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Proximate composition, nutritional profile and health benefits of legumes – A review

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ABSTRACT

Legumes consumption is a usual and beneficial part of the human diet and contributing to health. Moreover, it is presently taking place a re-evaluation for its useful effects of consumption in the diet, which is the basis for various health claims. They are essential source of protein, carbohydrates, dietary fibre, micronutrients and various phytochemicals. Legumes have appreciable quantity of all the essential amino acids excluding sulphur containing amino acids, which can be balanced to combine with cereals in daily intake. Starch is the major stored carbohydrate followed by dietary fibre, simple sugars and oligosaccharides. Calcium, magnesium, potassium, phosphorus and iron are also present in legume seeds. Bioavailability of nutrients can be increased by soaking, sprouting and fermentation. Consumption of legumes reduces the risk of cardiovascular disease, some cancers (colon, breast and prostate) and also helps to manage body weight due to its satiety value. FAO has chosen 2016 as the International Year of Pulses which will emphasize the health and environmental benefits of pulses. Nutritional composition, anti-nutritional factors and health benefits of legumes are summarised in the current review.

Key words: Anti-nutritional, Beans, Dhal, Health benefits, Legumes, Nutritional profile, Proximate composition.

Abbreviations: OS: Oligosaccharide, FAO: Food and Agricultural Organisation, Ca: calcium, Cr: chromium, Cu: copper, Fe: iron, K: potassium, Mg: magnesium, Mn: manganese, Mo: molybdenum, N: nitrogen, Ni: nickel, P: phosphorus, S: sulphur and Zn: zinc.

Legumes are used as a staple food in diverse parts of the world by various people (Youseff *et al*., 1989). They are excellent source due to its ample wide availability of proteins for human consumption. The legumes (or pulse) consist of plants that generate a pod with seeds inside and belong to family *Leguminosae*. The word legume is applied to illustrate the seeds of these plants. Common edible legumes comprise broad beans, dry beans, chickpeas, dry peas, lentils, lupins, mung beans, soybeans, sprouts, lotus, peas, green beans and peanuts. As all pulses are considered legumes but not all legumes are considered pulses, so the terms "legumes" and "pulses" are used interchangeably. The term pulse, the same as described in the FAO definition, is absolutely for crops yield solely for the dry seed of leguminous plants (FAO, 2004). As per FAO definition, the term "pulse" is exclusively for crops harvested solely for the dry seed of leguminous plants. Legumes which used as harvested green for food (peas, green beans and sprouts) and for oil extraction (peanut and soybean), are not included in "pulse" category. Consumption of legumes have geographical impact and has been diversified in many ways like bean sprouts (China, Korea), tofu (Japan, China), dhal and papadums (India), chilli and refried kidney beans (Mexico), navy bean soup (Mediterranean),falafel and hummus (Middle East), tempeh (Indonesia), baked beans and peanut butter (US, Australia) and pea soup (Sweden) (Kouris-Blazos and Belski, 2016).

Legumes are adaptable to cultivate under unfavourable ecological conditions, nutritious and stress-tolerant, possessing characteristics for enhancing the sustainability of dry sub-tropical and tropical agricultural systems (Khoury, 2015). Legumes are fit in various cropping systems owing to their wide flexibility, low input requirements, nitrogen fixing and weed repressing potential. Their short growing period and photoperiod sensitivity make them more suitable for crop intensification and diversification (Sardana *et al.*, 2010). The Romans initiated the exercise of crop rotations and plantation of leguminous crops used for green manuring (Gebrelibanos *et al.*, 2013).

Legumes possess some significant health protective compounds such as inositol phosphates and phenolics and are considered to be an inexpensive dietary source of protein, minerals, carbohydrates and vitamins. They have high nutritive value and contain on an average about double proteins in comparison to cereals (Vijayakumari *et al.*, 1997).

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In some countries complementary diets based on cereals, tubers and root along with legumes is recommended as best solution for undernourishment. This reveals that legumes have prospective role in improving the nutritional status of malnourished persons (Mudryu *et al.*, 2014).

In this review efforts has been made to overview the literature regarding the proximate composition, nutritive value and potential health benefits of legumes.

