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Ethnobotanical Insights into Lima Bean (*Phaseolus lunatus*): Exploring Its Traditional uses, Cultural Significance, and Educational Value

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ABSTRACT

Phaseolus lunatus, commonly known as the Lima bean, is a highly nutritious legume with significant ethnobotanical importance that extends far beyond its value as a food source. This review consolidates knowledge on its traditional uses, cultural significance, and educational potential. Nutritionally, Lima beans are a robust source of plant-based protein (17-40 g/100g), comparable to meat, and are rich in dietary fiber, vitamins, and minerals, offering health benefits for cardiovascular disease, diabetes, and cancer prevention. Its traditional applications are vast, encompassing ethnopharmacology for treating fever, inflammation, and wounds, and ethnoveterinary medicine as a galactagogue and general tonic for livestock, demonstrating a sophisticated, empirical understanding of its properties and safe preparation to neutralize cyanogenic glycosides. Culturally, the bean holds profound symbolic meaning, particularly in African and African Diaspora traditions, where it is used for spiritual protection in Hoodoo practices, divination, and as a symbol of resilience and cultural identity. Furthermore, the Lima bean serves as an exceptional model organism for interdisciplinary education. Its morphological traits and rapid growth cycle are ideal for teaching botany and plant physiology, while its well-defined composition provides a tangible case study for lessons in nutrition, food science, and food safety. In conclusion, the Lima bean is a vital repository of biocultural heritage, whose full appreciation underscores the deep interconnections between plants, human health, and culture.

Keywords: *Ethnobotany, Plant-Based Protein, Biocultural Heritage, Traditional Medicine and Agroecology*

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INTRODUCTION

Sustainable Lima bean, (*Phaseolus lunatus*) a member of the family leguminosae often times refered to as: haba beans, sugar beans, butter beans, Guffin beans, civet beans, Hibbert beans, Pallar beans, Sieva beans, Madagascar beans, and Burma beans (Yellavila, *et. al.,* 2015). It is an easy to grow grain legume and of a high food valve with many health benefits. Its protein content ranging from 17 to 40 g/100 g, quite higher than that of cereals (7-11.8 g/100g) and approximately equal to the protein content of meat 18-25 g/100 g (De Oliveira, 2006). Lima has a low-fat content and also contains carbohydrate (sugar and starches), vitamin and minerals (calcium, iron,

phosphorous, and potassium). Despite its yield potential, ubiquiosity, and diversity, lima bean is not considered as a major crop and its production in many countries is relatively low but mostly cultivated in South America (Debouck, 2021 and Yellavila, et. al., 2015). It is the second most important crop cultivated worldwide with the con-specific wild ancestor of Lima bean sparsely distributed from Mexico to Argentina according to current germplasm and herbarium records (Debouck, 2021). Wild Lima bean is structured into three gene pools (Serrano-Serrano et al., 2010), the Mesoamerican I gene pool (MI) occurs in central-western Mexico, to the north and west of the Isthmus of Tehuantepec; the Mesoamerican II gene pool (MII) is seen in Mexico to the south and east of the Isthmus of Tehuantepec, along the coastal plains of the Gulf of Mexico, in Central America, northern South America, southern Peru, Bolivia, and northern Argentina; the Andean gene pool (AI) is distributed in a narrow geographic range in the Andes of Ecuador and northern Peru (Chacón-Sánchez, and Martínez-Castillo, 2017). Lima bean is observed to have a greater yield on a moderately heavy, fertile soil, and it fruits earlier on light sandy well fertilized soil. As a hardy plant, it is scarcely injured by frost unlike snap bean plants. Seeds of Lima bean are planted in a cold soil; so, it is advised to plant it a week or ten days later in the spring on like snap beans.

During planting, cultivators are advised to plant on soil well prepared as the seed leaves of Lima beans tends to pull up to the surface with a plantlet during germination. Lima plant is good plant for crop rotation practice because of its ability to fix nitrogen, increase soil biomass and little need for pesticide but seed treated with antifungal agents will help improve germination rates. Soil should be kept moist (but not soaking wet) until the seedlings come through the ground; do not allow a crust to form on the soil, since the seedlings will have trouble pushing through. Prevent crusting and conserve moisture by spreading light mulch over the seeded row. A cold, wet spell can cause Lima flowers to drop, as can excessively hot and dry periods, reducing yields (Davis, 2004). Since consumption of animal protein has been traced to be a one of the causes of health complications like hypertension, gall-stone formation and it is quite alarming.

