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Review

An assessment of faba bean (*Vicia faba* L.) current status and future prospect

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Faba bean (*Vicia faba* L.) is among the oldest crops in the world. Globally, it is third most important feed grain legume. Currently, 58 countries produce this bean on large scale. Probably faba beans are one of the best performing crops under global warming and climate change scenario because of its unique ability to excel under all most all type of climatic conditions coupled with its wide adoptability to range of soil environment. Faba bean being incredible and crop complete food, unfortunately some part of world including India, it is still underutilized crop and not fully exploited so far, though it is seen as an agronomically viable alternative crop to cereal, with a potential of fixing free nitrogen upto 300 kg N ha^{-1}. It is a good source of lysine rich protein and good source of *levadopa* (*L-dopa*), a precursor of dopamine, can be potentially used as medicine for the treatment of Parkinson's disease. There is need to improve its anti-nutritional factors to make it more acceptable to other countries. Now Zero tannin contacting varieties are available with greater acceptability to Indians and other countryman as well. An assessment has been made for boosting area production and acceptability with technological backup keeping in view the enormous potential for food and nutritional security.

Key words: Faba bean, bottleneck, potential crop, uses, agro-technology.

INTRODUCTION

Faba bean is an annual legume botanically known as *Vicia faba* L. (Hanelt and Mettin, 1989; Harlan, 1969). The crop is known by many names, most of which refer to a particular subgroup rather than the whole species (Hawtin and Hebblethpiait, 1983; Zohary and Hopf, 1973). Faba bean, Fava bean, Broad bean, Horse bean, Windsor bean, Tick beans (small types), Bakela (Ethopia), Boby kurmouvje (former USSR), Faveira (Portugal), Ful masri (Sudan), Feve (French) and Yeshil Bakla (Turkey) are the few names used in different parts of world (Hawtin and Hebblethpiait,1983; Naqvi, 1984; Singh et al., 2010). In India in Hindi language, it is popularly known as Kala Matar and Bakala as well (Singh et al., 2012a; Singh et al., 2013). It is among the oldest crops in the world, worldwide it is third most important feed grain legume after soybean (*Glycine max* L.) and pea (*Pisum sativum* L.) area and production (Mihailovic et al., 2005). The area under faba bean crop in India is very less and that is why it is still categorized as minor, unutilized, underutilized, less utilized, and still not fully exploited crops. Though, its green pod is mainly used as vegetables, dry cotyledons are one of the excellent and cheap sources of lysine rich protein for poor's (Bond, 1976; Hawtin and Hebblethpiait, 1983; Abdel, 2008). Faba bean is also a good source of *levadopa* (*L-dopa*), a precursor of dopamine, can be potentially used as medicine for the treatment of Parkinson's disease (Oplinger, 1982; Vered et al., 1997).

It is one of the best crop that can be used as green

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manure and one of the best bio factory of nitrogen by fixing 130 to 160 kg N/ha (Hoffmann et al., 2007; Horst et al., 2007). Faba bean cannot only be grown on diver's agro-climatic conditions successfully, but it can also be produced on residual soil moisture, relatively more tolerant to biotic and abiotic stress, with minimum input (Singh and Bhatt, 2012a; Singh and Kumar, 2009). Being responsive to added input, unfortunately it is grown by poor farmers on poor and marginal land. In India, faba bean productivity is low as compared to other major faba bean growing countries (Singh et al., 2010, 2012a). Faba bean had already proven its potential and at present, faba beans are grown in 58 countries (FAO, 2009). In India, faba bean potential is not fully realised. In this presentation, we are discussing the probable bottleneck for poor and slow expansion of this grain legume.

