Harnessing the Health Benefits of Pulses *(Fabaceae)*: Pulses *(Fabaceae)* Nutrient Contents & Phytochemical Composition.

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ABSTRACT

Pulses, dry seeds of legume family, their roles have been very significant in human diets & agriculture for thousands of years. This comprehensive review paper delves into the nutritional properties, health benefits, & culinary uses of pulses. Pulses are very rich in plant proteins, dietary fiber, minerals, vitamins, antioxidants & bioactive compounds, making them valuable for human nutrition. Furthermore, highlighting the potentially health benefits which the pulses provide, including their role in heart health, weight management, & blood sugar control. Pulses may lower your risk of developing cardiovascular disease, weight loss, & improved glycemic control in various studies. Pulse seeds vitally possess potential in the prevention of many chronic diseases e.g., cancer. Incorporating pulses into diets, especially in regions with dietary diversity challenges, is emphasized as a means to enhance nutritional status. Different culinary methods for pulse consumption are explored, along with the impact of processing techniques on nutrient retention. However, there are certain anti-nutritional factors in pulses, which can affect nutrient absorption & bioavailability. Traditional food preparation methods are discussed as strategies to mitigate the effects of these anti-nutrients. Overall, this review underscores the nutritional significance of pulses & their potential in promoting human health, while also acknowledging the importance of understanding & managing their anti-nutritional components. Pulses, with their diverse nutritional profile, have potential in contributing to sustainable & health-conscious diets worldwide.

Keywords: pulses, phenolic compounds, heart health, weight management, antinutritive compounds.

Introduction

The legume family's dry seeds are cultivated in variously shaped & sized pods as pulses. These belong to the family *Leguminosae*, subfamily *Papilionoideae* of the family *Phaseoleae* (Graham & Ranailli,1997). Evidence from history & archaeology indicated that America was where cultivated beans & pulses first appeared (Papa et.al., 2005). In the terms of output, economic value & acreage pulses rank with food grains & oilseeds as a significant sector of the Indian agricultural economy (Chaudhary Ak et.al., 2014). Chickpea, lentil, pigeonpea, urdbean, mungbean & fieldpea are significant pulse crops (Ali & Gupta, 2012). Pulse crops, a class of leguminous plants cultivated largely for their nutrient-dense seeds, have been known to play a special & central role in development of agriculture & the history of human meals. Archaeological discoveries from between 7000 & 8000 BCE show that pulse crops have been farmed for thousands of years (Zohary et.al., 2012) Famous authors such as Zohary & Hopf have shown how pulse crops, such as lentils, peas & chickpeas weren't only essential food crops but also improved soil fertility by fixing nitrogen, phenomena early farmers were aware of.

Pulses' nutritional qualities have been well studied, & it has been claimed that they have physiologically advantageous benefits on people. Pulse grains are a great source of various nutrients & are abundant in proteins, carbs, & dietary fiber (Tharanathan & Mahadevamma, 2003). Peas, chickpeas, beans, faba beans & lentils are examples of pulses used for human sustenance (Rochfort & Ponnozo, 2007). Consuming legumes frequently has been linked to a 22% & 11% decreased risk of developing cardiovascular disease (CVD) & coronary heart diseases, respectively (4 or more time per week as opposed to the consumption of less than once) (Flight & Clifton, 2006). Enzyme inhibitors, oligosaccharrides, lectins, phenolic compounds & phytates are just a few of the bioactive components found in legumes. These molecules also perform metabolic functions in people & other animals who ingest legumes on a regular basis. These outcomes might be beneficial, bad, or both (Champ et.al., 2002). Epidemiological research repeatedly shows that whole grains reduce the risks for chronic diseases like cardiovascular disease & diabetes (He et.al., 2010), the metabolic syndrome, & multiple cancers (de Munter et al., 2007). However, refined grain consumption goes above what is advised (Lin B et.al.,2014). Consuming pulses is advised by both the U.S. Dietary Guidelines (USDA-DHHS, 2010) & the National Heart, Lung, & Blood Institute's Dietary Approaches to Stop Hypertension (DASH) Eating Plan (DASH eating Plan, 2013).

The goal of good nutritional diet is to provide human body with all kinds of nutrients it needs in the right amounts & ratios. Pulses are one of the plant groupings that are beneficial in terms of nutrition. These plants are an abundant supply of biologically active compounds, vitamins, minerals, fiber, & plant proteins. (Singh & Shevkani, 2017). Pulses are frequently suggested in sustainable diets since they have both nutritional & environmental advantages (Chaudhary et.al., 2018). Additionally, to meet the basic energy & protein needs required by human diet, health organizations like the Food and Agriculture Organization for UN (FAO) suggest pulses as a staple food (Leterme P et.al., 2002). Animal proteins that are obtained from meat & milk differs from vegetable protein in its amino acid makeup. According to basic guidelines of rules for healthy eating, meat ought to be partly substituted with pulses since nutrient value of proteins found in pulse products are slightly less than the nutritional quality from meat proteins (Jarosz & Charzewska, 2019).

