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Horsegram [*Macrotyloma uniflorum*]: an underutilized pulse crop as a sustainable plant-based protein

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The demand of consumers for plant-based protein is high and is anticipated to increase in the future due to various underlying health benefits. Moreover, the production of high-quality animal protein globally results in a challenging situation for the sustainability of the environment. Contemporary, to find new alternative protein sources, underutilized legumes are given more attention to meet the ever-increasing requirement for vegetable protein. One of the indigenous underutilized legumes is Horsegram (*Macrotyloma uniflorum*), having superior nutritional quality with better potency to adapt to rough environmental conditions. Horsegram is considered a wholesome food as it provides 23% protein, less than 1% of fat, and 60% of carbohydrates. However, due to the presence of anti-nutritional factors such as lectins, trypsin inhibitors, and phytic acid; the absorption and bioavailability of nutrients fall away. Optimal utilization of the nutrients can be achieved by conventional processing methods which increases the acceptability and nutritional quality of horsegram. Additionally, it provides several bioactive components in minimal quantities which has substantial metabolic and/or physiological effects. Therefore, the horsegram can be used as an underutilized sustainable protein source in the food industry for manufacturing plant-protein-based functional food.

1. Introduction

Protein is a dietary component that plays many constructive and agile roles in the body. In addition, protein-based ingredients play several different technical roles in processed foods and contribute to texture, colour, taste, and other food properties (Loveday, 2019). It is estimated that from 2010 to 2050, the world's demand for food will be doubled and as a result, the demand for animal-source protein will increase by 70%, especially for light meat (cattle, sheep, and goats) (Henchion et al., 2017). To fulfil this high upsurge in the proteinaceous food demand, the global pressure (yields and pastures) will increase and contribute to higher gas emissions (GHG). This is a major environmental challenge and therefore switching to a more stable diet and exploring other sustainable protein sources has been at the utmost forefront of 21st century food research.

In 1987, Brundtland World Commission reported "Sustainability is the development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." Sustainability is generally defined by focusing on ecology, economy, and society and has various elucidations determined by the circumstances. Therefore, a sustainable diet does not certainly be defined evenly

for consumers, farmers, or food manufacturers (Sabate and Soret, 2014). Sustainable food is defined as a diet that improves the overall health and well-being of the individual; has low pressure and impact; is affordable, safe and equitable; and culturally acceptable' (Thakur et al., 2020). The principles of a sustainable diet are based upon the use of raw or processed foods, especially cereals, pulses, fruits and vegetables, milk, poultry, and fish in moderation and a lesser amount of meat from cattle, sheep, and goats.

Global change in our food cycle and system requires a combination of major changes in plant-based food patterns and significant improvements in food production activities. The need for trade should be recognized and at the same time, unintended consequences should be avoided which has often been linked with large gaps in our understanding of the sustainable credibility of alternate protein sources (Lonnie and Johnstone, 2020).

Proteins are indispensable components of the human daily diet which can be procured from either plant or animal sources. Although, animal proteins are higher in demand but are less environmentally sustainable. Consequently, a gradual transition of preference from animal protein to plant protein is seen to maintain the stability of the environment, ethics, food affordability, and food safety, fulfilling higher demands of consumers, and fighting protein-energy malnutrition. Plant proteins are an acceptable source of essential amino acids and significant macronutrients. Therefore, the main goal is to provide an overview of plant-based protein that helps in sustaining a better life for humans (Langyan et al., 2022).

On that account, we review a nutritionally important underutilized legume crop: *Macrotyloma uniflorum*, which is a pulse crop that has economic, agricultural, and medicinal importance and is highly drought-tolerant, yet less popular tropical legume commonly called 'Kulthi'. The major points about Horsegram are discussed here: (1) Morphology, (2) Cultivation, (3) Composition, and (4) Medicinal benefits. To strengthen Horsegram's prospects, future perspectives have also been highlighted.