BRIEF ACCOUNT OF ORIGIN, DISTRIBUTION AND TAXONOMY OF FABA BEAN

Faba bean is assigned to the Central Asian, Mediterranean, and South American centers of Diversity and believe to be a native to North Africa and southwest Asia, and extensively cultivated elsewhere (Harllan, 1969; Zohary and Hopf, 2000). Cubero (1974) postulated a Near Eastern center of origin, with four radii to Europe along the North African coast to Spain, along the Nile to Ethiopia, and from Mesopotamia to India (Hawtin and Hebblethpiait, 1983). Secondary centers of diversity are postulated in Afghanistan and Ethiopia. However, Hajjar and Hodgkin (2007) reported the origin to be Central Asia. The Chinese used them for food almost 5,000 years ago, and they were cultivated by the Egyptians 3,000 years ago, by the Hebrews in biblical times, and a little later by the Greeks and Romans (Mihailovic et al., 2005; Singh and Bhatt, 2012). Probably, it was introduced by Europeans as a garden crop into India during the Sultanic period (1206–1555), during which its cultivation has been mentioned (Naqvi, 1984; Razia Akbar, 2000). The wild progenitor and the exact origin of faba bean remain unknown. Several wild species (*Vicia narbonensis* L. and *V. galilaea* Plitmann and Zohary) are taxonomically closely related to the cultivated crop, but they contain $2n = 14$ chromosomes, whereas cultivated faba bean has $2n = 12$ chromosomes Cubero, 1974). Numerous attempts to cross the wild species to cultivate faba bean have failed (Zohary and Hopf, 1973; Hajjar and Hodgkin, 2007). Although, usually classified in the same genus *Vicia* as the vetches, some botanists treat it in a separate monotypic genus as *Faba sativa* Moench (Zohary and Hopf, 2000; Hanelt and Mettin, 1989). *V. faba* is an annual herb with coarse and upright stems, unbranched 0.3 to 2 m tall, with 1 or hollower stems from the base. The leaves are alternate, pinnate and consist of 2 to 6 leaflets each up to 8 cm long and unlike most other members of the Genus; it is without tendrils or with rudimentary tendrils. The plant flowers profusely but only a small proportion of the flowers produce pods.

Flowers are large, white with dark purple markings, borne on short pedicels in clusters of 1-5 on each axillary raceme usually between the 5 and 10^{th} node; 1-4 pods develop from each flower cluster, and growth is indeterminate though determinate mutants are available (Hanelt and Mettin, 1989). About 30% of the plants in a population are cross-fertilized and the main insect pollinators are bumblebees. There is a robust tap root with profusely branched secondary roots. Based on seed size, two subspecies were recognized, paucijuga and faba. *V. faba* has a diploid (2n) chromosome number of 12, meaning that each cell in the plant has 12 chromosomes (6 homologous pairs). Five pairs are acrocentric chromosomes and 1 pair is metacentric (Alghamdi, 2009; Hanelt and Mettin, 1989).

Present status of faba bean production and consumption

Presently, faba beans are major crop in many countries including China, Ethiopia and Egypt, and are widely grown for human food throughout the Mediterranean region and in parts of Latin America (Razia Akbar, 2000; Naqvi, 1984). China is major share holder in production with 60% (FAO, 2009). Other important producers are northern Europe, The Mediterranean, Ethiopia, Central Asia, East Asia and Latin America. In the United States and northern Europe, faba beans are not grown in large quantities and are used almost exclusively for livestock pasturage, hay, and silage (Singh and Bhatt, 2012a; Oplinger, 1982). World production of dry faba bean seeds in 1999 to 2003 amounted to 3.90 million tones/year from 2.60 million ha. The main producing countries are China (1.9 million tones/year from 1.2 million ha) (FAO, 2009). The annual production in sub-Sahara Africa in 1999 to 2003 was estimated at 510,000 tones, almost entirely from Ethiopia (405,000 tones) and Sudan (100,000 tones). It is worth to mention here the annual production during 2000 (data available) in sub-Sahara Africa increased from 230,000 tones (250,000 ha) to 540,000 tones (450,000 ha) (Mihailovic et al., 2005). The annual world production of dry faba bean seeds declined from about 5 million tons (from 5 million ha) in the early 1960s to about 4 million tons (from 2.7 million ha) in the early 2000s. The reduction in area under cultivation in China from about 3.5 million ha in the early 1960s to about 1.25 million ha in the early 2000s accounted for the largest share of the reduction in production. In contrast, the annual production in sub-Sahara Africa increased during the same period from 230,000 tones (250,000 ha) to 540,000 tones (450,000 ha). The world production of green faba bean seeds in 1998 to 2003 was estimated at 940,000 t/year from 2.6 million ha, with Algeria (118,000 tones/year), China (114,000 tones/year) and Morocco