By physical separation of grains into its fundamental components, such as proteins, fiber & starch & using these products to complement the other components of food in order for improvement in nutritional content of meals, the value of pulses may be increased. The benefits of pulses in terms of health are now more understood in western nations. When consumed often, numerous bioactive components found in pulse grains can help with metabolism (Guilon & Champ, 2002). The present state of knowledge on certain types of pulse phytochemicals, such as starch, alkaloids, phytosterols, isoflavones, bioactive carbohydrates & saponins is reviewed in this work. These metabolites' potential to affect human health is examined, as well as the processing techniques & agricultural practices that affect how much of these chemicals end up in food.

Nutritional Profile of Pulses

The nutritional qualities of pulses that are said to have physiologically advantageous impacts on people have been well studied. Pulse grains are a great source of various nutrients & are abundant in protein, carbs, & dietary fiber (Tharanathan & Mahadevamma,2003). Pulses include substantial amounts of plant protein, dietary fiber, calories, a variety of minerals, & bioactive compounds (Gupta & Patel, 2021). The primary plant protein source for humans is pulses. In emerging & underdeveloped nations, pulses represent a significant source of nourishment. Due to the large number of vegetarians, pulses are frequently utilized as source for protein (McDermott & Wyatt, 2017). According to Parikh & Patel (2011), up to 70% of seeds in pulses are made up of carbohydrates. Dietary fiber mostly consists of elements of plant cell walls & contains macromolecules that withstand digestion by human endogenous enzymes (Tharanathan & Mahadevamma,2003). Dietary fiber consists of lignin, oligosaccharides, polysaccharides, & other related plant compounds (AACC International, 2013). Higher levels of insoluble fiber found in pulses have been shown to promote colon health. Additionally, pulses include a variety of phytonutrients, such as antioxidants, which may have anti-cancer potential (Campos Vega et.al., 2010).

Protein content & quality

Seed proteins are categorized as structural proteins, storage proteins and biologically active proteins. Among most important proteins that are biologically active are enzymes, enzyme inhibitors and lectins. Compared to storage proteins, these minor proteins possess a more nutritionally balanced amino acid makeup. The only function provided by seed storage proteins is to supply the proteins needed for seed germination. Osborne (1942) used empirical classification for categorizing seed proteins. Glutelins (soluble within diluted acid/base) & Prolamins (soluble in alcohol) are minor proteins that make up a small fraction of pulse proteins, often less than 5%. Globulins, that are soluble in salt solutions, & albumins, which are water soluble, make up the majority of pulse proteins. Depending on the kind of pulse (beans, black gram, lentils & chickpea), the content ratio of albumins to that of globulins can range from 1:3 to 1:6 (Gupta & Dhillon, 1993), They might also include some anti-nutritional bioactive constituents e.g., chymotrypsin &/or trypsin inhibitors, amylase inhibitors & hemaglutinins/lectins inhibitors (Boye J et.al., 2010).

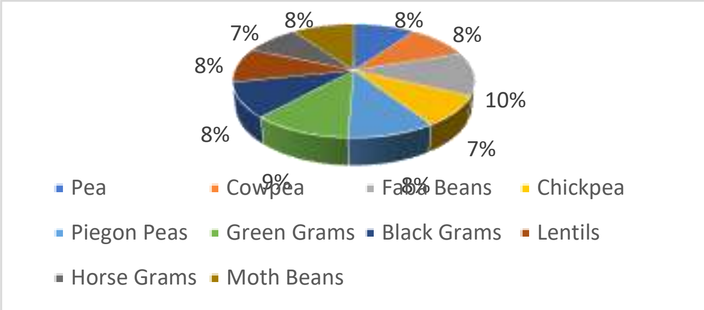

Fig 1. *Protein Content of Major Pulses*(Source: Venkidasamy et al., 2019)

The main storage proteins found in kidney beans, cowpeas, mung beans, red beans, & urad beans, where it can make up to 88% of all globulins, is Vicilin (Tang & Sun, 2010) (Shevkani K et.al., 2015). Despite having certain similarities between pulses, vicilins have variable MWs & compositions. Vicilins were found in the proteins from cowpeas, kidney bean, mung beans, red beans, peas, & fava/faba bean, which ranged in size from 133 to 140 kDa, 136 to 150 kDa, 162 to 173 kDa, 155 to 163 kDa, respectively (Shevkani K et.al., 2015) (Vioque J et.al., 2012).

