Journal of Science Research International (JSRI)
ISSN: 2456-6365 (Online)

NUTRITIONAL AND FUNCTIONAL PROPERTIES OF HORSE GRAM: A REVIEW

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Received: 26 July 2026	Revised: 30 August 2026	Accepted: 10 October 2026	Published: 30 October 2026

DOI: https://doi.org/10.5281/zenodo.24183720

Abstract:

Horse gram (Macrotyloma uniflorum) is an underutilised, stress tolerant legume with strong impending to improve worldwide nutritional security and food, strengthen sustainable cooking and promote health of the human. Plants provide a wide range of nutrients that includes proteins, vitamins, carbohydrates, minerals, phytochemicals and antioxidants. Because of these beneficial compounds, they have various pharmacological effects and serve as valuable nutraceutical sources that may support health, help prevent disease, and, in some cases, assist in treating specific health conditions. These bioactive compounds, including phytic acid, phenolic acids, dietary fibre, and enzyme or protease inhibitors, can significantly affect metabolism and overall physiological function. Horse gram has also long been valued in folk, traditional, and alternative medicine for its potential therapeutic benefits. It has traditionally been used to help manage kidney stones, urinary disorders, piles, common colds, throat infections, and fever. It provides a range of health-promoting benefits and is remarkably resilient to both biological and environmental stresses. In this review, dietary and useful properties of Horse gram and their knowledge gaps at present are elaborated.

Keywords: *Macrotyloma uniflorum, Antiobesity, Antiinflammatory, Pharmacocology, Horse Gram, Nutritional*.

1. Introduction

Macrotyloma uniflorum, generally recognized as horse gram and in the past referred to as *Dolichos biflorus L.*, is an underutilised legume through several valuable nutritional and functional properties. The crop is primarily cultivated in tropical Africa and Southeast Asia, predominantly all through the delayed rainy season from August to October. The genus names *"Macrotyloma* taken from the Greek words *makros* (large), *tylos* (knob) and *loma* (margin), describing the distinctive knob-like structures along the pod margins. It is known as "hulga" in certain regions, horse gram serves as an important source of food for human consumption and fodder for livestock [1, 2].

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Legumes are widely recognised for their rich nutritional composition and potential health-promoting properties, which are largely attributed to their bioactive compounds and nutraceutical constituents [3]. These compounds may support several physiological functions and contribute to disease prevention. For example, vitamin D acting an important role in calcium regulation and immune modulation and may also help reduce inflammation [4].

Although horse gram has long been an important dietary staple for many people in India, it continues to carry social stigma. In southern India, it is often viewed as a low-status food associated with economically disadvantaged communities [5]. Consequently, it has been described as the "poor man's meat," predominantly in growing countries [6]. The crop is well suited to infertile soils and other stressful growing conditions and is cultivated in several regions, including India, parts of Africa, Myanmar, Nepal, Australia and Sri Lank. Within India, major production occurs in Sikkim, Andhra Pradesh, Himachal Pradesh, Karnataka, Tamil Nadu and Maharashtra [7]. It is also cultivated in Chhattisgarh, West Bengal, Odisha, Uttarakhand and Bihar, demonstrating its ability to thrive across equally hilly and dryland environments. Because of its pliability in marginal conditions, horse gram remains significant pulse yield in areas where some of the legumes may struggle to grow as shown in table 1 [8].