Therefore, plant protein of which legumes form a great majority has been found to be of medical importance as it will play a role in promoting physiological responses, such as reducing heart and kidney diseases, lowering the sugar indices of diabetic patients, increasing in satiety, and reducing the occurrence of cancer (Kaur, and Gupta, 2009 and Messina, 2002). It is a plant deeply woven into the human story, offering a rich case study in ethnobotany a science of understanding the relationships between people and plants and can provides a critical lens to view the Lima bean not merely as a source of calories but as a cultural entity. Its journey from ancient American staple to global food source reveals a narrative of domestication, cultural adaptation, and practical wisdom while its traditional uses demonstrate a profound understanding of the plant's properties, encompassing food, medicine, and agroecology (Hevžek, et al., 2015 and Gutiérrez-Salgado, et al., 2021). Therefore, this review aims to consolidate the ethnobotanical knowledge surrounding *P. lunatus*, delving into its traditional uses beyond the dinner plate, its deep-seated cultural significance, and its potential as a powerful educational tool to illustrate the principles of biocultural diversity.

Botanical Description of Lima Bean

Lima Bean (Phaseolus lunatus) is also known by the following names Butter bean, Java bean, Madagascar bean, sieva bean, sugar bean (English); haricot de Lima, haricot du Cap, pois du Cap (French); feijão de Lima, fava belém (Portuguese); frijol de luna, haba lima, judía de Lima, pallar, garrofón, guaracaro (Spanish); kacang kratok (Indonesian); Limabohne, Mondbohne (German); fagiolo di Lima (Italian); pwachouk (Haitian Creole); patani (Tagalog), pois de souche; pois souche (Haiti); Bakla (India); Broad bean (Jamaica); Kratok (Netherlands); Kokondo (West Africa); Awuje (Nigeria); Jinjiyokanpak (Kataf); Waken rumfa (Hausa); Papala (Yoruba); Akidi-nwangwu, Ukpa (Ibo); (Ibeawuchi et al., 2007, Ezenagu and Ibegbu, 2010, Sharasia et al., 2017, and Farinde et al., 2018). The herbaceous vine and twining bean species, include both annual determinate bush type and perennial indeterminate climbing type (Figure 1a & b). It has an enlarged root stock for the storage of starch (Mackie, 1943). The bush types are usually short, ≥0.6 m tall, while the climbing type is 2-5 m tall. At maturity, the plant produces dehiscent pods containing two – four seeds in large numbers (Figure 2). They pods are usually oblong, curved and terminates in a sharp beak facing the dorsal suture. They seed size is determined by the type of lima bean. Seeds could be small, medium or large-sized (Figure 3). Seed weight varies from 0.5 g/seed to 3.4 g/seed in the small seeded types and the large-seeded types respectively. There is also variability in seed color pattern as it may be speckled, mottled, or full-colored. These variations in colour can include white, grey, and yellow, brown, purple or black (Debouck, 2021). Lima Bean leaves are alternate, trifoliolate with chartaceous leaflets, and an acute apex or short-acuminate, sinuate leaf margins. The leaves upper surface is dull, glabrous and dark green, while the lower surface pale green or glabrous, with the primary and secondary venation outstanding. The leaflet terminals is 5.5-11 × 3.57.5 cm, with ether a rhombic or deltate shape, and an asymmetrically deltate lateral leaflet with a truncated base.

The bases of leaves are cuneate or truncate. Lima Bean petiolules are 3-5 mm long, pubescent and thick. The leaves rachises are between 1.5-2.5 cm long; with a sulcate, puberulent, slightly broadened base petioles between 6.5-9 cm long (Acevedo-Rodriguez, 2005). Inflorescences in Lima Bean are 15 cm long and bear 24 white or violet bisexual flowers. Flowers of Lima bean have minute bracteoles, pilose, oblong pedicels of about 6-9mm

Figure 1a. Photo of herbaceous vine (Perennial indeterminate bush type).