Carbohydrates & dietary fiber

Dry beans comprise up to 60~ carbohydrates (mostly starch) & they are a solid source of dependable proteins. When ingested in humans as a food or by cattle as its feed, carbohydrates can also be categorized based upon their chemical makeup or on how easily they can be digested. Carbohydrates are divided into four groups based on their polymeric nature: mono, di, oligo, & polysaccharides (Chibbar et.al., 2004). Simplest among all the sugars, Monosaccharides serve as a foundation for all other bigger carbs. In general, 200–3,000 monosaccharide units make up polysaccharides, which are polymers having at least 20 monosaccharides (AACC, 2001). When compared to other, more prevalent carbohydrates, including those in the disaccharide group, oligosaccharides, or carbohydrates with between 3 & 10 single sugar residues, are not as prevalent in the diet. Dietary fiber is made up of lignin, oligosaccharides, polysaccharides, & other related plant compounds. In addition to encouraging laxation, dietary fibers may also lower blood cholesterol levels &/or blood sugar levels (AACC, 2001). The indigestibility of the different food fibers inside human small intestine is a feature that is common in them. Based on dietary fiber's solubility within a pH-controlled enzyme solution (representing human alimentary enzymes) during separation & extraction dietary fiber may be further divided into soluble & insoluble fiber fractions (Tungland & Meyer, 2002).

Sr No.	**Pulse**	**Carbohydrate (g/100g)**	**Minerals (mg/100g)**					**Fiber (g/100 g)**	**Vitamins**					**References**
			Ca	**Fe**	**Zn**	**Na**	**K**		**C (mg)**	**B9 (mg)**	**A (IU)**	**B1 (mg)**	**BS (mg)**	
1	Chickpea	62.95	57	4.31	2.76	24	718	12.2	4.3	557	67	0.47	1.58	Wallace, et.al, 2016
2	Cowpea	60.03	126	1.1	1.01	4	431	10.6	2.5	NA	816	0.11	NA	Zaheer et.al., 2020
3	Piegon Pea	48.15	1.39	5.36	2.3	NA	NA	7.25	NA	229	NA	0.74	1.56	Talari and Shakappa, 2018
4	Lentil	60.1	56	7.5	4.8	6	955	30.5	4.4	479	39	0.9	2.1	Faris et.al., 2013
5	Mungbean	19.15	81-114	3.4-4.4	1.2-2.1	8.7-13.2	363-414	7	4.8	615	114	1.91	1.96	Kumar and Panday., 2020
6	Bambara Bean	60.8	30.2	8.8	1.9	NA	NA	10.3	NA	NA	NA	NA	NA	Yao et.al, 2015
7	Faba Bean	58.29	103	6.7	3.14	13	1.062	25	1.4	423	53	<1	<1	Dhul et.al., 2021
8	Vetches	43.5	1.35	0.41	36.2	1.77	10.5	NA	NA	NA	NA	NA	NA	Hang et.al., 2017

Table 1. Carbohydrate and Nutritional Profile of Major Pulses.

Vitamins & minerals

One of the essential component of nutritional & toxicological assessments is the identification of minerals & trace elements in food. Micronutrients like copper, iron, chromium & zinc are crucial for human health. Along with studies of links between status of trace element & oxidative disease, these elements also play a significant role in the human metabolism, & interest in them is increasing (Fennema & O.R., 2000). Many enzymes contain copper, some of them are necessary for the metabolism of iron. e. According to Neilson & F.H. (1994), decreased glucose tolerance is the most frequent symptom of chromium insufficiency. Chromium participates in the metabolism of carbohydrates & lipids. The micronutrient content of pulses is likewise very high (Winham & Hutchins, 2007). The B-vitamins e.g., niacin, thiamin, pyridoxine, folic acid & riboflavin are also abundant in pulses. These vitamins play crucial roles in fatty acid metabolism pathways & energy metabolism. In the pathways for the metabolism of fatty acids & energy, niacin functions as a coenzyme. It takes part in the alteration of chromosomal proteins which work in the nucleus to regulate & repair DNA as well as differentiate cells. According to Gropper et al. (2009), niacin is also necessary for the release of calcium from the intracellular reserves. They include a lot of thiamin,folate, niacin, pyridoxine & riboflavin & are a rich source of selenium (Canadian Food Inspection Agency, 2011). Although dried pulses don't contain vitamin C, but their sprouted versions do (Raatz S et al., 2010). Pulses also contain vitamins E & A. Despite the fact that the amount of iron in different types of pulses can vary significantly (for example, white beans have nearly twice as much iron as in black beans), a half-cup serving of beans provides close to 10% of the daily recommended amount of iron (Patterson et al., 2009).