Table 1: Climate toughness traits of horse gram [9]

Trait	Horse gram response	Agricultural significance	References
Tolerant to Drought	Tolerant to Drought and hardy	Supports farming in irrigate-scarce regions	[10, 11, 12]
Low water requirement	Grows underrainfed conditions	Decreases irrigation needs in climate-vulnerable areas	[13]
Pest resistance	Resists major diseases	Lowers crop losses and pesticide use	[14, 15]
Marginal soil adaptability	Thrives in marginal lands	Increases soil fertility through nitrogen fixation	[6, 13]

2. Geographical location

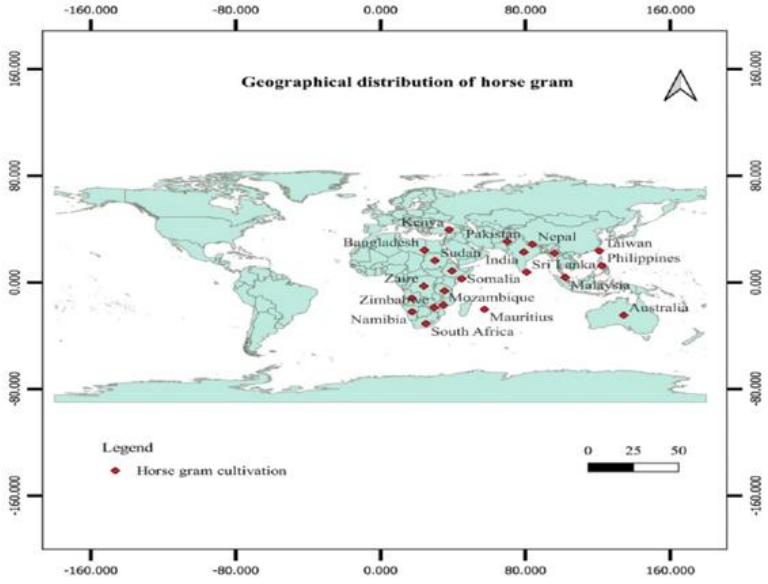


Figure 1: Geographical location of horse gram

Horse gram (HG), indigenous to the Indian subcontinent, has a long history of cultivation and domestication, with established roles in traditional cuisine and indigenous medicinal practices. Its historical significance is reflected in ancient literary sources, including the Yajurveda, Rigveda, Buddhist, Sangam and Jain literature [16]. Archaeological evidence from Khunjun in the Neolithic settlements and Vindhyan Plateau across Karnataka and Andhra Pradesh further highlights the crop's longstanding association with the agricultural and cultural heritage of the region [17]. Human migration during the Neolithic period may have contributed to the spread of HG across northern and western India [18].

Today, HG is extensively cultivated as both a food and fodder crop in several Asian countries as shown in Figure 1[19], including India, Myanmar, Philippines, Pakistan, Taiwan, Sri Lanka, Malaysia, Bangladesh and Nepal. It is also grown in various African countries, such as Zimbabwe, Sudan, Somalia, Zaire, Mauritius, Ethiopia, Angola, Namibia, Kenya, Mozambique, South Africa and Tanzania, as well as in Australia [20, 21]. In India, its cultivation is concentrated mainly in Maharashtra, Bihar, Uttarakhand, Tamil Nadu, Madhya Pradesh, foothills of Himachal Pradesh, Chhattisgarh Uttar Pradesh, Karnataka, Jharkhand, Odisha and Andhra Pradesh [22].

3. Bioactive compounds

Regular consumption of legumes as part of a balanced diet may supply to the hindrance and management of a range of health conditions that include certain cancers, age-related disorders, diabetes, gastrointestinal diseases, cardiovascular diseases, and osteoporosis. Legumes may also support weight management and psychological well-being [23, 24]. These health-promoting and nutraceutical properties are associated with diverse bioactive constituents, including flavonoids, tannins, glycosides, beta-sitosterol, urease, saponin, sterols and phytic acid, as summarized in Table 2 [25].