Horsegram is an overlooked and under-valorised crop that has a great new potential to hold up small farmers by providing income, food, and nutritional security as well as sustaining the genetic resources required to confront present and future environmental challenges (Bhartiya et al., 2015).

1.1. Existing protein sources

Proteins are found in various food sources; this includes animal and plant origin foods as well as novel sources like algae or fungi (Figure 1). Determining the efficacy of a protein is achieved by determining its quality and digestion, where quality refers to the availability of amino acids it provides, and digestion

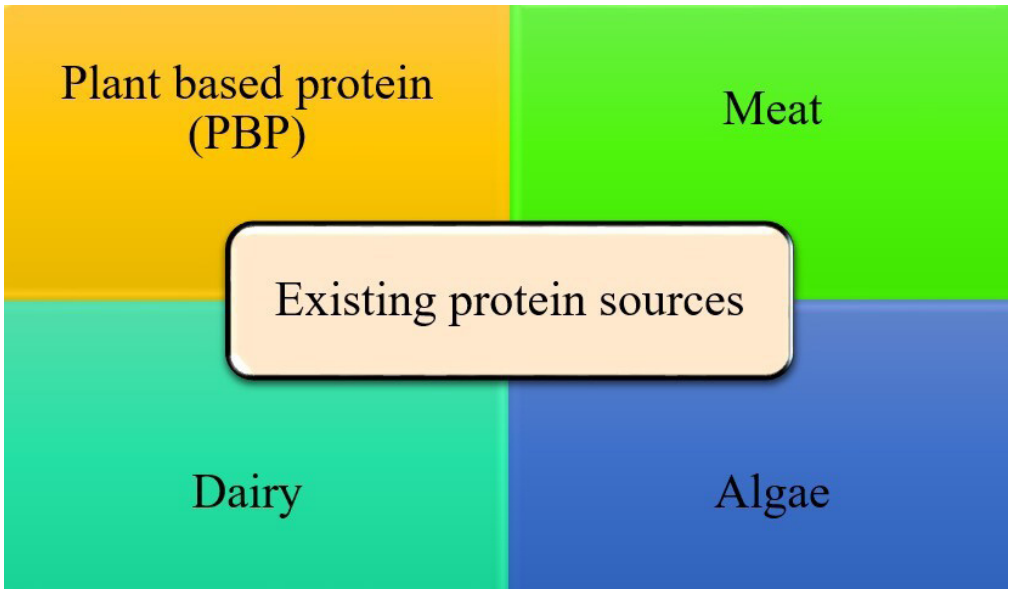

Figure 1. Existing sources of protein

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determines how well protein is utilized by the body. Generally, all the sources of animal protein are considered complete proteins as they contain all the essential amino acids, while proteins from vegetable sources are incomplete because they often lack one or two essential amino acids. Therefore, a vegetarian is required to consume protein from different vegetarian sources like grains and legumes to ensure the intake of most of the essential amino acids (Hoffman and Falvo, 2004).

Contemporary, plant protein sources preside over protein supply globally with 57%, 18% with meat, 10% with dairy, 6% with fish and shellfish, and 9% by utilizing other animal products and making up the rest.

i. Plant-based protein: A variety of plants and their parts (e.g., seeds or leaves) are commonly available protein sources. Some of them have a long history of use as protein sources including soy and wheat, while others are currently emerging.

a. Pulses were considered the poor man's meat however over recent years; these have been considered as excellent sources of plant protein. The protein content in grain legumes ranges from 18 to 34%. Pulses have high lysine, leucine, aspartic, and arginine contents, although methionine, cysteine, and tryptophan levels are very low. Examples of protein-rich pulses and lentils are green gram, soybean, horsegram, etc.

b. Cereal grains and pseudo-cereals: Cereals generally contain 8-11% of protein. These proteins are rich in methionine, cysteine, and tryptophan however, levels of lysine and threonine are very low. The protein from amaranth, quinoa, and buckwheat have gained much attention because of their high nutritional and functional properties and are also suitable for patients with celiac disease.

c. Oilseeds: The end products of oil processing from oil seeds contain around 45- 65% protein depending on the ingredient and processing conditions. Examples of oilseeds are sunflower, canola, peanut, palm kernel, etc (Schweiggert-Weisz et al., 2020).

