g/kg) [9].	Recommended daily intake [41]
Proximate composition (dry basis)		
Protein	287,7 ± 1.8	0,85-1,2 g / kg body weight / day (Child) 0.80 g / kg body weight / day (Adult).
Fat	53,7 ± 8.6	
Crude fiber	37,2 ± 7.9	
Ash	127,0 ± 17.0	
Moisture	710,0 ± 0.95	
Available Carbohydrate	390,50 ± 2.01	
Calorific Value (kcal/kg)	1892,2	
Minerals		
Calcium	22,2 ± 0.50	210-800mg/ day (Child) 1000 -1300mg/day (Adult).
Magnesium	3,82 ± 0.06	80-410mg / day (Child) 310-420mg/day (Adult).
Phosphorus	3,24 ± 0.01	460-1250mg/ day (Child) 700mg/day (Adult).
Potassium	27,05 ± 0.27	0,4-4,5g/ day (Child) 4,7g/day (Adult).
Sodium	0,06 ± 0.02	1,5-2,3 g / day (Child) 2,3g/day (Adult).
Iron	0,14 ± 0.01	7-15mg/ day (Child) 8-18mg/day (Adult).

Manganese	0,15 ± 0.00	0,6-2,2 mg / day (Child) 1,8-2.3mg/day (Adult).
Zinc	0,39 ± 0.01	3-8 mg/ day (Child) 8-11mg/day (Adult).

Table 5. Amino acid composition of *Momordica balsamina* leaves.

Amino acid	Concentration (g/100g protein) [30]	Recommended daily intake in mg/day body weight for +12 years [42]
Essential amino acids		
Isoleucine	2,94	10
Leucine	8,38	14
Lysine	3,94	12
Methionine	0,90	
Phenylalanine	3,94	
Threonine	3,13	7
Valine	4,11	10
Histidine	2,50	8-12
Non-essential Amino Acids		
Cystein	0,56	
Total Sulphur	1,46	
Tyrosine	2,62	
Total aromatic	6,46	
Alanine	4,16	
Arginine	4,87	
Aspartic acid	8,21	
Glutamic acid	12,38	
Glycine	4,66	
Proline	3,21	
Serine	4,00	

9. Conclusions

In summary, this review underscores the extensive utilization of *Momordica balsamina* within traditional African medicine. The breadth of its traditional applications finds validation in its diverse array of biological properties and intricate chemical compositions. Consequently, we advocate for the incorporation of *Momordica balsamina* in phytotherapeutic practices. It is imperative, however, to acknowledge the potential toxicity associated with many plants employed in traditional medicine, and therefore, meticulous attention must be dedicated to ensuring proper usage, adherence to prescribed doses, and mitigation of potential toxic effects. Simultaneously, it becomes essential to safeguard a sustainable and ample reservoir of active compounds, thereby averting the depletion of vital natural resources. In this context, comprehensive investigations into the innovative methodologies and strategies for the synthesis or biosynthesis of these naturally occurring bioactive constituents.

Overall, *Momordica balsamina*'s nutritional richness suggests a pivotal role in enhancing dietary diversity, managing health, and supplementing nutrients across populations. *Momordica balsamina*, rich in vital micronutrients, holds significance in African cuisine as a versatile plant. Its leaves, a valuable green vegetable, offer high protein content making it a potential protein supplement, particularly for resource-scarce communities. With considerable dietary fiber and modest caloric value, it aids nutritional intake and suits calorie management.

Furthermore, given its prevalent application in addressing dermatological concerns, particularly in Senegal, there exists a compelling rationale to embark on comprehensive studies exploring its potential within the cosmetic sphere. As the intricate interplay between tradition, science, and

sustainability unfolds, embracing the multifaceted potentials of *Momordica balsamina* beckons us toward a realm of holistic health and well-being.

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