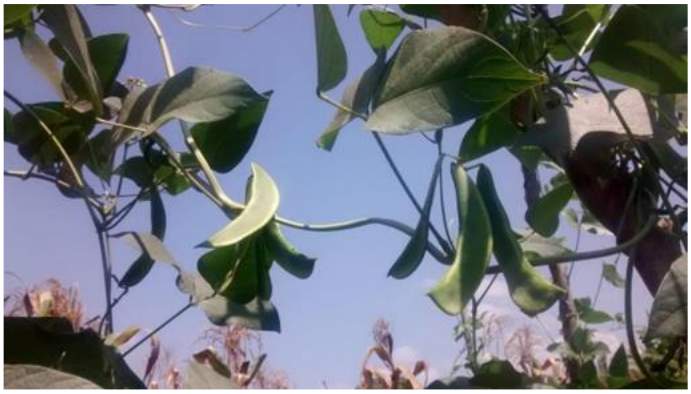

Figure 1b: Photo of twining Lima bean (Perennial indeterminate bush type). Source: (Ebube, 2020)

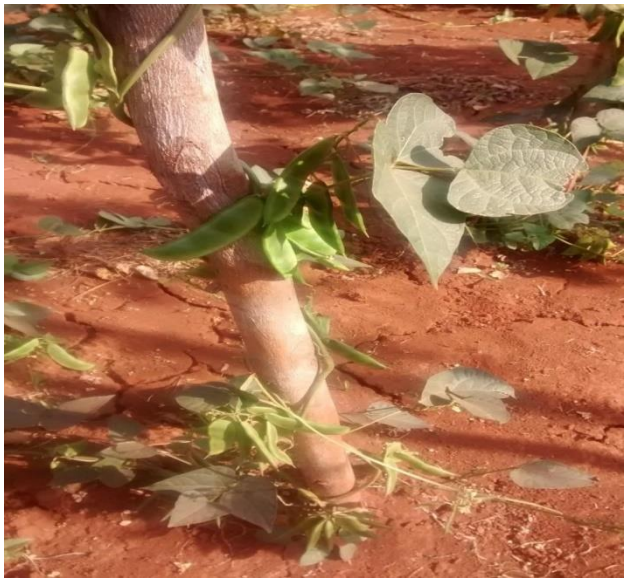

Figure 2: Photos of Lima Beans Immature Pods
Source: (Ebube, 2020)

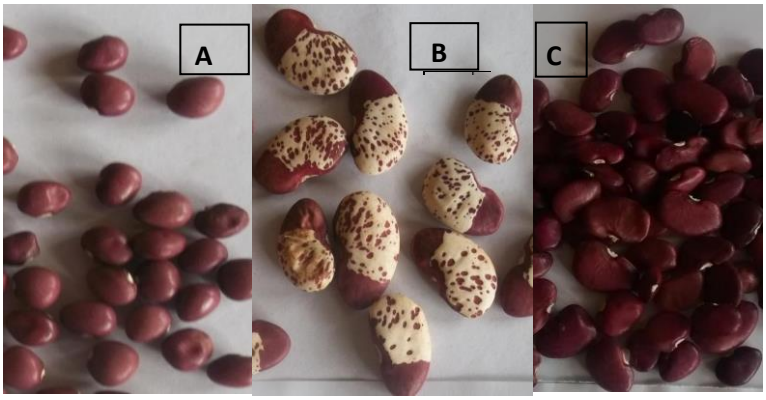

Figure 3: Photo showing Seed Sizes A: Small seed size B: Large seed sizes C: Medium seed size. Source: (Ebube, 2020)

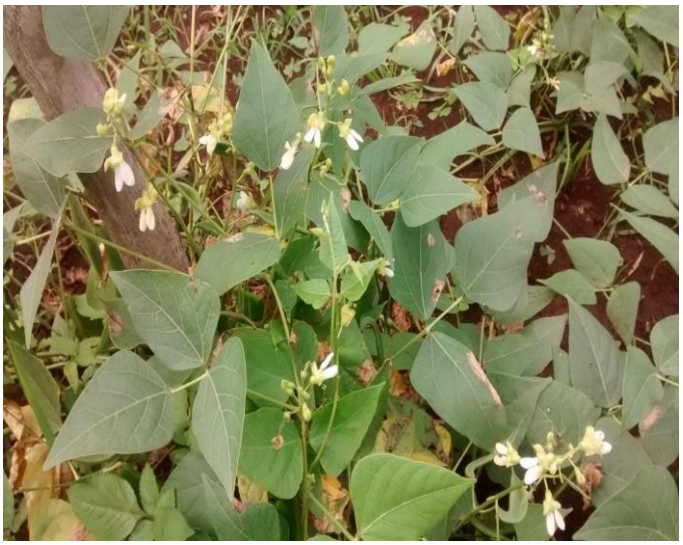

Figure 4: Photo of Lima Bean white corolla flower. Source: (Ebube, 2020)

