

Utility Of Horse Gram: A Narrative Review

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ABSTRACT

A neglected pulse crop that can be grown in a range of unfavorable environmental conditions is horse gram (kurthi dal). It is mostly cultivated in South India and Uttarakhand. Horse gram is widely used in South Indian dishes like Rasam and Sambar. The present study used new scientific knowledge to review the potential for exploring the horse gram as a source of food and nutraceutical components with an eye toward the growing demand for food with nutraceutical features. An integrative analysis of the literature was carried out in June-July 2022 by the narrative review method. The result of the study shows that It has a significant impact on human nutrition as a result of its high protein, mineral, and vitamin content. Because it contains non-nutritive bioactive compounds, in addition to its nutritional benefits, it has also been associated with a lower risk of contracting several ailments. These bioactive compounds have a big impact on metabolism and physiology. The nutrients and photochemical present in horse gram impart various physiological benefits, starting from relieving intestinal diseases, diabetes, heart diseases, and prevention of dental carries to treating kidney stones, urinary diseases, piles, common cold, throat infection, fever, etc.

Keywords: Horse gram dal; kurthi dal; medicinal value; medicinal dal; healthy dal; Medicinal pulses; non-nutritive compounds.

Introduction

Horse gram dal (*Macrotyloma uniflorum*) is known as Kulathi, Kulath, Kharthi, Garhat in Hindi, and Kulathika in Sanskrit. Horse gram is also known as Kulthi in Gujarati and Hulga in Marathi and "Gahhat" in the local language of Uttarakhand¹. Kurthi dal is consumed as a staple food mostly in the southern part of India⁴. Its stem is bushy, slender, gray, 30 to 45 cm high, and with many branches from the root². Its leaves are yellowish green with bilva-like triplets and long stems. Its seeds are like urad in appearance, light red, black pied, sticky, and shiny. Its color is dark brown and looks like lentils⁷. It is used to prepare some major dishes of South India like Rasam etc. Apart from Karnataka, Andhra Pradesh, Odisha, and Tamil Nadu, this pulse is also grown in Chhattisgarh, West Bengal, Madhya Pradesh, Bihar, Uttarakhand, and Himachal Pradesh¹.

It not only provides adequate nutrition to the body but can also reduce the risk of much serious health problems³. Let us tell you that the problem of stones can be overcome by the consumption of regular horse grams⁸. Not only this but horse gram is also considered very beneficial for weight loss and heart health⁴.

Table 1: Mazor nutrients in horse gram¹

Constituent	Cotyledon*	Embryonic axe*	Seed coat*
Moisture	5.8	8.4	3.9
Protein	22.6	18.6	9.1
Fat	1.8	2.6	0.6
Ash	2.9	2.2	3.8
Crude fiber		11.2	21.8
Total carbohydrate	66.9	68.2	82.6
Soluble sugars	6.4	4.8	0.96
Reducing sugar (mg/100 g)	538.3	211.7	108.6
Non reducing sugar	5.86	4.6	0.85
Dietary fiber	16.7	22.6	36.4
Soluble	1.32	3.1	3.9
Insoluble	15.38	19.5	32.5

* Values are mean

Source: Khazaeiet al., 2019

Horse gram is nutrient-rich and contains a variety of minerals, including iron, calcium, phosphorus, and protein⁵. As a result, it is regarded as being particularly healthy for people. Horse gram is categorized as animal feed, and its potential as a food for humans has not yet been fully exploited⁶. It can be eaten as seeds, sprouts, or an entire meal. It helps with rheumatism, neuralgia, and other conditions and is generally used as a tonic, astringent, and diuretic⁷. Horse gram seeds are rich in natural phenols, including phenolic acids, flavonoids, and the main antioxidants⁸.

Methodology

Review method: An integrative analysis of the literature was carried out before June-July 2022 by the narrative review method. Relevant articles were identified by applying exploration strategies to six academic electronic databases: Scopus, PubMed, SpringerLink, Wiley Online, ArticleFirst, and ScienceDirect. Horse gram, *Macrotyloma uniflorum*, the medicinal qualities of Horse Gram, and the medicinal qualities of pulses were some of the search terms and keywords used. All titles, abstracts, and full-text publications that were retrieved were examined and checked for topical relevance. To find further pertinent publications, references from the retrieved articles were also examined.

Criteria for inclusion: Observational-based studies and refereed research articles are included in the study. Other article types, such as communications, editorials, comments, brief reports, position statements, and abstracts from conferences, were not included. Publications without peer review and grey literature were also removed.

Results and discussion

Nutritional properties of horse gram

A total of 102 articles were searched, out of which after studying the abstract, only 28 articles were left for reading the full paper. After reading the full paper, only 20 research papers were found eligible to be included in the study.