The advantages of plant proteins on long-term health have been a trending subject matter in current years. Several studies have explored the potential impact of plant proteins on reducing cardiovascular diseases, diabetes, and the incidence of cancer. Therefore, inevitably plant proteins are also studied for their potential activity as functional foods. Plant proteins help in reducing low-density lipoproteins, very low-density lipoproteins, and apolipoprotein B which help individuals with coronary heart disease. Various studies have also shown positive effects of plant proteins on postprandial glucose and ghrelin responses, and have improved the levels of HbA1c, fasting glucose, and insulin levels of people with diabetes. It is established that there are numerous constituents present in plants like carotenoids and flavonoids which help in conferring bioactive benefits for the health of the individuals (Hertzler et al., 2020).

ii. Meat: Meat is considered one of the most important protein sources, a wholesome and energy-rich food, consumed by humans to satisfy their daily protein requirements. Although, a number of research have highlighted a possible relationship between its consumption and the high risk of cardiovascular diseases, cancers, and various metabolic disorders. However, proteins from meat are an excellent source of essential amino acids and have high protein content which is easily digested and provides minerals (iron, zinc, and selenium) and vitamins (A, B9 & 12, D, and E). Chicken breast, beef, pork, mutton, and lamb are some of the sources of meat protein. Focussing on the presence of saturated fats in meat which can cause coronary heart disease and other metabolic disorders there is a point to be considered about its consumption as overuse can lead to serious health consequences. Therefore, plant-based meat processing methods are made with many of the products already on the market (Ahmad et al., 2018).

iii. Milk: Ingredients for milk control the protein market, mainly due to the highly developed global dairy industry and the quality of milk which helps to diversify through the production of vital product streams. They have practical and health benefits supported by scientific/medical studies, which form the basis for a balanced diet. The global milk protein market is complex, multifaceted, and driven by ever-changing markets and, more recently, healthy eating patterns.

iv. Algae: Aquatic plants like seaweeds and microalgae exhibit as a positive and innovative upcoming source of protein. Both seaweeds and microalgae are together called algae, although, seaweeds are the composite

multicellular structure that grows in saltwater, on the other hand, microalgae are one-celled organisms that grow in a variety of environmental conditions. Examples of microalgae which is consumed by humans are Arthrospira spp, Spirulina spp, Chlorella spp, and Dunaliella salina. However, there are certain limitations related to toxicity, microbial load, and other sanitation issues. Nutritionally, microalgae are compared with plant proteins but because of high production costs and challenges in extraction, refining, sensory and palatability hamper its inclusion in food products.

Although focusing on the content of Eicosapentaenoic Acid (EPA) and Docosahexaenoic acid (DHA) of microalgae, they are being sold as health foods. On the other hand, red and green varieties of seaweed are very rich in protein (approx. 47%) and are referred to as sea vegetables with greater consumer acceptance. The presence of amino acids in seaweeds is compared to protein sources such as eggs or soybean.

There are regulatory restrictions on innovative food and revolutionary food ingredients and therefore food safety, nutritional and health claims can hold up the rate of market exploitation of algae.

However, overall, in the foreseen future, the technological establishment will continue to position plant-based protein as a beneficial course of action from a sustainability frame of reference (Henchion et al., 2017).

1.2. Emerging sources of plant-derived protein

Globally, plant-based proteins are very important and there is great interest in their ability to meet the growing demand for proteins. They are preferred over animal-derived proteins as they are associated with lower land use requirements, and it is widely acknowledged that plants produce lower levels of greenhouse gas (GHG), and are associated with climate change (Henchion et al., 2017). In addition, because of the high cost and limited availability of animal protein in several countries and consumer concerns about the health benefits of animal-derived proteins, increased attention is focused on the use of plant-based proteins as the most cost-effective protein source of food (Tilman and Clark, 2014). Among plants, pulses are considered an important source of dietary protein and other nutrients. In many parts of the world, pulses are a major source of protein in the diet where plant proteins are found in the cotyledon and the embryos of small seeds in the seed coat.