long, with a green, campanulate, and pilose calyx of about 2-2.5 mm long. The sapals are deltate and subequal, with a white or lilac, pink or bluish corolla (Figure 4) (Acevedo-Rodriguez, 2005). Fruits are flattened ranging from 5-12 cm long and 1- 2 cm width with a shape like a half-moon or oblong-falcate legume. Fruits are also puberulent with uncinate hairs or glabresent. It contains about 10 diadelphous, vexillar stamens which are broadened at the base (Hevzé et al., 2015 and Acevedo-Rodriguez, 2005).

Traditional Uses of *Phaseolus lunatus:* Ethno pharmacopoeias, ethno veterinary medicine (EVM) and Culinary-Nutritional Uses

The relationship between humans and the Lima bean is characterized by a sophisticated understanding of its properties, leading to diverse applications in food and medicine. The usage of *P. lunatus* in conventional pharmacopoeias is documented by ethnobotanical research. A variety of illnesses have been treated with different plant components, such as leaves, pods, and seeds. Extracts of these plant parts were tested for pharmacological properties, they demonstrated anti-diabetic, antifungal, and antiproliferative properties as well as inhibition of cysteine proteinase, hypocholesterolemia, and inhibition of trypsin and chymotrypsin. Seeds are a common dietary remedy for fever in the Indo-Pak subcontinent. To encourage healing, the powdered seeds are applied to small cuts and abscesses in Africa (Salman, et al., 2016).

Teas, decoctions, tinctures, capsules, poultices, creams, mucillages, oinments, oils, and syrups are the finest forms of *Phaseolus lunatus* medical preparations. One of the ingredients in lima bean when used as skincare products like the moisturizers, hydrating masks, soothing after-sun products, body lotions and even hand creams is an emollient. These helps to smooth rough spots, lessen stiffness, and improve suppleness by creating a thin,

breathable layer on the skin's surface. Because the extract's natural lipids mirror some of the skin's natural barrier, creams that contain it tend to feel richer without being greasy. This makes the extract a good option for daily hydration treatments that target normal to dry skin (Franklin, 2025). Other medicinal uses include fever and alleviate inflammation reduction from decoctions of the leaves or pods, promotion of urination and support kidney function from beans consumption, promotion of wounds, sores, and abscesses healing from crushed seeds or poultices (Silva et al., 2020).

Phaseolus lunatus has been introduced into these practices because to its availability and nutritional density, especially in small-scale and rural agricultural systems where access to commercial veterinary services is restricted. The traditional knowledge, abilities, techniques, and practices used to preserve animal health and treat illnesses are all included in the ethnobotany subgroup of ethno veterinary medicine (EVM). Lima bean seeds, leaves, and occasionally pods are used in ethno veterinary medicine mostly to treat common animal diseases. Utilizing the plant's nutritional value and suspected medicinal qualities, the methods are frequently practical (Rebello, et al., 2014). Example; Lima beans is as a galactagogue (milk production enhancer) to stimulate and increase milk production in lactating animals, such as dairy cows, goats, and sows. Farmers commonly boil the mature seeds and feed them directly to the animal or mix the bean broth into the animal's feed. This practice has a sound nutritional basis. Lima beans are rich in protein and energy, which are critical for sustaining high milk yields. The boost in milk production is likely due to this concentrated nutritional supplementation, addressing potential energy deficits in the lactating animal (Mathias, 2007). Lima beans are used as a general tonic to improve the overall condition, vitality, and body score of livestock, especially before mating seasons, during recovery from illness, or in working animals like oxen and horses. Small quantities of cooked beans are added to the regular ration. As a dense source of protein, complex carbohydrates, and minerals like iron and magnesium, Lima beans provide a high-quality nutritional boost that can improve an animal's physical condition and energy levels (McCorkle, 1986). Decoctions made from the leaves or pods of the Lima bean plant are sometimes administered to ruminants to treat symptoms of bloating, indigestion, or mild diarrhea. An infusion or decoction is prepared from the green leaves and pods and given to the animal as a drench (oral liquid medicine). While less documented, this use may be linked to the fiber content and other bioactive compounds in the plant matter that could help regulate gut function.