Proximate Composition: Grain legumes are considered as essential source of nutrients and popular as poor man's meat especially in developing countries (Hayat *et al.*, 2014). Legumes with their scientific and hindi names are presented in Table 1. The proximate contents like moisture, protein, fats, minerals, crude fibre, carbohydrates and energy value are given in Table 2 as per 100 gm of seeds. Amongst all the legumes mentioned in the table soybean have highest protein content, minerals, phosphorus, iron and energy i. e. 43.2%, 4.6 %, 690 mg, 10.4 mg and 432 Kcal, respectively, whereas bengalgram (whole) is rich in carbohydrates (60.9%) and horse gram is rich in calcium i.e. 287 mg. All legumes have low fat content i.e. below 6%, except soybean (19.5%). The moisture contents of all the dry legumes are in the range of 9-13% making them favourable for long storage (Mohan *et al.*, 2011). The energy value varies from 321-432 Kcal for all dry legumes whereas green pea and redgram tender have less than 120 Kcal per 100 gm of seeds.

Vitamin contents of legumes are presented in Table 3, which includes Carotene, Thiamine, Riboflavin, Niacin, $B_{6,}$ Folic acid, Choline and Vitamin C. Carotene content of all the legumes ranges from 9-469 µg whereas it is not present in field beans. Redgram is rich source of carotene (469 µg). In all the legumes thiamine and riboflavin present in the range of 0.20-0.73 mg and 0.01-0.39 mg, respectively, although riboflavin is negligible in green peas. Soybean contains considerable quantity of thiamine and riboflavin (0.73 mg and 0.39 mg, respectively). Green peas have lowest amount of niacin (0.8 mg) and roasted peas comprise highest quantity of niacin (3.5 mg). Pyridoxine value of redgram dhal is 0.54 mg as reported in Table 3. Folic acid in black gram (dhal),

Table 1: Popular legumes with their Hindi and scientific name

Legumes	Hindi Name	Scientific Name
Bengal Gram (Chick pea)	Chana	*Cicer arietinum*
Soybean	Soybean	*Glycine max* (L.) Merrill
Rajmah (Kidney bean)	Rajmah	*Phaseolus vulgaris*
Horse Gram	Kulthi	*Dolichos biflorus*
Cowpea	Lobia	*Vigna catjang*
Field Bean	Sem	*Dolichos lablab*
Red Gram (Pigeon pea)	Arhar	*Cajanus cajan* (L.) Millsp.
Moth Beans	Moth	*Vigna aconitifolia* (Jacq.) Marechal
Khesari	Khesari	*Lathyrus sativus*
Lentil	Masoor	*Lens esculenta*
Black Gram	Urd dhal	*Phaseolus mungo Roxb.*
Peas	Matar	*Pisum sativum*
Green Gram	Mung	*Phaseolus aureus Roxb.*

(Gopalan, *et al.*, 1989; Pueppke and Broughton (1999)

Table 2: Proximate composition of legumes (All Values as per 100 gms. of seeds)

Legumes	Moisture (gm)	Protein (gm)	Fat (gm)	Minerals (gm)	Crude fibre (gm)	Carbohydrates (gm)	Energy Kcal	Calcium (mg)	Phosphorus (mg)	Iron (mg)
Black Gram, Dhal (Urd)	10.9	24.0	1.4	3.2	0.9	59.6	347	154	385	3.8
Bengal Gram, Whole (Chana)	9.8	17.1	5.3	3.0	3.9	60.9	360	202	312	4.6
Bengal Gram, Dhal	9.9	20.8	5.6	2.7	1.2	59.8	372	56	331	5.3
Bengal Gram, Roasted	10.7	22.5	5.2	2.5	1.0	58.1	369	58	340	9.5
Field Bean, Dry (Sem)	9.6	24.9	0.8	3.2	1.4	60.1	347	60	433	2.7
Cowpea (Lobia)	13.4	24.1	1.0	3.2	3.8	54.5	323	77	414	8.6
Horse Gram, Whole (Kulthi)	11.8	22.0	0.5	3.2	5.3	57.2	321	287	311	6.77
Green Gram, Whole (Mung)	10.4	24.0	1.3	3.5	4.1	56.7	334	124	326	4.4
Green Gram, Dhal	10.1	24.5	1.2	3.5	0.8	59.9	348	75	405	3.9
Khesari, Dhal	10.0	28.2	0.6	2.3	2.3	56.6	345	90	317	6.30
Moth Beans	10.8	23.6	1.1	3.5	4.5	56.5	330	202	230	9.5
Lentil (Masoor)	12.4	25.1	0.7	2.1	0.7	59. 0	343	69	293	7.58
Rajmah	12.0	22.9	1.3	3.2	4.8	60.6	346	260	410	5.1
Peas, Green (Matar)	72.9	7.2	0.1	0.8	4.0	15.9	93	20	139	1.5
Peas, Dry	16.0	19.7	1.1	2.2	4.5	56.5	315	75	298	7.05
Peas, Roasted	10.1	22.9	14	2.4	4.4	58.8	340	81	345	6.4
Soybean	8.1	43.2	19.5	19.5	3.7	20.9	432	240	690	10.4
Redgram, Dhal (Arhar)	13.4	22.3	1.7	3.5	1.5	57.6	335	73	304	2.7
Redgram, Tender	65.1	9.8	1.0	1.0	6.2	16.9	116	57	164	1.1