Table 2: N**utritional composition in horse gram**

Plant part	Main constituents	Health benefits	Other uses
Seed coat	Fibre	Improves digestion	Human food and animal feed
Seed coat	Phenolic acids	Antioxidant and anti-inflammatory effects	Natural antioxidants
Seed coat	Calcium	Strengthens bones	Food formulations
Seeds	Saccharides	Supports gut health	Prebiotic products
Seeds	Proteins and amino acids	Supports growth and tissue repair	Plant-based protein source
Seeds	Lipids	Provides energy	Food products
Seeds	Vitamins	Supports normal growth	Nutritional supplements
Seeds	Minerals	Supports normal body functions	Nutrient-enriched foods
Seeds	Bioactive compounds	Antioxidant and potential liver-protective effects	Functional foods
Dark-coloured seeds	Phenolic compounds	Increases antioxidant activity	Natural antioxidant source
Horse gram seed soup	Isoflavones	Potential health-promoting effects	Traditional food preparation

Horse gram (HG) flour exhibits considerable antioxidant potential, with a total phenolic content of 0.78 mg/g, entire flavonoid content of 0.91 mg/g, and ferric-reducing antioxidant power (FRAP) of 1.2 mg/g. Its seeds provide an expensive resource of essential nutrients, including proteins, lipids, carbohydrates, and dietary fibre. The carbohydrate composition and fibre content of horse gram may contribute to improved glycaemic regulation, supporting dietary management of diabetes. Furthermore, its lipid constituents play important roles in maintaining neurological function, while linoleic acid and other fatty acids may contribute to cardiovascular health and metabolic regulation [26].

Yet, linolenic acid and linoleic acid work mutually to slow down the improvement of Parkinson's and Alzheimer's disorders [27]. Dissimilar parts of the HG plant have unlike concentrations of phytocompounds; that is, stems and leaves hold all the bioactive chemicals and antioxidants; flowers and seeds contain a minor number of phytochemicals in comparison to stems and leaves [28]. It is a rich resource of minerals such as phosphorus, iron and molybdenum and many vitamins like thiamine, niacin, vitamin C and riboflavin. HG kernel coat contains calcium, fibre and phenolic acids that help regulate digestion, reinforce the bones, and also reduce the risk of heart disease [29].

Ssimilarly, seeds are a good resource of lipids, amino acids, carbohydrates, minerals, proteins and vitamins, particularly potassium and calcium [30]. Amongst amino acids, glutamic acid and aspartic acid are present in plentiful amounts, and the mixture of together is reported to reduce tumor cell proliferation [31].

4. Pharmacological properties of horse gram

A number of studies shown that a diet rich in HG is not only nutritionally complete but also provides defense touching some situation such as hiccups, piles, lumps in abdomen, diabetes, kidney stones, asthma, heart diseases and urinary discharges. Many information has tinted the plenty of plant secondary metabolites in HG, which have a variety of genetic properties such as anti-inflammatory, antiobesity antidiabetogenic, and antioxidant, as discussed in specify in the below sections [32].

5. Antidiabetic properties

Diabetes is a major wellbeing problem worldwide with important economic and social consequences. The International Diabetes Federation estimates the global cost of diabetes treatment was approximately $673 billion in 2015 and is expected to rise to $802 billion by 2040 [33]. Hence, the aim is to encourage vigorous way of life choices, including consumption of low glycemic index and selection of crops to reduce the monetary burden and get better value of life. Diabetes is caused by a number of factors such as the inability of β-Langerhans islet cells to produce insulin resistance, insulin and malfunctioning of glucose metabolism [34].

Diabetes or hyperglycemia can be treated in clinical practice by blocking the pancreatic amylase and α-glucosidase, which interrupt the digestion of complex carbohydrates to simple sugars and hence slow down the absorption of glucose into the blood [35]. HG seeds are loaded with resistant starch, low glycemic carbs, oligosaccharides and dietary fibers. In count, these seeds are accountable for diabetes management due to the presence of elevated amounts of non-digestible carbohydrates that decrease the liberate of glucose into the circulation of blood [32].