However, this area requires more scientific validation to understand the mechanism. However, the implicit understanding of processing to guarantee safety is a crucial component of the ethnopharmacopoeias and ethnoveterinary usage of Lima beans (McGaw, and Eloff, 2008). Like a number of other legumes, uncooked Lima beans, especially some wild and traditional landraces, contain cyanogenic glycosides called lotaustralin and linamarin, which can cause the plant tissues to rupture and produce poisonous hydrogen cyanide (HCN). Almost always, traditional methods call for boiling the beans before giving them to the animals. These cyanogenic substances are efficiently broken down and removed by boiling, soaking, and heating, rendering the beans fit for human consumption (Baudoin, 2022). This shows that conventional knowledge systems have a comprehensive, empirically derived grasp of food safety.

Mature Lima bean seeds are often consumed boiling, stewed, or crushed into flour as a staple food. They are an essential component in many North American succotash recipes and Peruvian puré de pallares, among other meals throughout the Americas. As a fresh vegetable, immature pods and seeds are also eaten. The regular combination of Lima beans with grains (such as rice and maize) demonstrates the dietary knowledge of traditional civilizations and offers a full protein profile, correcting deficits in critical amino acids (Baudoin, 2022). Long before its physiological foundation was understood, this combination reflects an intuitive awareness of complementary nutrition.

Lima bean green seeds are used in a similar way as peas in soups and stews. They can be as dried pulse. Seeds in their matured state are dried before storage. Mature seeds can be poisonous especially in their raw state. Cooking has been an effective way to destroy the seed poison. The raw seed must be soaked 12 hours before cooking. The Chinese uses germinated seeds in their delicacy as the dried seeds can also be ground into a powder and used in soup or stew as a thickener, as well as flour in bread making. One advantage Lima bean have over other legumes is its fat free quality of protein. It has high fiber content as well as serves as a very good source of cholesterol-lowering fiber therefore can be used to maintain blood sugar level. A hundred grams seed of Lima contains 338 calories with a daily recommended protein intake of 21.46 g (38%). Despite is diet improvement capacity; it can be used to maintain digestive system function. Some other health benefits of Lima Bean consumption include; Cardiac health Improvement since It is evident that high plasma levels of homocysteine, increases blood levels of cholesterol and triglycerides which are significant contributing risk for cardiovascular disease. A significant reduction in serum lipids has been observed in experimental rats fed with lima bean diet (Oboh and Omofoma, 2008), this suggests that the consumption of lima bean could be recommended to promote cardiovascular health. The significant amount of fibre, folate and magnesium present in lima bean could help in decreasing heart attack risk. Fibre binds with bile acids that are used to make cholesterol and it is being egested from the body alongside with faeces. Lima beans consumption helps to prevent colon cancer as it contains substantial amounts of dietary fibre of about 18.40g/100g (Ezeagu and Ibegbu, 2010). Dietary fibre protects the mucous membrane of the colon by decreasing its

exposure time to toxic substances as well as binding to cancer causing chemicals in the colon. Generally, beans are natural sources of antioxidants and phytochemicals, and research shows that regular bean consumption may reduce certain types of cancer including colorectal, breast and prostate.

A trace amount of isoflavones (genisten and daidzein) are found in Lima bean and helps to fight against breast cancer. Lastly Lima bean serves as blood sugar levels suppressant targets diabetes a chronic metabolic disorder, characterized by high blood glucose (hyperglycemia), associated with impaired carbohydrate, fat and protein metabolism, resulting from either insufficient or no release of insulin by the pancreas in the body. It is becoming more prevalent throughout the world and a major public health problem in developing countries. People suffering from diabetes are usually counseled on moderation of food intake and incorporation of low glycemic index foods that contain slowly digestible carbohydrates and increased consumption of dietary fibre-rich foods. Lima beans are low on glycemic index and its rich-fibre content is a good nutritional component for managing blood glucose level. Consumption of heat-treated lima beans produced a significant hypoglycaemic effect in diabetic rats (Ebube, 2020).