(112,000 tones/year) as the largest producers (FAO, 2009). The production of green faba bean seeds in tropical Africa and Asia is negligible (Mihailovic et al., 2005). Egyptians are leader in consuming the faba bean and about 75% of daily per capita protein intake of Egyptians is of vegetable origin, mostly cereals and beans. Mediterranean's and Chinese may depend upon faba beans to supply much of their dietary protein (Hawtin and Hebblethpiait, 1983; Razia Akbar, 2000). At present, world average of faba bean productivity is 1.5 t/ha, though Egypt ranked first with 2.96 t/ha Indian productivity is 1.2 t/ha (FAO, 2009). The world production of green faba bean seeds in 1998 to 2003 was estimated at 940,000 t/year from 2.6 million ha, with Algeria (118,000 tones/year), China (114,000 tones/year) and Morocco (112,000 tones/year) as the largest producers. The production of green faba bean seeds in tropical Africa and Asia is negligible.

Faba bean in world trade

World exports of dry faba bean seeds in 1998 to 2002 amounted to 475,000 tones. The main exporting countries were Australia (201,000 tonnes), the United Kingdom (114,000 tonnes), China (63,000 tonnes) and France (53,000 tonnes). The main importers in this period were Egypt (197,000 tonnes), Italy (169,000 tonnes) and Spain (52,000 tonnes). The exports from African and Asian countries are negligible (FAO, 2009).

Global adaptation of faba bean

The faba bean is very cold hardy, but cannot take excessive heat during flowering. As faba beans mature, the lower leaves darken and drop, pods turn black and dry progressively up the stem (Hekneby et al., 2006; Singh et al., 2013). This annual legume grows best under cool, moist conditions. Hot, dry weather is injurious to the crop, so early planting is important. Faba bean tolerates frost. Rainfall of 650 to 1000 mm per annum evenly distributed is ideal for faba bean (Abdel, 2008; Gasim and Link, 2007). Medium textured soils are ideally suited for faba bean production. It prefers types of soil with pH ranging from neutral to alkaline (pH of 6.5 to 8.0) (Rajan et al., 2012). Since the crop requires a good moisture supply for optimum yields, moderate moisture supply is necessary. Faba beans do not tolerate standing water. Moisture requirement is highest about 9 to 12 weeks after establishment (Subash and Priya, 2012). It is grown as a winter annual in warm temperate and subtropical areas; hardier cultivars in the Mediterranean region tolerate winter temperatures of -10°C without serious injury whereas the hardiest European cultivars can tolerate up to -15°C. It can be grown anywhere and does not winterkill.

Faba bean is more tolerant to acid soil conditions than most legumes (Singh et al., 2010). Tolerates nearly any soil type; grows best on rich loams. They are considered to be the least drought resistant of legume crops; however, cultivars with high water use efficiency have been developed at ICARDA (Subash and Priya, 2012). Faba beans are slow to emerge and takes 20 to 25 days, seeds must be in constant contact with moisture until seedlings are well established. The time from seeding to harvest ranges from 80 to 120 days depending upon the cultivars and climatic conditions. Faba beans should be grown in rotation in the same field to avoid a build-up of soil-borne diseases, their susceptibility to diseases which are common in rapeseed and in sunflower limit their place in a crop rotation with other specialty crops.

Agro-technology for faba bean production

Since faba beans are slow emergers, good seedbed should be prepared to insure good soil to seed contact (Knaak et al., 1993; Rajan et al., 2012). In order to maximize N_2 fixation in the *Vicia faba* legume-rhizobia symbiosis, both host and micro-symbiont must be considered (Antoun and Prevost, 2005; Imaizumi-Anraku et al., 2005). The mechanism by which these bacteria and fungi stimulate plant growth are not well understood but it has been suggested that production of plant hormones, enhancement of plant nutrient uptake, suppression of pathogens in the plant rhizosphere, solubilization of phosphorus, rhizospheric nitrogen fixation or conversion of materials to a form useful to the plant may be involved. Beneficial rhizobacteria are termed either plant growth promotory rhizobacteria (Jensen et al., 2010; Jacobsen and Feenstra, 1984). In last few decades a large array of bacteria including species of *Pseudomonas*, *Azospirillum*, *Azotobacter*, *Klebsiella*, *Enterobacter*, *Alcaligenes*, *Arthrobacter*, *Burkholderia, Bacillus* and *Serratia* have reported to enhance plant growth (Antoun and Prevost, 2005; Singh and Bhatt, 2012a).