There has been an earnest investigation by the researchers on utilizing the alternative or underutilized plant species for multitudinous use (Thakur, 2020). Researchers also investigated that many protein-rich pulse crops in India are still unexplored and underutilized, one such plant protein source is the underutilized pulse crop i.e., horsegram (*Macrotyloma uniflorum*). This neglected and unpopular plant has great potential that can be used to support smallholder farmers' communities by providing income, food, and healthy food security and maintaining the needed genetic resources to address current and future environmental challenges (Gulzar and Minnaar, 2017). Thus, the underutilized pulse crops are better sources of a sustainable food system.

2. Horsegram as a sustainable source of protein

Horsegram (*Macrotyloma uniflorum* (Lam.) Verdcourt (Figure 2 and Figure 3) is a legume and crop used for animal fodder that is generally found in Southeast Asia and tropical Africa; however, Southern India is known for its origin (Chahota et al., 2013). It is a crop of semi-arid tropics. It is an annual herb, which grows to the height of 30- 40cm (Fuller and Murphy, 2017). It has three leaflets, 7–10mm long continual stipules, and typically a 3–7 cm long petiole. Leaflets are oval, round from base, acute or slightly pointed, usually 3.5–7.5cm long, 2–4cm wide, and length and breadth ratio of 1.5: 2.5. Flowers are stubby and immobile with 10–12mm in height (Fuller and Murphy, 2018). It is known by the names of various regions in India such as gahat or kulath, kurti kalai, kulith (Maharashtra, Uttrakhand, Himachal Pradesh), ulavalu (Andhra Pradesh), hurali (Karnataka), madras or gram beans (Chennai), kollu (Tamil Nadu) and muthira (Kerala) (Bhardwaj and Yadav, 2015) (Table 1).

Horsegram has been a lesser-known pulse species in terms of marketing and research, and it is very well adapted to marginal and stress conditions. Its ethnobotanical data and indigenous potential are well known to the people (Bhardwaj and Yadav, 2015).

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Figure 2. Horsegram plant

Figure 3. horsegram seeds

Table 1. Scientific classification of Macrotyloma uniflorum (Bhardwaj and Yadav, 2015)

Kingdom	Plantae
Phylum	*Tracheophytes*
Class	*Dicotyledons*
Order	*Fabales*
Family	*Fabaceae*
Genus	*Macrotyloma*
Species	*uniflorum*

It is a plant that requires a long period of darkness and an average temperature of 20–30 °C, however, it cannot tolerate frost or waterlog. It is grown in areas with less than 980 mm annual rainfall or drought conditions and on poor soils with pH 5–7.5. It is a cheap and good source of protein, antioxidants, and minerals. Parts of the horsegram plant are utilized for therapies in the treatment of heart conditions, asthma, bronchitis, leucoderma, urinary discharges, and kidney stones. It is typically advised for persons having trouble with jaundice, common cold, cough, body pain, tiredness, and obesity. It is considered to be useful for people with iron deficiency and helps in maintaining body temperature in the winter season (Bhardwaj and Yadav, 2015).

Drought is one of the abiotic stresses that severely impairs pulse production. Thus, in the export-oriented market, dried legumes have gained a foothold. Although drought-tolerant and stable horsegram is still low in production. This is because less than 0.7 million ha area is under horsegram as compared to that of well-known legumes such as chickpea (6 million ha), soybean (7 million ha), and mungbean (1 million ha). This important legume crop is still unexplored apart from being drought tolerant.

Dry legumes such as horsegram have emerged as an important plant in combating such environmental stress. There is a need to increase the area and produce horsegram. Therefore, even in vitro cultivation of horsegram can be beneficial.