(Gopalan, *et al.*, 1989)

Table 3: Vitamin content of legumes (All Values as per 100 gms. of seeds)

Legumes	Carotene (ìg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Total B_6 (mg)	Folic acid (ìg)		Vitamin C (mg)	Choline (mg)
						Free	Total		
Black Gram, Dhal	38	0.42	0.20	2.0	-	24.0	132.0	0	206
Bengal Gram, Whole	189	0.30	0.15	2.9	-	34.0	186.0	3	194
Bengal Gram, Dhal	129	0.48	0.18	2.4	-	32.0	147.5	1	-
Bengal Gram, Roasted	113	0.20	-	1.3	-	22.0	139.0	0	-
Field Bean, Dry	0	0.52	0.16	1.8	-	-	-	0	352
Cowpea	12	0.51	0.20	1.3	-	69.0	133.0	0	202
Horse Gram, Whole	71	0.42	0.20	1.5	-	-	-	1	-
Green Gram, Whole	94	0.47	0.27	2.1	-	-	-	0	167
Green Gram, Dhal	49	0.47	0.21	2.4	-	24.5	140.0	0	-
Khesari, Dhal	120	0.39	0.17	2.9	-	-	-	0	-
Moth Beans	9	0.45	0.09	1.5	-	-	-	2	-
Lentil	270	0.45	0.20	2.6	-	14.5	36.0	0	299
Peas, Green	83	0.25	0.01	0.8	-	-	-	9	20
Peas, Dry	39	0.47	0.19	3.4	-	4.6	7.5	0	235
Peas, Roasted	18	0.47	0.21	3.5	-	-	-	0	-
Redgram, Dhal	132	0.45	0.19	2.9	0.54	19.0	103.0	0	183
Redgram, Tender	469	0.32	0.33	3.0	-	-	-	25	72
Soybean	426	0.73	0.39	3.2	-	8.65	100.0	-	-

(Gopalan, *et al*., 1989)

bengal gram (whole, dhal and roasted), cowpea, green gram (dhal), lentil, dry peas, redgram (dhal) and soybean having range of 12.1-220.0 µg. The range of folic acid is 12.1-220.0 µg in black gram (dhal), bengal gram (whole, dhal and roasted), cowpea, green gram (dhal), lentil, dry peas, redgram (dhal) and soybean. Among all the legumes listed in the Table 3 bengal gram (whole and dhal), horse gram (whole) and moth bean have vitamin C in the range of 1-3 mg, whereas green peas and tender redgram have 9 mg and 25 mg respectively. Choline is available in the range of 20-352 mg in some legumes (black gram (dhal), bengal gram (whole), dry field bean, cowpea, green gram (whole), green peas, dry peas, redgram, (dhal and tender) and lentil.