Faba beans which can be grown as a cultivated row crop or as a non-cultivated narrow-row crop like small grains, respond favorably to narrow row spacing. It is best to grow 30 plants per m^2 (Singh et al., 2013). When a seed size of 35 g/100 seeds with a germination of 80% is used, sow 130 kg of seed per hectare. In a study ranging from 80 to 300 kg, the optimum seeding rate was 160 kg/ha (Singh et al., 2012a). Although, high rates of sowing and narrow rows tend to produce higher yields, seed cost is an important restriction to optimum seeding rate (Singh et al., 2010). Planting depth is critical, since the hard, dry seed takes longer to absorb water and germinate than those common beans (Singh et al., 2013). Deep planting (6 to 10 cm) is necessary to get the seed below the surface so it does not dry out. Legumes require neutral to alkaline soil for maximum N fixation by nodule bacteria. Soils should be tested and, if necessary, limed to at least pH 6.0 (Rajan and Singh, 2012). Soils need to have P and K soil test levels in the medium to high range to ensure adequate fertility levels for maximum crop yields. These soil test levels are at least 11 ppm P and 81 ppm K depending on subsoil category (Rajan et al., 2012). Soils should be tested and, if necessary amend with P_2O_5 and/or K_2O prior to seeding (Singh and Kumar, 2009).

Harvesting of faba bean should begin while stems are still slightly green. Faba beans turn black when they are ripe (Singh et al., 2011). Appropriate timing to start harvesting when the lowest two bunches of pods begin blackening or when most seed easily detaches from the hilum. At this stage, the moisture content of the beans is from 30 to 35%. Swathing in this moisture range provides the highest bulk density and 1000-kernel weight (Fraser et al., 1978; Vinod and Bera, 1995).

Generally, 15 to 18% moisture in the seed at harvest is enough to overcome a tendency to shatter. Rapid drying at high temperatures often causes stress cracks. The maximum moisture content for a "straight grade" of faba beans is 16% (Irvine et al., 1992). The average yield is 1.6 t/ha. Yields may range from 1.2 to 3.5 t/ha. Much higher and lower yields have been observed on individual plots, crude protein percentage has ranged from 27 to 32%.

Biotic stress

Faba beans are poor competitors with weeds, particularly in the seedling stage (Ali et al., 2000). This makes integrated weed control essential for successful crop production. Select fields with light weed pressure. Do the primary tillage several weeks before planting and kill emerged weeds with shallow tillage just ahead of planting. Consider rotary hoeing fields 7 to 10 days after planting and use a row cultivator if rows are 50 cm or more apart.

The major insect pest and disease which reduces the quantity and quality of faba bean are Red-legged earthmite (*Halotydeus destructor*) is a black-bodied mite with red legs; it damages seedlings as they emerge. Symptoms include leaves that turn silvery, then brown and shrivelled. Lucerne flea (*Sminthurus viridis*) is a small (2.5 mm), wingless, light green hopping insect. It chews through leaves in layers resulting in "window-pane" like holes. The crop shrivels and becomes stunted Native budworm (*Heliothis punctiger*).

The caterpillar damages the maturing seed in the pods. The newly hatched caterpillars are small (1 to 2 mm) and therefore are easily missed when crops are being inspected. When mature (40 to 50 mm long) they have a yellow-white stripe downs each side of the body and dark stripes down the centre of the back (Uessly et al., 2004; Singh et al., 2012a).

Leaf, stem and pod spot is a major problem. It is caused by the fungus *Ascochyta fabae*. Grey-brown spots form on leaves. Small fruiting bodies may appear on leaves after rain. On stems and pods, dark-coloured spots appear which may spread to the seed. Stems may collapse. Chocolate spot is another major problem. It is caused by Botrytis fabae. The symptoms are reddish or chocolate brown spots on leaves and reddening of stems. The spots may enlarge and merge, forming a black mass on the leaves (blighting), which is followed by defoliation and lodging. Chocolate spot and Ascochyta usually require a minimum of two sprays for control. Dense crops, waterlogging and wet weather favour outbreaks of these diseases. Rust (*Uromyces viciae-fabae*) appears as orange-brown pustules with a light green halo on leaves, which can spread to stems (Ali et al., 2000).