2.1. Consumption of horsegram

Horsegram is considered a legume with medicinal value in Ayurveda. Therefore, it is an important part of the kitchen. It is eaten as a whole seed, dhal, or in the form of sprouts by many people in the rural areas of India. The whole horsegram is either cooked

or fried or used to prepare the curry. A thick soup of horsegram is prepared by soaking the seeds in boiling water and stirring occasionally to form a thick paste. This is often used in the treatment of cough and bronchitis in rural India. The cotyledon known as 'dhal' obtained after the removal of the husk of horsegram is consumed in various regions. It has a faster cooking time, increases digestion, and lowers anti-nutrient levels compared to whole grains. However, for split horsegram it can be soaked in water for 30-60 minutes and can be consumed in form of curry. Apart from this, it is often used to make special dishes that taste good by frying in oil with onions and other spices. The sprouted seeds are used for curries or either it is tempered with oil and onions, peppers, and other spices to make them more palatable. This preparation is commonly used as a side vegetable in many parts of India (Kadam and Salunkhe, 1985).

Horsegram flour is used to prepare certain ingredients by mixing it with other cereals. The addition of horsegram dhal and sesame flour (8%) significantly improves growth and protein-energy balance (PER) which promotes better utilization of protein. In addition to providing a protein-rich diet, horsegram provides the right amount of fibre and low ash content and is therefore used as both food and fodder for livestock.

2.2. Nutritional composition of Horsegram

Horsegram has a very important place in human nutrition as it is a nutritious and cheaper and abundantly available food source in developing countries. Table (2) explains the nutritional composition of horsegram.

The estimation of all the macronutrients i.e., protein, fats, and carbohydrates, and determination of ash and fibre content were carried out according to the method of AOAC 1990, for conversion of nitrogen to crude protein the factor of 6.25 was used. The seeds of horsegram were procured from Himachal Pradesh and were cleaned to remove any foreign particles, they were then stored in a cool and airtight container. To estimate the nutritional composition, the seeds were grounded to procure whole horsegram flour.
It has a high nutritional value parallel to other commonly grown pulse crops in all facets and is also an excellent source of iron, molybdenum, and calcium (Bhokre et al., 2012). Even so, various factors like genotype, soil, cultural practices, weather and climatic factors, and postharvest handling can exert influence on the nutritional quality. Seeds of horsegram have low-fat content and a great amount of protein, dietary fibre, a variety of micronutrients, and phytochemicals yet it has remained an underutilized legume, generally exhausted by the farming communities of remote areas and low-income groups (Bhartiya et al., 2015).

2.3. Proteins of horsegram

Horsegram seeds contain 23.6% protein which is higher in content as compared to whole egg protein

Table 2. Nutritional composition of whole horsegram

Nutritional composition	Value
Protein (%)	26.07
Fat (%)	1.1
Carbohydrates (%)	61.9
Crude fibre (%)	2.95
Ash (%)	4.3

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which ranges between 7-13% (Kadam and Salunkhe, 1985). Although like other legumes; horsegram also cannot match the essential amino acid composition of egg protein. Compared to animal proteins, the consumption of legumes is low due to their low digestion and poor cooking quality. However, it has been found that the protein of unprocessed horsegram is found to be easier to digest than other legumes. The seed coat accounts for 13.7% of protein. Horsegram protein extraction studies have shown sodium chloride salt and sodium carbonate to be the best salts to extract protein. Water and oil absorption operations were found to be better after such extraction. The protein content in horsegram increased to a certain extent as an adaptive mechanism to combat drought stress conditions (Bhardwaj and Yadav, 2015).

2.4. Protein isolation of horsegram

Even though the nutritional and pharmaceutical potential of horsegram has been acknowledged, horsegram protein concentrate (HGPC) or isolates are not available for use in the food industry. Its eminent lysine content makes it an attractive protein source as most plant proteins are deficient in this essential AA. Horsegram protein concentrate (HGPC) with enhanced protein content and lowered anti-nutrients (like trypsin inhibitors) will find extensive applications in the food industry. Table (3) shows the essential amino acid composition of dehulled HORSEGRAM flour and HORSEGRAMPC (Lalitha and Singh, 2020).