Cultural Significance and Symbolism

There is an inherent connection between the transatlantic interchange and the cultural journey of the Lima bean *(Phaseolus lunatus)* in Africa. It was brought to the continent from the Americas after 1492, and it quickly became ingrained in regional agricultural and cultural systems. The Lima bean gained deep symbolic implication throughout Africa and the African Diaspora, especially in the Americas, expanding beyond its use as a food source. This was especially true in spiritual and folk-magical traditions. One of the most significant symbolic roles of the Lima bean, and beans more generally, is as an agent of spiritual protection. In Hoodoo, an African American folk magic tradition, specific types of beans, including those that are multi-colored or eye-patterned, are carried in a mojo bag (a small flannel bag filled with symbolic items) or simply in a pocket for protection against evil spirits, negative energy, or "crossed conditions." Their hard, enduring nature symbolizes resilience and the ability to ward off harm. According to history, the most famous talisman is the "John the Conqueror" root (Ipomoea jalapa), certain beans certainly the lima bean are sometimes used in a similar context or as a substitute. They are believed to impart luck, personal power, and the ability to overcome obstacles, reflecting themes of survival and triumph over adversity that are central to the Diasporic experience (Chireau, 2020). Most, physical characteristics of beans, particularly those with a distinct eye-like spot (hilum), have led to their use in divinatory practices across several African cultures. In the Ifá divination system often observed by the Yoruba people in Nigeria, Benin, Togo, sacred palm nuts (ikin) are the primary tool (Abiodun, 2014).

However, other systems within the region utilize castings of smaller objects, and the principle of casting and interpreting patterns is widespread. Beans, with their ability to land in random configurations, are used in similar geomantic traditions for binary (yes/no) or more complex answers from the Orishas (deities) or ancestors. Lima bean and other beans hilum can be interpreted as an "eye." This associates the bean with visions, insight, and the ability to "see" into the spiritual realm or perceive hidden truths. This symbolic connection between beans and spiritual sight was transferred to the Americas, reinforcing their use in rituals seeking guidance or revelation (Voeks, 2013). The integration of the Lima bean into African cuisines, such as in stews, soups, and rice dishes, represents a form of cultural adaptation and resilience. Dishes that now feature Lima beans are part of a creolized culinary tradition that blends indigenous African ingredients (e.g., okra, palm oil) with those from the Americas (e.g., beans, maize). The persistence of these dishes, like various bean and rice preparations, serves as a daily reminder of cultural heritage and historical survival, making the bean a silent but persistent symbol of cultural identity (Carney and Rosomoff, 2009). As a prolific and nourishing crop, the Lima bean naturally symbolizes fertility, agricultural bounty, and the sustenance of life. Most African agricultural communities, first harvest of a crop is often dedicated to the gods or ancestors to ensure continued fertility and protection of the fields. Beans, including Lima beans, can be part of such offerings. Their numerous seeds within a single pod make them a potent symbol of fertility and multiplicative abundance. In Diasporic religions like Candomblé and Santería, specific foods are prepared as offerings (comida) for the Orishas. While specific attributions vary, beans are a staple food and can be included in meals intended to honor deities associated with the earth, prosperity, and sustenance.

Educational Value of *Phaseolus lunatus*

As a Model for Botany and Plant Physiology

The Lima bean possesses a suite of morphological and physiological traits that make it an exceptional model organism for teaching and research in botany and plant physiology. Its accessibility, rapid growth cycle, and distinct anatomical features allow for the clear demonstration of fundamental plant processes, from germination to reproduction. The large dicotyledonous seeds are easy for students to handle and dissect, allowing for clear observation of the seed coat, hilum, micropyle, and the two large food-storing cotyledons. Under optimal conditions, Lima beans can germinate in 3-5 days, enabling students to observe the entire process within a short timeframe. Dried Lima beans are inexpensive and can be purchased from most grocery stores, making them ideal for large classroom settings. The plant exhibits clear

morphological differences between its root system, hypocotyl, epicotyl, and primary leaves, facilitating the study of plant development.