Faba bean and nitrogen economy

Faba bean is excellent crops for cropping systems because its unique ability to fix atmospheric N_2 symbiotically which is heavy depends on the sufficient populations of effective rhizobia (Jensen et al., 2010). It can accumulate N both from soil and the atmosphere (Rajan and Singh, 2012). Due to their indeterminate growth habit, faba beans continued assimilating N for a longer period, reaching about 315 kg N ha^{-1} after 110 days (Singh and Bhatt, 2012a). The N concentration in the faba bean crop biomass was around 5% a few days before flowering; during the initial stages (30 days) of reproductive growth, the N concentration declined rapidly to c. 2.5–3%, due to the biomass accumulation rate being faster than the N assimilation rate, and the N concentration remained at this level until maturity (Knaak et al., 1993). Faba bean accumulates N from N^2 fixation at an increasing rate until initiation of the maturation process unless other factors such as water availability restricts the N^2 fixation process earlier in growth (Antoun and Prevost, 2005).

Bee pollination

V. faba is a partially allogamous species (Self-fertile with about equal amount of self and cross-pollination occurring depending on the presence of insect pollinators). The Apoides play a decisive role in the pollination of allogames lines. The importance of bees in cross-pollination of this plant and the improvement of its production has been demonstrated and recognized by several authors (Singh and Bhatt, 2012a). Inadequate pollination is considered as a major obstacle to achieve the potential yield and improved seed quality of faba bean. Insects appear to be the major pollinators of faba bean. Numerous studies have shown the value of honey bees as pollinators of faba beans in Australia and overseas (Somerville, 1999).

Genetic diversity for development of new variety

Seed is the basic unit for any agricultural production system without quality seed no one can even think of good harvest. Production of high quality seed of improved varieties having high analytical quality, coupled with high germination capacity, vigour and uniformly large size, is need of hours for improving faba bean culture in this country (Loss, 2006). Greater insight into the pattern and dynamics of genetic resources of Faba bean (*V. faba* L.) is needed in order to understanding and establishing the relationship among collected germplasm from Bihar region. Plant exploration and collection of germplasm is quickest way to collect modest variability.

At present, global collection of faba bean germplasm kept in various seed/field gene bank of respective country is more than 30000 accessions (Singh and Bhatt, 2012b). Characterization and preliminary evaluation is the one of the important technique which helps in to elucidate the extent and pattern of agro-morphological as well as molecular diversity in this crop (Singh and Bhatt, 2012b). The breeding objectives for this crop are grain yield and grain yield stability and lodging resistance, and furthermore resistances against drought (winter frost in case of winter bean breeding), and against fungi and further pathogens and pests, with additional objective of underground root dynamic and grain quality (Singh et al., 2012c).

BIOTECHNOLOGICAL APPROACH FOR FABA BEAN IMPROVEMENT

Several *in-vitro* techniques would be very useful for faba bean breeding. By means of protoplast fusion and regeneration or by embryo-rescue assisted interspecific crossing, e.g. resistance to black aphid, as occurring in the related species *Vicia johannis*, could probably be introduced to *V. faba*. Still, these techniques are not yet available for faba bean. The same is true for any approach to produce doubled haploid lines. Genetic transformation based on *Agrobacteria* is possible. Several RAPD markers linked to a gene determining hypersensitive resistance to race 1 of the rust (*Uromycese viciae-fabae*) have been reported by Rojo et al. (2007). Molecular breeding for resistance to broomrape, ascochyta blight, rust and chocolate spot have been obtained. A major aim for any crop breeding program is the development of good quality lines with an adequate resistance/tolerance to yield-reducing stresses (Gutie et al., 2006). The use of model legumes for comparative functional genomics may bring some new perspectives and enhances faba bean breeding efforts. In this way, identification of QTLs and/or candidate genes involved in stress tolerance and/or quality may be used to produce transgenic lines and/or these traits can be applied to breeding programs (e.g. MAS) (Hougaard et al., 2008).