Ghumman et al., 2019 also studied the amino acid composition of different varieties of Horsegram (Table 4).

2.5. Health benefits of horsegram

In the current scenario, people are now aware of the health benefits of an easily accessible underutilized, and cheaper source of protein. Horsegram is one such legume that is abundant in medicinal properties. Tests and clinical trials related to horsegram's cytotoxicity, antimicrobial and haemolytic activity were performed. Different extracts (ethyl acetate, dichloromethane, aqueous, and butanol extracts) of horsegram are to be non-toxic in a test for cytotoxicity concluding that they may be potential therapists. The release of ethyl acetate and dichloromethane showed antimicrobial activity while aqueous extraction with butanol did not show any significant activity. The extraction of 1-butanol per horsegram with an EC 50 value of 200 µg / ml of the haemolytic test was considered the most effective of all other extracts. Table (5)

Table 3. Amino acid profile of dehulled horsegram flour and horsegram protein concentrate (HGPC) (Lalitha and Singh, 2020)

Essential amino Acid	Dehulled horsegram flour	HGPC
Valine	5.20	6.47
Methionine	1.48	0.97
Lysine	6.84	8.13
Tryptophan	2.08	0.50
Histidine	3.24	3.24
Arginine	5.48	6.29
Threonine	3.19	4.26
Isoleucine	4.67	6.18
Leucine	7.99	9.07
Phenylalanine	8.69	6.84

Table 4. Amino acid analysis of horsegram

Amino acid	Amount (in g)
Aspartic acid	1.18
Glutamic acid	1.63
Asparagine	0.54
Serine	2.05
Glutamine	6.06
Histidine	5.92
Glycine	5.64
Threonin	20.9
Citrulline	3.02
Arginine	2.84
Alanine	8.22
GABA	5.65
Tyrosine	16.8
Cysteine	0.50
Valine	0.35
Methionine	3.56
Phenylalanine	2.07
Isoleucine	2.64
Leucine	7.55
Lysine	0.24
Proline	2.73