Mineral contents (magnesium, sodium, potassium, copper, magnese, molybdenum, zinc, chromium and sulphur) of various legumes are shown in Table 4. In most of the legumes Mg ranges from 74-238 mg but green peas and

Table 4: Mineral and trace elements of legumes (All Values are mg per 100 gms. of seeds)

Legumes	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Copper (Cu)	Magnese (Mn)	Molybdenum (Mo)	Zinc (Zn)	Cromium (Cr)	Sulphur (S)
Bengal Gram, Whole (desi)	119	37.3	808	1.18	1.21	0.154	6.1	0.008	179
Bengal Gram, Whole (kabuli)	169	-	-	1.01	0.74	-	2.9	0.032	-
Bengal Gram, Dhal	130	73.2	720	1.34	1.05	0.195	1.7	0.001	160
Cowpea	210	23.2	1131	0.87	1.34	1.890	4.6	0.029	165
Black Gram, Whole	154	-	-	1.05	1.01	0.810	3.3	0.012	-
Black Gram, Dhal	130	39.8	800	0.93	0.96	0.425	3.0	0.029	174
Green Gram, Whole	127	28.0	843	0.39	2.47	0.304	3.0	0.014	188
Green Gram, Dhal	122	27.2	1150	0.39	1.02	0.446	2.8	0.010	214
Horse Gram	156	11.5	762	1.81	1.57	0.749	2.8	0.024	181
Lentil, Whole	80	40.1	629	1.87	1.04	0.171	2.8	0.024	104
Lentil, Dhal	74	-	-	1.37	0.81	-	3.1	0.020	-
Khesari, Dhal	92	37.7	644	0.77	-	-	-	-	144
Moth Beans	225	29.5	1096	0.85	-	-	-	-	180
Peas, Green	34	7.8	79	0.23	-	-	-	-	95
Peas, Dry	100	20.4	725	1.29	0.58	0.638	2.3	0.032	189
Peas, Roasted	122	14.7	750	1.32	-	-	-	-	200
Redgram, Whole	86	-	-	1.23	0.96	0.222	3.1	0.010	-
Redgram, Dhal	90	28.5	1104	1.20	0.69	0.283	0.9	0.001	177
Redgram, Tender	58	93.0	463	0.40	-	-	-	-	494
Rajmah	184	-	-	1.45	1.60	-	4.5	0.029	-
Soybean (black)	238	-	-	1.38	2.35	-	4.4	0.029	-
Soybean, (white)	175	-	-	1.12	2.11	-	3.4	0.028	-

(Gopalan, *et al*., 1989)

tender redgram having less than 60 mg per 100 gm of seeds. Na is in the range of 7.8-93 mg, which is 7.8 mg and 93.0 gm in green peas and tender redgram, respectively. K present in legumes ranges from 629-1150 mg per 100 gm of seeds. Lentil (whole) having minimum quantity of K is 629 mg and green gram (dhal) having maximum 1150 mg while green peas and tender redgam have less than 500 mg of potassium. In green peas all the minerals are present in less quantity. Other minerals i.e. Cu, Mn, Mo, Zn and S in various legumes are in the range of 0.39-1.87 mg, 0.58-2.47 mg, 0.154-1.89 mg, 0.90-6.10 mg and 104-214 mg, respectively.

Nitrogen content and availability of amino acids in per gm of N have been enlisted in Table 5. In legumes amount of N has been reported in the range of 1.15-6.91 mg per 100 gm of seeds. Among amino acids arginine is in the range of 370-570 mg in legumes. Histidine is in the range of 130-250 mg. Lysine, tryptophan, phenylalanine, methionine , cystine, leucine, isoleucine and valine are in the range of 340-520, 30-80, 260-460, 30-90, 30-130, 410-580, 250-410 and 250-330 mg per gm of N, respectively. Amino acids play an important role for the growth of human body.

NUTRITIONAL PROFILE AND HEALTH BENEFITS OF LEGUMES

Legume seeds are excellent sources of protein, dietary fibre, various micronutrients and phytochemicals (Sreerama *et al*., 2012), but still some legumes have remained underutilized which are consumed merely by the rural communities and low-income groups (Aiyer, 1990).

