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Red kidney bean: Nutritious pulse crop

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Abstract

Red kidney bean (*Phaseolus vulgaris* L.) are nutritious and their consumption is associated with many health benefits that can fight against protein malnutrition. Based on the studies, the current review aims to provide up-to-date information on the health promoting effect of kidney beans, their cultivation practices which will help to explore their therapeutic values for future studies.

Keywords: Red kidney bean, cultivation practices, nutritional properties, bioactive compounds, diseases and pests

Introduction

Legumes are an important and inexpensive source of protein, dietary fiber and starch for a larger part of the world's population (Perla *et al.*, 2003)^[19] and therefore considered as poor man's meat (Tharanathan and Mahadevamma, 2003)^[28]. Common bean *Phaseolus vulgaris* L. is a major legume cultivated and consumed for its edible seeds and pods in all over the world. It has been estimated, that about 12 million tonnes of common bean are produced annually across the world (Rawal and Navarro, 2019)^[24]. This includes different types of common bean, which are of distinct colours, sizes and other attributes, grown in different parts of the world. Red kidney bean, known as rajma in northern India and Pakistan also termed as 'king of nutrition'. They are kidney-shaped, could be light red or dark red in colour, and have a soft texture. *Phaseolus vulgaris* L. is originating in the western area of Mexico and Guatemala. Asia, South America and Africa are massive producer of beans.

Botanical Description

Phaseolus vulgaris L. is the best known species of the genus *Phaseolus* in the family Fabaceae of about fifty plant species, all native to America. The bean is an annual herbaceous plant, climber or erect. The leaves of this species are composite, with three leaflets diamond-oval, widths and integers sometimes covered of villi. the habit of climbing plants have stems and fickle tendrils formed by the modification of terminal leaflets. Flowering is abundant; with flowers typically papilionaceas arranged in bunches of 2 to 20 flowers, white or scarlet and on long stalks. Once self-pollinated, the flowers give rise to pods and seeds which are the bodies of consumption of the species. The seeds are white, red, yellow, brown, black, purple, gray, and pinto or fluted and the dry seeds are eaten as pulse which is enriched with nutrients.

Nutritional Properties

Nutritionally, dry beans are an excellent source of complex carbohydrates (up to 60%), protein (20-27%), fiber (up to 28%), vitamins and minerals (4-6% ash) and are low in fat (< 2%) (Gepts, 1990; van der Poel, 1990; Yoshida *et al.*, 2005; Feregrino-Perez *et al.*, 2008; Marquezi *et al.*, 2016)^[12, 29, 31, 8, 15]. Its protein has highest lysine content about 5% (Qayyum *et al.*, 2012)^[23]. Beans are also one of the best sources of iron, providing 23-30% of daily recommended levels (Pachico, 1993)^[18]. Kidney beans are an excellent source of minerals such as Calcium, Magnesium, copper, iron, manganese, phosphorus, potassium, molybdenum, Vitamin E and Vitamin K₁ and folate, and possessing a low glycemic index (GI). Polyphenol-rich kidney beans have potential effects on human health, and possess anti-oxidant, anti-diabetic, anti-obesity, anti-inflammatory and anti-mutagenic and anti-carcinogenic properties (Geil and Anderson, 1994; Cardador-Martinez *et al.*, 2002; Oomah *et al.*, 2010; Wani *et al.*, 2010; Pradeepkumar *et al.*, 2014, 2015; Ganesan and Xu, 2017; Celmeli *et al.*, 2018; Salma *et al.*, 2018; García-Cordero *et al.*, 2021; Rodríguez Madrera *et al.*, 2021)^[11, 6, 17, 30, 22, 21, 9, 7, 26, 10, 25].