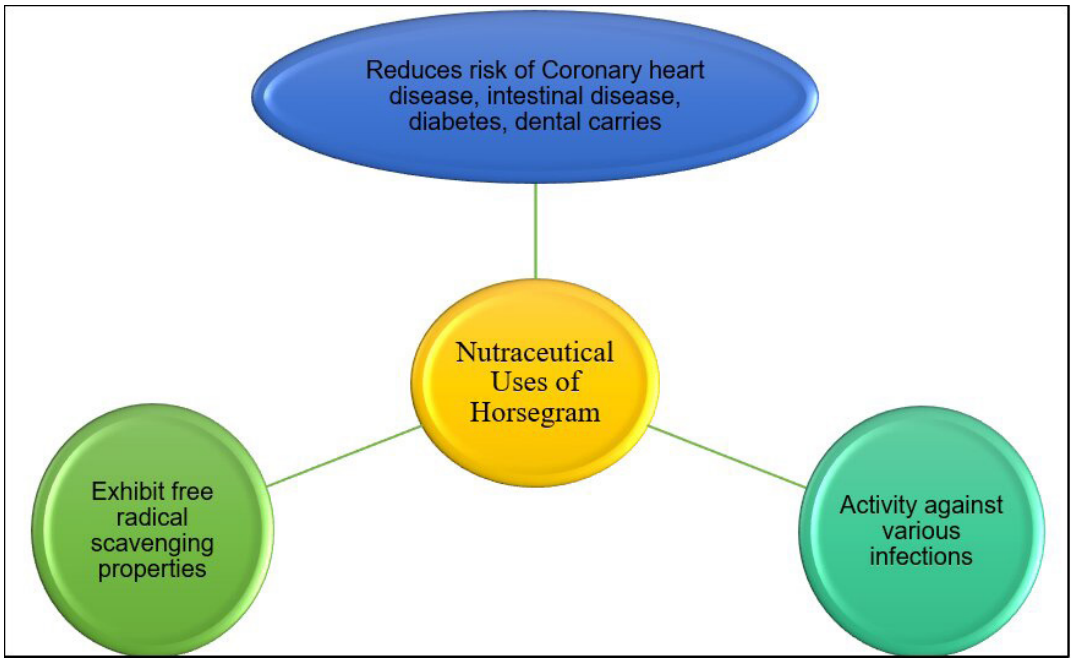

Figure 4. Nutraceutical uses of horsegram

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below explains the health benefits of different parts of horsegram (Bhardwaj and Yadav, 2015).

3. Uses and future perspectives of horsegram as nutraceuticals

3.1. Ethno-botanical uses of horsegram

Horsegram is a legume with various functions to perform and has a variety of end uses as food, forage, or green manure. It is generally utilized to prepare gravies and is consumed with rice. It is also utilized as fodder

Table 5. Composition and health benefits of horsegram (Bhardwaj and Yadav, 2015).

Part of horsegram plant	Major components	Health benefits	Miscellaneous benefits
Seed coat	Insoluble dietary fibre	Improves bowel movements	Food and fodder
	Calcium	Strengthens bones	Food product formulations
	Phenolics	Reduces oxidative stress, related to heart diseases, cancer and inflammation	Endogenous antioxidants
	Ash content	Low ash content index of feeding quality	Livestock maintenance
Seeds	Carbohydrates	Slowly digestible starch, galactooligosaccharides help in the growth of intestinal bifidobacteria, linked with reduced risk of diabetes, obesity and heart diseases.	Oligosaccharides are used as prebiotics in various products as aerated drinks, candies, infant food, etc.
	Proteins	Cheaper and safer protein source on health grounds improves protein efficiency ratio, reduces plasma low-density lipoprotein	
	Lipids	Improves shelf life, used in weight restriction diets, possesses hypolipidemic activity	
	Vitamins	Overall growth and development	
	Minerals	Low sodium and high iron are advantageous for high blood pressure	
	Bioactive peptides	Antioxidant activity, antihepatotoxic activity	
	Trypsin inhibitors	Suppression of carcinogenesis	
Dark coloured seeds	Higher phenolics	High ferric reducing antioxidant power (FRAP)	Elevated levels of anti-oxidative enzymes
Soup of horsegram seeds	Isoflavones and glucopyranosides	Potential against cold, throat infections, fever generates heat and possesses anti lithic activity, inhibits calcium oxalate crystallization	

and nutritious forage for livestock. Horsegram is also grown as a preparatory crop in South India in order to improve the fertility of the soil. People also prepare soups of horsegram and consume them to treat fever. In some parts of India, sprouted horsegram is consumed in the form of a vegetable (Aditya et al., 2019). South India is popular for various tasty preparations out of horsegram such as curry, pappad, and so on. Panch Dhani, which is a mixture of five crops namely, Horsegram, Indian bean, Cowpea, Niger, and castor is grown by farmers of Karnataka (Bhartiya et al., 2014).

3.2. Future perspectives of horsegram as nutraceuticals.

A nutraceutical is a dietary supplement or part of a diet that provides health benefits. The benefits of phytochemicals and nutraceuticals and/or active foods may be due to the complex combination of chemical and cellular interactions (Lakhanpal and Rana, 2005).