Proteins: Legumes are the barely cultivated plant which has the capacity to fix nitrogen from the environment by the action of unique bacteria which survive in nodules on their roots. This nitrogen is being utilized through the plant to compose protein which becomes available to humans. Legume seeds accumulate large amounts of proteins during their development (Duranti, 2006). Legumes have superior quantity of protein in comparison with other plant foods and have twice the dietary protein content of cereal grains (Kouris-Blazos and Belski, 2016). Legume seeds enclose numerous rather minor proteins, which includes protease and amylase inhibitors, lipoxygenase, lectins and others, which are related to the nutritional or functional quality of the seed (Murray, 1979).

In legume seeds proteins present about 20% in pea and up to 38-40% in soybean and lupin (Derbyshire and Boulter, 1976; Gueguen and Cerletti, 1994) whereas in khesari dhal is about 28.2% and in lentil 25.1% (Gopalan *et al.*, 1989). In the legumes methionine, cystine and lysine are in the range of 30-90, 30-130 and 400-520 mg per gm of nitrogen (N), respectively (Gopalan *et al.*, 1989). Legume seeds are among the richest food sources of proteins and amino acids for human and animal nourishment. On the other hand, legumes are considered to be incomplete proteins

Table 5: Essential amino acids of selected legumes

Legumes	Approximate Total N g/ 100 gms	Arginine	Histidine	Lysine	Tryptophan	Phenylalanine	Tyrosine	Methionine	Cystine	Theronine	Leucine	Isoleucine	Valine
		mgm per gram Nitrogen (N)											
Bengal Gram, Whole	2.74	570	160	440	50	360	180	80	80	220	580	320	310
Black Gram, Dhal	3.84	520	170	400	70	310	140	90	80	220	500	340	310
Field Bean	3.98	530	180	500	30	330	-	40	80	250	550	360	310
Cowpea	3.86	420	200	430	70	320	230	90	80	230	480	270	310
Green Gram, Whole	3.84	500	170	460	60	350	100	80	60	200	510	350	320
Khesari, Dhal	4.51	490	160	470	50	260	-	30	70	140	410	410	250
Horse Gram	3.52	530	190	520	70	380	-	70	130	230	540	370	390
Lentil	4.02	540	160	440	60	270	200	50	70	220	470	270	310
Peas	1.15	570	130	400	60	250	220	60	80	240	380	290	290
Peas, Dry	3.15	570	130	440	60	280	170	50	70	240	430	280	300
Moth Beans	3.78	-	210	340	40	280	-	60	30	-	420	310	200
Rajmah	3.66	370	180	460	60	340	100	60	40	270	470	300	330
Soybean	6.91	450	150	400	80	300	210	80	100	240	480	320	320
Redgram, Dhal	3.57	360	250	480	40	460	130	60	60	200	450	250	260

(Gopalan, *et al.*, 1989)

(except soy) because they contain relatively low quantities of the essential sulphur containing amino acids cystine, methionine and cysteine (which are found in higher quantity in grains). However, grains contain relatively low quantities of lysine, whereas legumes contain appreciable quantity (Curran, 2012; FAO, 2014).

Dietary fibre: Adequate dietary fibre is vital for proper working of the gut, which is related to reduce risk of a number of chronic diseases including certain cancers, heart disease and diabetes. Fibre comprises pectin, mucilage, cellulose, gum, hemicelluloses and lignin (Khogare, 2012). Most of the legume grains which are consumed as pulses by humans, their fibre content ranges from 0.9-5·3% (Gopalan et al., 1989). Legumes are mainly rich in resistant starch (RS), have low glycaemic index carbohydrates (Munro, 2007). The oligosaccharides (mainly raffinose and resistant starch) and fibre pass through the stomach and small intestine in the undigested form until they reach the colon, where they act as food (prebiotics) for the probiotic or beneficial bacteria which resides there. This bacterial fermentation leads to the development of short-chain fatty acids, such as butyrate, which possibly will improve colon health through promoting a healthier gut micro biome and reducing colon cancer risk (Bird *et al.,* 2010). They also play a positive role in weight reduction due to its satiety value (Papanikolaou and Fulgoni, 2008; Li *et al.,* 2014). In addition, they are capable to help in moderating blood sugar levels after meals and improve insulin sensitivity (Sievenpiper *et al.*, 2009; Mollard *et al.,* 2011; Jenkins *et al.,* 2012).