The Lima bean is a classic subject for studying the phases of seed germination: imbibition, activation of metabolism, and radicle emergence. For imbibition demonstration, students can measure the mass increase of dry seeds over time as they absorb water, graphically demonstrating the first critical step in germination. The large, attached cotyledons are a clear example of a food reserve which best explains the role of cotyledons. Experiments can be designed where one cotyledon is carefully removed from a germinating seed, and the subsequent growth of the seedling is compared to an intact control, visually demonstrating the dependence of the embryo on these reserves (Meyer et al., 2021). Lima bean seedling's structure is a perfect specimen for learning basic anatomy and morphology. With its dicot structure and features, indicating two cotyledons, a taproot system, and net-veined leaves. A cross-section of the hypocotyl or root during tissue examination can be stained and viewed under a microscope to identify primary tissues: epidermis, cortex, vascular bundles (arranged in a ring, characteristic of dicots), and pith. Lima beans can be used to investigate core physiological processes like photosynthesis by carrying out Iodine staining of leaves from light- and dark-treated plants can visually demonstrate the production of starch as a product of photosynthesis, Simple setups with bromothymol blue or CO_2 sensors can be used to show oxygen production or carbon dioxide consumption during photosynthesis in a closed system. It can also be used to carry out tropisms (phototropism and gravitropism). During phototropism, seedlings grown in a box with a unilateral light source will exhibit clear bending towards the light, illustrating the role of auxins while in experiment for gravitropism, lima bean potted seedling is placed on its side demonstrates the re-orientation of the shoot (negative gravitropism) and root (positive gravitropism). The large, robust hypocotyl makes this response easily measurable (Muday and Murphy, 2020). Lima bean for experiments on nutrient transport and transpiration, demonstrates xylem flow by placing the cut stem of a seedling in a solution of a dye like eosin or food coloring allows students to track the path of water ascent through the xylem, which becomes visible in the veins of the leaves and along the stem.

Transpiration rate is demonstrated by sealing a potted Lima bean plant in a plastic bag with a humidity sensor or using a simple potometer, the rate of water loss through transpiration can be measured under different environmental conditions (e.g., light, wind, humidity). Demonstrations on plant-environment interactions like the effect of abiotic factors using Lima bean is a standardized experiment that test the effect of salinity, heavy metals, or nutrient deficiency (e.g., nitrogen or phosphorus) on germination rates, root architecture, and overall plant growth and biomass. In the area of soil science, Lima beans can be used to demonstrate the importance of soil texture, pH, and the presence of mycorrhizal fungi on plant health and productivity. Lima bean offers distinct pedagogical advantages over other model crops like Arabidopsis thaliana is the dominant genetic model and *Pisum sativum* (pea) has a storied history in genetics. Its larger size and structures are easier for young students or large classes to handle and observe compared to the small seeds of Arabidopsis or even Pisum. It is generally hardy and forgiving of minor fluctuations in classroom conditions and its use bridges the gap between a purely biological model and a culturally significant crop, enabling interdisciplinary learning.

Teaching Nutrition and Food Science

Apart from an exceptional pedagogical tool for making abstract concepts in nutrition and food science tangible, relevant, and engaging for students, Lima bean is a well-characterized composition, coupled with its historical context as a traditionally prepared food, and provides a rich narrative for interdisciplinary learning. Lima beans are a high-quality source of plant-based protein, containing 20-25% protein by dry weight. However, like most legumes, they are limiting in the essential amino acids' methionine and cysteine. This provides a perfect case study to teach like essential land non-essential amino acids where students can learn why certain amino acids must be obtained from the diet. The traditional practice of consuming lima beans with cereals (e.g., maize, rice) or seeds can be examined. Maize is rich in methionine but limiting in lysine, which is abundant in lima beans. Together, they form a complete protein. This demonstrates how cultural foodways often intuitively solved nutritional challenges long before the biochemistry was understood (Baudoin, 2022). A laboratory technician working with Lima ben can conduct activities like, dietary pairing where students analyze the amino acid profiles of different foods (using published data) and create culturally appropriate, complementary meals, a simple demonstration by blending cooked lima beans with water and observing the viscous gel (soluble fiber), students can research the mineral content of lima beans and then investigate how preparation methods like fermentation (e.g., in some traditional African dishes) or soaking can reduce phytic acid and enhance mineral bioavailability (Samtiya et al., 2020). A laboratory practical can be designed (with safety protocols) to qualitatively test for the presence of cyanogenic glycosides in raw vs. soaked vs. boiled lima beans using commercially available test strips or picrate paper. Students can make a simple lima bean puree and observe how its viscosity changes with temperature and concentration, directly demonstrating the principles of starch gelatinization and a sensory evaluation where students prepare lima beans in different ways (boiled from dried, rinsed canned, seasoned) and evaluate differences in texture, flavor, and color, linking these sensory properties to the processing methods.