6. Antiobesity properties

Obesity has emerged as a major global public health concern, and the World Health Organization (WHO) recognized it as a global epidemic in 1997 [36]. According to the World Obesity Federation, approximately 800

million people worldwide are considered obese, of which 340 million are children aged between 5 and 19 years [37]. Additionally, obesity and stout can considerably increase the risk of multiple illnesses like Type 2 diabetes, hypertension, cardiovascular diseases, dyslipidemia, respiratory problems, cancer, reproductive disorders, liver diseases and psychosocial problems [38]. Published literature has indicated that obesity is a risk factor for multiple types of cancer that includes liver, breast, esophageal, endometrial and colorectal cancer, and abundant researchers have demonstrated a favorable association among liver cancer and obese individuals [39].

7. Antiinflammatory properties

Inflammation is linked to long-term health problems. These include arthritis, heart diseases, liver damage, lung scarring, asthma, Alzheimer's disease, kidney issues, epilepsy, inflammatory bowel disease and Parkinson's disease. It is also believed that 15 percent of all cancer cases are caused by ongoing inflammation [40]. Using - inflammatory medicines is not a new idea. People have used them for a time. Using too much of these drugs can lead to serious problems. These include damage to the kidneys, stomach ulcers, bleeding and internal bleeding [41]. Because of these dangers scientists and researchers are now looking closely at plants that can help to reduce inflammation. Plants have shown promising effects and one such plant is HG. This plant is known to block two enzymes: inducible nitric oxide synthase and cyclooxygenase-2. These biocatalysts are directly involved in the body's response and in the process of inflammation [42]. By blocking them HG may help keep inflammation under control. Studies have shown that HG seeds hold 158.1 μg/g of epicatechin and 6.51 μg/g of daidzein. These compounds are known to bind with cyclooxygenase-2, which is the target of many anti-inflammatory drugs. This means they could be useful in managing inflammation [43]. In addition, the oil from HG seeds has something called Bowman–Birk-type inhibitors. These have been tested in animals. They were found to reduce swelling in the paws of rats. This swelling was caused by red seaweed extract, known as carrageen [44]. This suggests that HG seed oil may be effective, in treating inflammation in real-life situations.

8. Antioxidant properties

An assortment of chronic diseases like obesity, cancer, cataracts, hypertension and cardiovascular diseases are caused by the process of nervous tension [45, 46, 47]. In a learning comparing the antioxidants found in seeds of legume like lentils, common bean, pea, chickpea and HG the maximum 2,2- diphenyl-1-picrylhydrazyl (DPPH) scavenging and ferric-reducing activity was found in HG black seeds [48]. The type of solvent used is very important in activity tests. Parasurama [49] studied the outcome of the solvent on the activity of HG and found that methanolic and ethanolic seed extracts had the highest DPPH and hydroxyl radical scavenging activity. In addition to seeds the leaf extract also has an amount of phenol and tannin and therefore shows the highest scavenging activity, such as hydrogen peroxide radical nitric oxide radical, DPPH, 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) superoxide radical and metal chelating activity [50]. Eating sprouts has become popular because of the nutritional value and antioxidant activity. HG sprouts and seeds were compared for their total phenolic, DPPH reducing power assay and total antioxidant assay. It was found that the uppermost antioxidant activity was from sprouts compared to seeds. Testing for plant chemicals using DPPH, GC-MS analysis and ABTS assays showed that many antioxidants are present in the HG seed extracts [51].

9. Conclusion

Horse gram (*Macrotyloma uniflorum*) is a legume that is not used much but has a lot of potential. It offers nutrition. It has proteins, fibre, vitamins, minerals and special compounds like phenolics and flavonoids. The research shows

that it can help fight radicals, control diabetes reduces weight and lower inflammation. Also, it can grow in areas and poor soil. This makes it a good choice for farming that is good for the environment and for food. Even though there are benefits people do not eat horse gram much anymore. So encouraging people to eat it and adding it to foods and health products might make it better for health. More studies are needed to prove the benefits and uses in humans. Overall, horse gram is a cheap and lasting option for better food and better health.

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