The use of marker assisted selection (MAS) can complement conventional field breeding by speeding up the selection of desirable traits and increasing selection efficiency. Recently, markers linked to a gene controlling growth habit or to select against traits affecting the nutritional value of seeds (tannins, vicine and convicine content) have also been reported (Hougaard et al., 2008). Little is known about the functional correspondence of model legume genes and their putative faba bean orthologues (Hougaard et al., 2008). Notwithstanding, lack of information predictions can be made based on the sequence similarities between the relatively few *M. truncatula* and faba bean gene pairs that are available and the high conservation and synteny existing between legume genomes. Whereas for highly conserved genes, favourable mutations observed in model legumes are likely to correspond to favourable alleles in faba bean, for less conserved genes (that is, many transcription factors), the relation is less reliable. Possible complications include (1) differences in gene copy number, (2) differences in transcript or protein abundance and (3) differences in specific activity (Horst et al., 2007). Therefore, the information obtained in model legumes can be used as a guide to narrow down candidate genes, but proof can only come from functional studies, preferably in the homologous system. The involved steps are: (1) confirmation of candidate gene functions either directly in faba bean or indirectly in any of the model legumes, (2) identification of favourable alleles for selection and (3) variety improvement by MAS or by transformation of an elite line (Singh et al., 2012c).

Several approaches have been developed to confirm candidate gene function at the biochemical and physiological level (Horst et al., 2007). Originally, functional analysis of proteins was performed through two main techniques, protein over-expression and monitoring of promoter activity. Over-expression of a candidate gene is obtained by transferring the coding region of the gene under control of a strong promoter such as the CaMV 35S into the plant and function is assigned by scoring the phenotype of the resulting transformed line (Rojo et al., 2007). Albeit with low efficiency, protocols for both *A. tumefaciens* and *A. rhizogenes* transformation have been established for faba bean and can be used for gene functional analysis in this species. Alternatively, the functional analysis could be performed in the model legumes *M. truncatula, L. japonicus* or soybean for which the transformation protocols are more efficient and rapid. In these model legumes, gene function can also be removed by modern molecular genetic techniques ncluding RNAi and even TILLING (Horst et al., 2007).

Faba bean modelling

Crop models such as CERES and CropSyst treat canopies as homogeneous entities without attempting to define canopy geometry, other than through row structure, nor deal with growth processes at time steps shorter than one day (Manschadi et al., 1998a). A functional-structural modelling approach can improve canopy simulation, in particular of indeterminate crops such as faba bean. A major challenge is to incorporate the plasticity of the canopy. Functional-structural models can accomplish this by introducing variation in several ways and at different levels of canopy composition. ALAMEDA is a functional-structural model of a faba bean (*V. faba* L.) crop that addresses these issues. An L-system provides the basic conceptual and program structure within which functional relationships can be connected. In this way, it plays a comparable role to physical plant structure that provides the linkage between morphology and physiological processes spatially distributed over plant components (Manschadi et al., 1998b). In accordance with results of previous studies with faba bean, the stem was selected as the main building module. An associated growth model is linked to calculate the lengths of the vegetative organs, and leaf allometries are used to compute leaf area. ALAMEDA is currently being extended by including a model of radiation interception and functions from classic models, for example, the variation of specific leaf area with temperature as specified in CROPGRO-legume (Manschadi et al., 1998a, b).

Zero tannin faba bean varieties

The feed quality of zero tannin (less than 1% seed tannin level) faba beans is excellent and the production factors for this crop are quite simple and easy to obtain (Martin et al., 1991). The large potential of the new zero tannin faba beans (variety “Snowbird”) is mainly as a feed for swine and meat poultry. “Snowbird” faba bean is a medium maturing cultivar (110 to 120 days to maturity) based on early seeding. Seed size is approximately 550 grams/1000 seeds (about 2 times larger than normal field pea seed size) (Hussein and Saleh, 1985).