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These legumes are packed with profuse quantities of bioactive compounds like isoflavone and flavonoid (Oomah *et al.*, 2005; Lin *et al.*, 2008; Pitura and Arntfield, 2018; Idoko *et al.*, 2019) [16, 14, 20, 13]. Isoflavone act as a potent phytoestrogens that regulate menstrual cycle, prevents osteoporosis and lowers the risk of breast cancer (Stephen *et al.*, 2011) [27]. The seed coat colour is due to the presence of flavonols, anthocyanins (pelargonidin) and tannins which play a role in averting the risk of heart diseases (Beninger and Hosfield, 1999, 2003; Beninger *et al.*, 1998, 1999) [2, 5, 3]. Kidney beans should be soaked in water for at least 5 hours and cooked thoroughly to eliminate most of the toxic protein phytohaemagglutinin, thereby making it harmless.

Cultivation Practices

The bean is a crop of warm climate that shows greater development in environments with average temperature of 15 to 25 °C during the growing season and a precipitation of 60 to 150 cm throughout the crop cycle. Red kidney beans are cultivated in both Rabi and Kharif season in various parts of India. For Rabi season middle of October to middle of November, For Kharif season middle of May to middle of June and for Spring season middle of February to first week of March is appropriate time for sowing seeds. Well drained loamy soils are the best for its cultivation. Soil pH should be 5.5 to 6.0 to obtain better yields. A deep ploughing followed by 3 to 4 harrowing will get to the fine tilth of the soil for preparation of bed. The rajma varieties have been classified in two groups, *viz.*, dwarf or bush types and climbing or pole types. The dwarf varieties types are Contender, Pusa Parwati, Pant Anupama, Arka Komal, Selection-9 and the climbing types are Kentucky Wonder, RCMFB-1 found suitable for the North Eastern Region of India (Anonymous, 2016) [1]. Some of the improved variety of kidney beans in India is: VL Rajma 125, VL Rajma 63, PDR-14, HUR-15 (Malviya Rajma 15), HUR-137 (Malviya Rajma 137), Amber, Utkarsh, and Arun. The seed rate required is 50 kg/ha. Before sowing seeds should be treated with Thiram @ 4 g/kg seed of seed. The bio-fertilizer should be applied @ 200 g/30 kg of seeds mixed with about 1300 litre of water or cooled off boiled rice starch. After mixing, seeds need to be dried in shade for 30 to 45 minutes before sowing. Seeds should be shown at a spacing 30 cm (row to row) and 10-15 cm (plant to plant) at a depth of 6 to 7 cm. The crop lack biological nitrogen fixation due to poor nodulation. Therefore, Nitrogen requirement is 100 to 125 kg/ha and P₂O₅ is 60-70 kg/ha. FYM at 4-5 tons per acre should be applied in soil 2 to 3 weeks before sowing. The crop requires pre-sowing irrigation for better germination of the seed. Four irrigation at 25, 50, 75 and 100 days after sowing the seed are required for optimum yield. Water-logging should be avoided in case of heavy rain. One hand weeding can carried out after one of sowing. Diseases like Anthracnose, rust, root rot, bean common mosaic virus, watery soft rot, angular leaf spot has been observed in various parts of India. To protect the plants from leaf diseases, Captaf @ 1g/L of water or Diathene M-45 @ 2g/L of water at every 9 to 14 days interval should be sprayed. Insect pests like aphid, leaf miner, pod borer, stem fly, blister beetle, stem boring weevil, and nematodes like root-knot, lesion have been observed. To control the pod borer Endosulfan @ 1.5 to 2 L/500 L of water per hectare should be sprayed. The crop will be ready for cutting when the pod turns to brown colour. Harvesting to be done after 120 to 130 days after sowing. Harvested plants should be kept on sun for 3 to 4 days and

threshing can be done by bullocks or with sticks. Seed bins are used for storing the clean seeds. Red kidney beans average yield is 10 to 12 quintals per hectare.

Conclusion

Red kidney beans are helpful in ameliorating many chronic diseases of mankind worldwide. The potential for red kidney beans to be used as nutraceuticals and functional food is very promising. Considerable improvement can be achieved in the yields of red kidney beans with greater adoption of improved varieties and scientific farm management practices.

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