(I) Protein and amino acid: Pulses are significant sources of food protein and frequently serve as an essential supplementary source of protein to other sources. Horse gram seed has a range of 18.5 to 28.5% protein⁷. In the milled horse gram fraction (Table 1), the protein concentration ranges from 9.1% in the seed coat fraction to 22.6% in the cotyledon fraction⁸. However, the protein content of the embryonic ax is higher than that of the seed coat and lower than that of the cotyledons⁹.

According to their solubility, proteins can be classified into four groups: salt- or salt-soluble globulins, alcohol- or salt-soluble prolamins, water-soluble albumins, and acid-soluble glutelins. The digestibility of uncooked and cooked legume protein ranges from 15–80 to 50–90%, respectively, compared to other legume proteins (75–90%). The nutritional value of high protein meals depends on the quantity and caliber of the protein used in their preparation.

Albumins (10–20%), glutelins (50–90%), and globulins (10–20%) make up the majority of the proteins in bean seeds. Albumin-globulin protein fraction makes up 75.27 to 78.76% of the total protein in a horse gram, while glutelin and residual protein range from 9.93-17.52 to 6.96-11.30%, respectively. In comparison to black gram (0.40 g g⁻¹ of nitrogen) and pigeon pea (0.48 g g⁻¹ of nitrogen), it also has a significant amount of the important amino acid lysine (0.52 g g⁻¹ of nitrogen)⁹. Other significant amino acids included in horse gram seed include arginine, histidine, lysine, valine, leucine, etc.; nonetheless, methionine and tryptophan are the two main exceptions (sulfur-containing amino acids)¹⁰.

Proteins and their peptides have been shown to inhibit the angiotensin-converting enzyme (ACE), antimicrobial activity, antioxidant activity, anti-carcinogenic activity, hypocholesterolemic effect, decreased serum triglycerides, increased lean muscle mass, defense against pathogens, control of blood glucose levels, and satiety effects^{1,5}. Leucine, isoleucine, and valine are branch-chain amino acids that are important for the brain's tryptophan and tyrosine metabolic activities, among others.^{1,2} Additional protein types found in legumes include lectins, enzymes, and protease inhibitors, all of which are referred to as "antinutritional compounds".

(II) Carbohydrates (starch, soluble sugar, and dietary fiber): Carbohydrates are the main component of legumes, occupying 50-70% of the dry matter, and are divided into digestible carbohydrates and indigestible carbohydrates^{7,10}. Starches and non-starch polysaccharides (fibers), including trace levels of oligosaccharides, make up the majority of the carbohydrates in legume seeds¹¹. Any starch that is not digested in the small intestine makes it to the large intestine where it is fermented by the intestinal flora and is referred to as resistant starch. Starch is thought to be partially digestible (Table 2).

Table 2: Soluble sugar and the starch fraction of raw horse gram (g/100 g dry matter)^{7,8,11}

Soluble sugar and starch fractions	g/100 g dry matter
Oligosaccharides	3.69
Sucrose	1.21
Maltose	0.53
Glucose	0.00
Xylose	0.64
Galactose	0.08
Arabinose	0.12
Fructose	0.03
Inositol	0.04
Total soluble sugar	6.38
Total starch	36.0
Digestible starch (% of Total starch-Resistant starch)	30.8
Resistant starch	5.21
IDF-RS Resistant starch associated with insoluble dietary fiber	1.22

Source: Lalitha et al., 2020

43.4% of all carbohydrates per horse gram are made up of resistant starch, a non-digestible carbohydrate¹². Butyric acid, which is known to have preventive benefits against colon cancer, is produced at quite high levels during the fermentation of resistant starch. It can reduce the risk of a drop in pH. Foods fortified with resistant starch are beneficial in diabetes management because they reduce postprandial blood glucose and insulin responses. The soluble sugars' oligosaccharides, disaccharides (such as sucrose and maltose), and monosaccharides make up their horsegram units (glucose, fructose, galactose, arabinose, and inositol). The main sugars in the soluble portion of the majority of legumes, including horsegrams⁸, are oligosaccharides. Horse gram has a 3.69% oligosaccharide content¹³. Minor amounts of maltose and monosaccharides were also detected in horse grams. In addition, total carbohydrates, soluble sugars, non-reducing sugars, and reducing sugars were more abundant in the cotyledon fraction⁸.