Carbohydrates: Commonly consumed legumes having carbohydrate content in the range of 20.9-60.9% (Gopalan *et al.,* 1989). Carbohydrate comprises monosaccharides, oligosaccharides, other polysaccharides and starch (Ekanayake *et al.*, 2000). In the legume seeds, starch is the main source of accessible carbohydrate and most plentiful 22-45% along with 1.8-18% oligosaccharides and 4.3-25% dietary fibre (Hoover and Zhou, 2003; Ofuya and Akhidue, 2005).

Minerals content: Legumes are excellent source of iron, calcium, zinc, selenium, magnesium, phosphorus, copper and potassium. In whole or dehulled legumes, while mineral content in the range of 2.1-4.6 mg per 100 gm of seeds (Gopalan *et al.,* 1989). In horsegram average concentrations of macro minerals (K, Ca, P, S and Mg) ranges from 1.3-14 mg and micro minerals (Cu, Fe, Ni, Zn and Mn) ranges from 1.0-95.0 µgm per gram dry weight (Morris *et al.*, 2013). It is a rich source of calcium which is 223 mg in dehulled seed and 238 mg in whole seed per 100gm of seeds (Sudha *et al.*, 1995). Among all the legumes shown in Table 2 soybean have highest (10.4 mg per 100 gm of seeds) iron content and highest amount of potassium (1150 mg per 100 gm of seeds) which is available in greengram dhal (Table 4).

Cereals grains generally supply the higher energy and make up the volume of diets. As sources of micronutrients legumes are much superior to cereals because legumes have higher initial minerals content. Many cereals are polished before eating for production of white rice or wheat flour for white bread (Welch *et al.*, 2000). The minerals are found in the seed coat (bran) in major proportions which are discarded during processing in case of cereals. Most legumes, including common beans are consumed whole, resulting in conserving their mineral contents.

Vitamins: Micronutrient deficiencies have become more common, even in developed countries. Legumes are superior source of vitamin B-complex, but are a poor source of vitamin C and fat soluble vitamins. Vitamins such as pyridoxine, niacin, riboflavin, folic acid and thiamine are under the group of B-complex. These vitamins are essential because body requires them from external sources to replenish (Dias, 2012). Vitamins and co-enzyme play important role in metabolism of carbohydrates and branched-chain amino acids, numerous oxidation and reduction reactions, hydrogen transfer with numerous dehydrogenases, glycogen, and sphingoid bases. Recent reports have also implicated that the low B-complex content of diets is a major factor in the outbreak of peripheral neuropathy and visual loss observed in the adult population (Martone *et al.*, 1994; Ordunez-Garcia *et al.*, 1996; Hedges *et al.*, 1997).

Fatty acids: Legumes are normally low in fat and have no cholesterol. Soybeans and peanuts are the exception, which have major levels of mostly mono and polyunsaturated fatty acids, including α-linolenic acid (Mudryu *et al.*, 2014). They are a superior source of linoleic and α-linolenic acid in the range of 21-53% and 4-22%, respectively (Messina, 1999). Chickpeas have the highest monounsaturated fatty acid content (34 gm/100 gm), kidney beans (Rajmah) the highest polyunsaturated fat content (71.1 gm/100 gm) and butter beans have the highest saturated fat content (28.7 gm/100 gm). Lupins contain a higher monounsaturated fat and lower saturated fat content (Bouchenak and Lamri-Senhadji, 2011). Saturated fatty acids are essential to keep reserved the fat soluble vitamins like vitamin A (German and Dillard, 2004). Mono and poly unsaturated fatty acids decrease the possibility of coronary heart diseases.

Anti-nutritional and phytonutrients factors: Legumes have anti-nutritional factors which affect its nutritional quality. Anti-nutritional factors are able to decrease palatability and diminish protein digestibility and bioavailability of nutrients (Jain *et al.*, 2009; Kalogeropoulos *et al.*, 2010). A number of the usually considered anti-nutritional compounds like phytic acid, phenols and tannins are currently considered as potential antioxidants containing health promoting effects. The phytic acid has now been revealed to have rich antioxidant, hypoglycaemic activities and also possess anticarcinogenic properties, thus retention

or elimination of these compounds depends upon consumer's preferences (Bhatt and Karim, 2009). Conventional food preparation techniques such as soaking, sprouting, boiling and fermentation, improve flavour and palatability of legumes as well as increase the bioavailability of nutrients, by deactivating anti-nutritional factors and also allows the digestion and assimilation of starch and protein (Xu and Chang, 2008; Kigel, 1999). Therefore legumes except sweet lupin should not be consumed raw.