The clinical success of nutraceutical products coupled with increased health leads to the rapid global growth of nutraceuticals. The major chemical compounds which provide benefits to health are phenolics, flavonoids, alkaloids, carotenoids, prebiotics, phytosterols, tannins, fatty acids, terpenoids, saponins, and soluble and insoluble dietary fibre. The horsegram plant exhibits astringent, diuretic, and antioxidant properties. It is used to treat many health problems, especially diarrhoea, bleeding during menstruation, and abdominal pain, and in the treatment of leukorrhea and bleeding during pregnancy. Regular intake of horsegram helps to get rid of worm infections, it also regulates the digestive system and maintains acidity and gastric issues. Horsegram also helps to lower cholesterol levels (Patangare et al., 2019). Horsegram fractions with a variety of fibre content can be found for the application of a variety of specialty food products for a specific target age group. Phenolic compounds that inhibit the activity of α-amylases and proteases provide an attractive goal in developing potent therapeutic agents to treat various diseases. Researchers have studied the polyphenolic properties of various underutilized legume seeds and reported that they contain powerful properties for healthy eating. Therefore, this could further augment nutraceutical research for underutilized pulses. Consumption of horsegram and its products is limited due to the presence of anti-nutrients and poor digestibility. Enzymatic therapy can be used to improve the function of horsegram to facilitate its use as an active food ingredient. Fractions of horsegram with high trypsin inhibitor (TIA) activity can be used as an effective dietary supplement similar to soy concentrate. Furthermore, seed coat fractions of legumes with high fibre and low protein may be useful in food product formulations. Horsegram has various future applications in the manufacturing of nutraceuticals, functional foods, and therapeutics (Figure 4) (Bhardwaj and Yadav, 2015). Extracts from horse gram seeds have shown significant activity against Bacillus subtilis, Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa.

4. Market trends

The global plant protein market is expected to grow rapidly due to its high protein content and the many health benefits of plant protein. Vegetarians and non-vegetarians need to supplement their protein sources and ensure that they get all the essential amino acids. Most plant proteins are extracted from seeds and vegetables.

Plant proteins are lower in saturated fats and cholesterol and are a good source of fibre, vitamins, and minerals. Thus, with the increasing consumer popularity of plant-based foods, food producers are creating plant-based foods with a vegan claim to affect market demand.

The market for plant-based food and beverages does not show signs of flagging. As per the Plant-Based Foods Association (PBFA), U.S. retail sales of plant-based foods grew by 11.4% in 2019, bringing the total market value of plant-based crops to $ 5 billion. Even with the COVID-19 epidemic, sales have not slowed down. Even the food retailers surpassed the growth of plant-based foods during the epidemic, indicating that more consumers are turning to plant protein during the crisis (PBFA 2020). In mid-March, plant food production increased by 90% compared to sales last year. In all four weeks following a major panic attack, total sales of plant-based foods grew by 27%, which is 35% faster than the total plant-based food sales. (Institute of Food Technologists, 2020).

5. Conclusion

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Plant proteins play significant contributions if current health protein recommendations are reviewed upward. It becomes an obligation to conduct research to identify and evaluate other less expensive methods that are not compatible with the horsegram for the future. Horsegram is underutilized but nutritious and is one of the most important plants. Its cultivation is inexpensive and economical. Horsegram is a sturdy and nutritious plant that has been overlooked for many years. Its current state of use cannot undermine its many beneficial functions. Our relentless obsession with not separating it as a major food crop needs to be reduced by showing it as a large pulse and therefore it is imperative to conduct research and explore other less expensive crops like Horsegram. It is a valuable store of a variety of therapeutic and life-sustaining qualities. The health benefits of the horsegram have been recognized in the western world recently, but it has been known for its ability to prevent and treat various diseases in the Indian "Ayurvedic" system for centuries. In addition, there is a scope of this legume to be studied for its chemical profile, pharmacology, biological testing, toxic effects, health-promoting properties, and many of the phytochemical screening that has not yet been discovered and there is a need to encourage and support this protein sustainable crop to address food and nutritional security.

To meet the global demand for protein, the sustainable crop- horsegram should be promoted for cultivation and utilization by researchers, plant breeders, technology providers, as well as by consumers who have been neglecting the usage of the crop. The benefits of the legume should be communicated to the community to increase the usage of the underexploited pulse crop.

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