Dietary fiber can only be found in plant-based diets. From negligible levels to about 50% by dry weight, fiber from plant sources makes up the majority of the average person's diet¹⁴. Polysaccharides that are digested and absorbed in the small intestine as well as fully or partially fermented in the large intestine are referred to as dietary fiber. Recently, oligosaccharides such as inulin and resistant starch are also included. Major dietary fibers include cellulose, hemicellulose, pectin, arabinoxylan, beta-glucan, glucomannan, plant gums, mucilages, and hydrocolloids found primarily in plant cell walls. Insoluble and soluble fiber are both abundant in legumes. Both soluble and insoluble fiber are present in horsegrams¹⁵. Compared to kidney beans, *Muniflorum* seeds have higher insoluble fiber (*Phaseolus aconitifolius*). The seed coat fraction had a larger crude fiber content than the hypocotyl and cotyledon fractions. Furthermore, legumes' high-fiber, low-protein seed coat portion may be used to create diets that enhance gastrointestinal health and satiety modifications.

Dietary fiber predominantly affects the gastrointestinal system in humans and is linked to several physiological changes, including bloating, changes in gastrointestinal transit, changes in satiety, effects on blood cholesterol levels, and changes in postprandial levels of serum glucose and insulin. impacts effectiveness and alters nutrient bioavailability¹⁵. The main bioactive functions attributed to dietary fiber are constipation relief, blood sugar regulation, cholesterol-lowering, prebiotic effects, prevention of certain types of cancer, cardiovascular disease (CVD), diverticulosis, obesity, and lower blood pressure. Similarly, soluble fiber has also been reported to lower serum cholesterol and reduce the risk of heart attack and colon cancer. Insoluble dietary fiber is necessary for normal lower bowel function in humans¹⁰.

(III) Non-nutrient bioactive compounds: Pulses comprise a variety of chemicals that can have both beneficial and detrimental biological effects on the human body¹⁶. It is appropriate to classify the undesirable ones as antinutrients or anti-nutritional factors (or compounds). Two types of antinutritional substances are present in pulse crops: protein ANCs and non-protein ANCs. Alkaloids, phytic acid, and phenolic substances like tannins and saponins⁸ are examples of nonprotein ANCs.

Table 3: Phenolic compounds in different milled fractions of horse gram

	Horse gram fractions		
	Cotyledon	Embryonic axe	Seed coat
	Concentration (µg/g on a dry weight basis)		
Flavonoids			
Quercetin	9.7	113.4	129.5
Kaempferol	6.0	67.4	117.2
Myricetin	2.4	32.9	35.5
Daidzein	4.1	22.2	0.94
Genistein	nd	44.7	nd
Phenolic acids			
Benzoic acid derivatives			
Gallic acid	26.9	19.8	5.5
Protocatechuic acid	39.0	11.8	23.1
p-hydroxybenzoic acid	20.1	13.1	28.8
Vanillic acid	58.4	53.2	42.4
Syringic acid	18.4	nd	4.5
Subtotal	162.8	97.9	104.3
Cinnamic acid derivatives			
Caffeic acid	88.9	61.5	10.6
Chlorogenic acid	160.8	26.8	22.5
Ferulic acid	70.1	31.4	37.5
Sinapic acid	9.7	nd	3.7
p-coumaric acid	40.9	21.4	24.5
Subtotal	370.4	141.1	98.8
Total	533.2	239.0	203.1

Source: Lalitha et al., 2020; Prashad et al., 2018

Antinutritional elements including phenols, tannins, phytic acid, and oligosaccharides that cause flatulence are now thought to be possible antioxidants. These antinutrients have several beneficial health special effects, including a lesser risk of coronary heart disease, dental caries prevention, intestinal illnesses (such as gallstones, diverticulosis, constipation, and colon cancer), and diabetes treatment. It has been shown that saponins and another frequent class of antinutrient chemicals have hypocholesterolemic and anticarcinogenic properties¹².

Nutraceutical properties of horse gram

Protein, fiber, phytochemicals, and micronutrients are all abundant in legumes. They can offer tiny amounts of several bioactive compounds with significant physiological and/or metabolic effects in addition to nutrients¹⁷. Non-nutritive bioactive chemicals are the name given to these bioactive molecules. H. Polymeric tannins, flavonoids, and phenolic acids. These substances can treat or prevent several illnesses, including obesity, diabetes, and coronary artery disease. They also have anti-inflammatory characteristics. The phrase "dietary supplement," first used by Stephen DeFelice in 1989, is defined as "a food (or portion of a food) that delivers medical or health advantages, including the prevention and/or treatment of disease." increase. Simply put, a nutraceutical is a food or food ingredient that provides health and/or medicinal benefits, such as prevention, protection, or treatment of disease. Nutraceuticals, also known as functional foods or health foods, have gained a lot of attention in recent years due to their therapeutic synergy, economic viability, and absence of side effects. and/or the health-improving properties of functional meals are probably brought on by a complex network of biochemical and cellular interactions that improve an individual's general health^{16,17}. It is accelerating the nutraceutical and functional food industries' rapid global growth in conjunction with increased health awareness.