Phytochemicals reduce the digestion and absorption of nutrients or interfere with their action. The bioactive phytochemicals including enzyme inhibitors are mainly represented as phytoestrogens, oligosaccharides, phytosterols, phytates, saponins, flavanoids and phenolic acids. The proteinaceous anti-nutritional factors include lectins, protease (trypsin, chymotrypsin), amylase inhibitors and lipoxygenase (Kouris-Blazos and Belski, 2016).

Saponins are gastric irritants but may also show anticarcinogenic and hypocholesterolaemic activity (Bouchenak and Lamri-Senhadji, 2011). Saponins are found in chickpeas, lentils, soy, various beans and peas. Soy beans are predominantly high in saponins even after general baking and processing.

In addition to tocopherols and glutathione, legumes contain several phenolic compounds which may protect against some cancers (Faris *et al.*, 2009). Isoflavonoids, a subclass of polyphenols, act as phytoestrogens. Research has linked soy foods and/or phytoestrogens to a reduced risk of certain cancers including prostate and breast cancer, osteoporosis, problems associated with menopause and heart disease (Anderson *et al.*, 1999; Messina, 1999; Yan and Spitznagel, 2009).

Phytosterols are structurally analogous to mammalian cholesterol, with 50-85% being β-sitosterol. These can obstruct the absorption of cholesterol from the food. Chickpeas (38.5 mg/100 gm) are high in β-sitosterol (Bouchenak and Lamri-Senhadji, 2011).

All edible plant seeds, together with legumes contain phytic acid. Phytate chelate minerals (especially calcium and zinc) form poorly soluble compounds which are not voluntarily absorbed from the intestine, thus interfering with the bioavailability of these essential minerals as well as inhibit enzymatic digestion of both starch and proteins (Pugalenthi *et al.*, 2005; Gibson *et al.*, 2014). Phytates can enhance the risk of mineral deficiencies sooner or later if animal food intake is low. Phytates do not show the influence on absorption of minerals from meat (Uzel and Conrad, 1998). Phytates are an alarm in developing countries where regular diets are based on legumes and grains as in case of vegetarians (Hunt, 2003). However dehulling, soaking, boiling or steaming, roasting, sprouting, sun drying and fermentation of legumes trigger an enzyme (phytase) which helps their breakdown (Lopez *et al.*, 2001; FAO, 2014; Gibson *et al.*, 2014). On the other hand phytates show useful health effects, having positive role as an antioxidant and are in protection against a variety of cancer and coronary heart disease, renal stones and diabetes mellitus, thus total removal of phytates is not desirable (Graf and Eaton, 1993; Kumar *et al.*, 2010). Due to presence of high fibre it also helps in reduction of cholesterols and other lipids (Thompson and Zhang, 1991; Shamsuddin *et al.*, 1997; Reddy, 1999; Midorikawa *et al.*, 2001).

CONCLUSION

Legumes and pulses utilization is a usual and beneficial part of the human diet and contributing to health. FAO has chosen 2016 as the International Year of Pulses which will emphasize the health and environmental benefits of pulses. Legumes have conventionally been an essential part of the diets of many cultures throughout the world. In contrast, beans presently have only a negligible dietary role in developed countries. It has also been confirmed that regular utilization of pulses provide manifold health benefits like healthy heart, control of diabetes, improvement in gastrointestinal health and cancer prevention. The nutritional report of legumes illustrate that they are rich source of protein, high in fibre, complex carbohydrates and low in saturated fat. Legumes are also a superior source of several micronutrients and phytochemicals. Conventional food preparation techniques such as soaking, sprouting, boiling and fermentation, improve flavour and palatability of legumes as well as increase the bioavailability of nutrients by deactivating anti-nutritional factors and also allow the digestion and assimilation of starch and protein.

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