Uses of faba bean

Cultivated faba bean is used as human food in developing countries and as animal feed, mainly for pigs, horses, poultry and pigeons in industrialized countries (Singh and Bhatt, 2012 a). It can be used as a vegetable, green or dried, fresh or canned (Gasim and Link, 2007). It is a common breakfast food in the Middle East, Mediterranean region, China and Ethiopia. The most popular dishes of faba bean are Medamis (stewed beans), Falafel (deep fried cotyledon paste with some vegetables and spices), Bissara (cotyledon paste poured onto plates) and Nabet soup (boiled germinated beans) (Hawtin and Hebblethpiait, 1983). Feeding value of faba bean is high, and is considered in some areas to be superior to field peas or other legumes. It is one of the most important winter crops for human consumption in the Middle East (Martin et al., 1991). Faba bean has been considered as a meat extender or substitute and as a skim-milk substitute (Oplinger, 1982). Sometimes grown for green manure, but more generally for stock feed (Singh and Bhatt, 2012a). Large-seeded cultivars are used as vegetable. Roasted seeds are eaten like peanuts in India. Straw from faba bean harvest fetches a premium in Egypt and Sudan and is considered as a cash crop. The straw can also be used for brick making and as a fuel in parts of Sudan and Ethiopia (Hulse, 1994).

ETHNIC AND TRADITIONAL AND MEDICINAL USES

In ancient Greece and Rome, beans were used in voting; a white bean being used to cast a *yes* vote, and a black bean for *no*. Pythagoras called on his disciples to abstain from beans. It is, however, uncertain whether they were meant to abstain from eating beans or from involving themselves in politics (Acharya and Shrivastava, 2008). In Ubykh culture, throwing beans on the ground and interpreting the pattern in which they fall was a common method of divination (favomancy), and the word for "bean-thrower" in that language has become a generic term for seers and soothsayers in general (Hulse, 1994). In Italy, broad beans are traditionally sown on November 2, All Souls Day. Small cakes made in the shape of broad beans (though not of them) are known as *fave dei morti* or "beans of the dead" (Lawes, 1980). According to tradition, Sicily once experienced a failure of all crops other than the beans; the beans kept the population from starvation, and thanks were given to Saint Joseph (Acharya and Shrivastava, 2008). In ancient Greece and Rome, beans were used as a food for the dead, such as during the annual Lemuria festival.

Medicinal uses

Potential use of fava bean is in the treatment of Parkinson’s disease being a good source of levadopa (*L*-dopa) a precursor of dopamine, as a result of Parkinson’s disease affected persons unable to synthesize dopamine which regulate motor cells (Lawes, 1980). L-dopa is also a natriuretic agent, which might help in controllinghypertension (Jambunathan et al., 1994).

Some also use fava beans as a natural alternative to drugs like Viagra, citing a link between L-dopa production and the human libido (Hulse, 1994). The elders generally restrict the young children from eating them raw (when unmatured) because they can cause constipation and jaundice-like symptoms. There are epidemiological and *in vitro* studies which suggest that the hemolysis resulting from *favism* acts as protection from malaria, because certain species of malarial protozoa such as Plasmodium *falcipacrum* are very sensitive to oxidative damage due to deficiency of *glucose 6-phosphate dehydrogenase* enzyme, which would otherwise protect from oxidative damage via production of glutathione reductase (Hussein and Saleh, 1985).

Health issue

Faba bean contains small amounts of antinutritional factors; however, their effects are less acute, and protease inhibitors are at much lower (2%) concentrations compared to soybeans. Inhalation of the pollen or ingestion of the seeds may incite the condition known as favism, a severe hemolytic anemia, perhaps causing collapse (Martin et al., 1991). Haemagglutinins (lectins), although found in many legumes, concentration is higher in faba bean and can be troublesome (Hulse, 1994). These substances are destroyed during the normal food preparation process (heat). Similarly, oligosaccharides mainly stachyose, raffinose and verbascose are also more prevalent in faba bean; these molecules contain glucose and galactose residues which can persist in sugar metabolism pathway in digestive tracts (Vered, 1995). They ferment and produce methane and other gases causing discomfort and abdominal pains. Faba bean contains other objectionable factors including, cyanogens, favogens, phytic acid, tannins, and tripsin inhibitors. The antinutrients and toxins are associated with the seed coat, sprouting the seeds generally reduces the level of toxins (Hussein and Saleh, 1985).

Future strategies

Faba bean is one of the best crops among the grain legume with more than 7.0 grain yield potential with addition of atmospheric nitrogen to soil as added advantages. Being so incredible crop, there is need to make faba bean more acceptable to all party. Despite of all good qualities, the major bottleneck is anti-nutritional element, taste and aroma. Availability of zero tannin cultivar is boon for expansion of it area and inclusion in the daily diet especially the population depends upon vegetable protein.

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