(I) Benefits for stones: As with kidney stones, it is evident for horse gram. According to data on the National Center for Biotechnology Information website, fennel has been used for stone treatment for a very long time¹⁸. Thanks to the antioxidant and detoxifying properties of horse gram, kidney stones can be washed away. . Perhaps, for this reason, the treatment of kidney stones is considered both traditional and alternative medicine⁹.

(II) Diabetes: Horse gram benefits are seen in the treatment of diabetes. Uma Gram is reportedly rich in antioxidant properties that may help reduce the risk of diabetes¹⁸. Horse gram is also highly resistant and may reduce postprandial hyperglycemia (high blood sugar levels after meals) by slowing the digestion of carbohydrates and reducing insulin resistance. Diabetics can benefit from this¹⁸.

(III) For Weight Loss: The benefits of taking horse gram are also seen in weight loss. Studies related to horse gram describe it as beneficial for weight loss¹⁹. The fiber elements it contains can be responsible for this and its soup can be taken for weight loss¹².

(IV) Cholesterol Control: Horse gram can also be taken for cholesterol control and it has a cholesterol-lowering effect, that is, a cholesterol-lowering effect. In addition, it contains plenty of dietary fiber²⁰. At the same time, fiber lowers LDL (bad cholesterol) and raises HDL (good cholesterol). Based on this, we can say that it helps control elevated cholesterol levels²¹.

(V) For Diarrhea: The benefits of horse gram are seen in conditions such as diarrhea. Horse gram is rich in elements such as flavonoids, which act as antidiarrheals. Apart from that, the fiber contained in curtidal can play an important role²². Dietary fiber is an essential nutrient for gastrointestinal problems and helps clear diarrhea.

(VI) Ulcers: In this case, the role of flavonoids in lentils is also seen. Flavonoids act as powerful anti-ulcer agents. Helps heal ulcers²³. Dietary fiber also plays an important role in conditions such as ulcers. The World Health Organization recommends a high-fiber diet for patients with stomach ulcers. Fiber may be beneficial for stomach ulcers by reducing bloating and pain in the gastrointestinal tract²⁴.

(VII) Colds and Fever: Krushi dal benefits are also seen in physical problems such as colds and fevers. This lens has been used for centuries as a traditional remedy for fevers and colds. Horse gram is not only good for colds and fevers but also for throat infections²⁵.

At the same time, another report states that horse gram water can relieve colds and coughs. Experts say horse gram effects are hot, so it's especially consumed in winter²⁶.

(VIII) Irregular Menstruation: The benefits of horse gram are also seen in the problem of irregular menstruation. Horse gram has long been used as a remedy in Unani medicine. It is also effective for diseases such as menstrual irregularities. However, more research needs to be done on this²⁷.

(IX) Constipation: The benefits of horse gram are also seen in getting rid of problems such as constipation. As mentioned earlier, horse gram is rich in dietary fiber, which helps in relieving constipation. Fiber softens stools and makes them easier to pass. In this situation, it can be said that we see the benefits of horse gram for constipation problems¹². Dietary fiber is one of the essential nutrients for the gastrointestinal tract, not only to make digestion smoother but also to eliminate problems such as constipation. Krutidal benefits can be achieved for healthy digestion.

(XI) To the Heart: One of the Krusi benefits is to keep the heart healthy. Research available at NCBI clearly states that the fiber in horse grams can significantly reduce the risk of heart attack by lowering cholesterol levels. It has also been studied to contain phenolic acids, flavonoids, and tannins that can protect against problems¹⁷.

(XII) For piles: The use of horse gram can also be considered beneficial to remove the problem of piles¹⁴. It has long been used in Ayurveda to treat many diseases, including piles¹³. Which quality of horse gram is responsible for this, there is a need for research on this.

(XIII) For the skin: The benefits of horse gram for the skin are many. According to a report, the use of grinding this pulse can get rid of rashes and boils²⁶. In addition, flavonoids are found in horse gram. While flavonoids can help protect the skin from the harmful ultraviolet rays of the sun²⁷.

Conclusion

After a critical evaluation of the nutritional and beneficial aspects of horse gram, it can now be accomplished that horse gram is a rich source of nutrients. The nutritional value of horse gram is similar to that of other legumes. The amino acid profile of Kulthi dal is also very impressive. It is rich in all the essential amino acids except tryptophan. A comparison of its nutritive value with a few other common legumes will give you a much clear picture. In addition to being a traditional source of protein and carbohydrates, horsegram exhibits high levels of antioxidant and free radical scavenging properties. It is rich in various natural beneficial compounds such as phytic acid, dietary fiber, and phenolic acids. These bioactive chemicals show promise in treating a variety of conditions, including albinism, asthma, bronchitis, colds, throat infections, fevers, and urinary stones. Therefore, given its immense potential as a health benefit, it should be used as a source of dietary supplements and in the food industry.

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