Compare the fiber content of canned and home-cooked dried beans to discuss food processing effects.

Lima beans are an excellent source of both soluble (role in moderating blood glucose levels and lowering cholesterol by forming a gel in the digestive tract) and insoluble dietary fiber (role in adding bulk to stool and promoting regular bowel movements). Lima beans are rich in essential minerals, notably iron, magnesium, potassium, and folate. Further, directions can be towards discussion the role of folate in DNA synthesis, iron in oxygen transport, etc., the presence of anti-nutrients like phytic acid in lima beans can bind to minerals, reducing their absorption. This leads directly into a discussion of traditional food preparation methods as a solution.

Lima beans are a classic example for teaching about naturally occurring toxins in food. They contain cyanogenic glycosides (linamarin and lotaustralin), which can release hydrogen cyanide upon cellular disruption. Lectures like the biochemical pathway cutting across intact glycoside → enzyme (linamarase) activation upon tissue damage → cyanohydrin → hydrogen cyanide (HCN) is obtained. Different cultivars have vastly different HCN potentials, providing a lesson in genetic diversity and selective breeding for safety as we subject Lima bean to quantitative analysis (Baudoin, 2022). The traditional methods of soaking, boiling (often with multiple changes of water), and fermentation are not just "recipes"; they are effective food safety protocols that inactivate enzymes and leach out the cyanogenic compounds.

Lima beans are commercially available in multiple forms: dried, canned, frozen, and fresh. This allows for comparative studies like nutrient retention which involves comparing the sodium content of canned (high) with home-cooked from dried (low) beans, analyzing the loss of water-soluble vitamins (e.g., B vitamins) during the blanching and canning process.

Conclusion

The Lima bean (*Phaseolus lunatus*) emerges from this review not merely as a source of sustenance but as a profound biocultural entity. Its story is one of remarkable duality: it is both a nutrient-dense legume with significant health benefits and a plant deeply woven into the cultural and spiritual fabric of societies, particularly those in Africa and the African Diaspora. Nutritionally, its profile is impressive; with a protein content rivaling meat, high fiber, and essential minerals, it offers a compelling plant-based solution to modern health challenges like cardiovascular disease, diabetes, and cancer.

The traditional understanding of its properties is evident in culinary practices, such as complementing it with cereals to form complete proteins, and in the meticulous processing methods used to neutralize its cyanogenic glycosides, showcasing an intuitive grasp of food science and safety. Culturally, the Lima bean's significance transcends the plate. In traditions like Hoodoo, it serves as a powerful talisman for protection, luck, and overcoming adversity, while its use in divination practices links it to spiritual insight and connection with the ancestors. These symbolic roles, born from the transatlantic exchange and refined through the experience of the Diaspora, highlight the plant's integration into the core of cultural identity and resilience. It became a silent witness to history and a symbol of survival.

Furthermore, the Lima bean stands as an exceptional educational tool. Its rapid growth, large dicotyledonous seeds, and clear physiological responses make it an ideal model for teaching botany, from seed germination to tropisms (Bewley, et al., 2013). Simultaneously, its well-defined nutritional composition and inherent food safety challenges provide a perfect, tangible case study for interdisciplinary lessons in human nutrition, food toxicology, and the science behind traditional processing techniques. In conclusion, the Lima bean is a microcosm of ethnobotany itself. It demonstrates the inextricable link between a plant's biological properties and its human uses, from the pragmatic to the sacred. Appreciating the full scope of its traditional uses, cultural symbolism, and educational value allows us to see it not as a minor crop, but as a vital repository of biocultural heritage, practical wisdom, and enduring relevance for human health and culture.

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