Antioxidants/Bioactive Compounds

Oxidative stresses might play critical role in health issues e.g. obesity, diabetes, cancer, neurological disorder & cardiovascular diseases, in accordance to numbers of conducted studies. According to Singh et al. (2016), polyphenols are the main antioxidants that work by giving free radicals hydrogen atoms. Tannins, phenolic acids and flavonoids are the main phenolic compound found within pulses. A minimum of one aromatic ring having one or more hydroxyl groups present in phenolic compound. They can chelate metal catalysts, inhibit oxidases & activate enzymes in addition to transferring electrons to eliminate free radicals (Heim et al., 2002). These substances are widely known to possess antimicrobial, anto-inflammatory & antioxidant properties that shield tissues of body from oxidative stresses (Crozier A et al., 2009). The aromatic rings of phenolic compounds, that is one of major classes of bioactive compounds found in pulses, have one or also more than one hydroxyl substituents, giving rise to simple and extremely complex polymers (Singh & Shevkani, 2015), phenolic acids which are discovered in the pulses are either the cinnamic (e.g.,ferulic, caffeic, p-comaric ferulic, & sinapic acids) or benzoic acids (e.g., syrinigic, gallic, & vanillic acid) derivatives, which are found as esters of caffeic & quinic acids(Singh B et.al., 2015). Other minor components found in pulses, like phytic acid & saponins, are beneficial to the human health. According to Vucenik et al. (2006), phytic acid induces malignant cells to differentiate & mature, frequently returning them to their normal phenotype. By controlling the enzymes that are involved in apoptosis pathway, which results in programmed death of cells, saponins reduce the likelihood that tumors will metastasize (Thom & E.A., 2000).

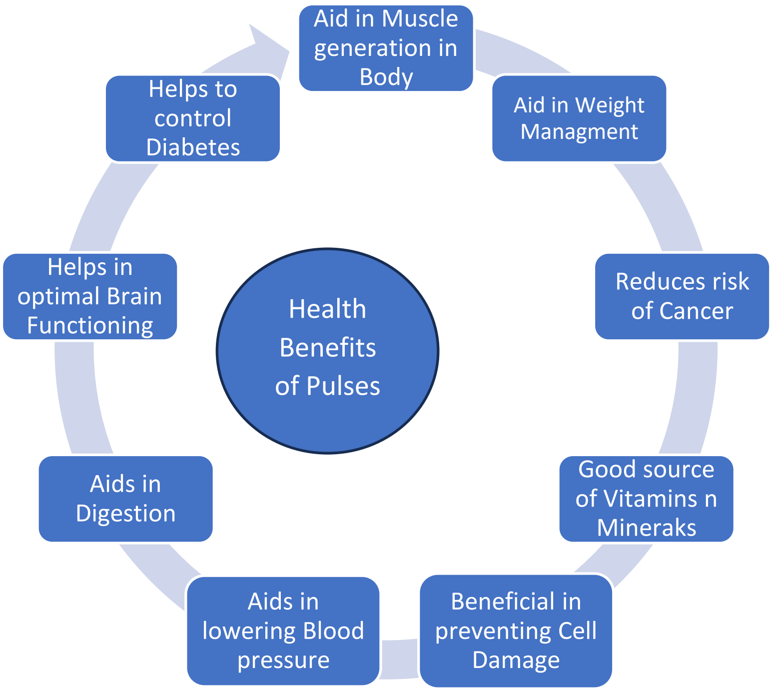

Fig 2. *Health Benefits of Pulses.*

Pulses & Heart Health

According to several studies, pulses might have significant protective affects on the risk of cardiovascular disease (Anderson & Major, 2002). Due to the positive effects that pulses have on blood pressure, diabetes, glycemia & the risk for obesity, pulse consumption on a regular basis lowers the risk of cardiac issues. A significant inverse association between consumption of pulses & the risk of heart issues was discovered by Bazzano et al. in 2001. Pulses' ability to decrease cholesterol is mostly attributed to the phytosterols, isoflavones & indigestible carbohydrates that they contain. According to Anderson & Major (2002), eating pulses reduces blood triacylglycerol levels by more than 10% & LDL-cholesterol levels by 7%. According to epidemiological data, eating legumes four or more times per week as opposed to once per week results in a 22% decrease in coronary heart disease & an 11% decrease in cardiovascular disease (Bazzano LHJ et al., 2001). After adjusting for characteristics like smoking, hypertension, abdominal obesity, diabetes & physical activity, consuming one serving of beans per day is related with a 38% lower risk of myocardial infarction than consuming none or less than one serving per day (Kabagambe et al., 2005). A high-pulse diet significantly reduced total cholesterol & LDL-C levels when compared with a high-protein diet, diets high in fatty fish, & a control diet (Abete et al., 2009). Due to their widespread consumption throughout the world, pulses constitute the primary dietary source of saponins (Gurfinkel & Rao, 2003). According to clinical trials, saponins in diet can lower blood lipid levels & blood glucose response. They helped reduce blood cholesterol levels in people by inhibiting the body's absorption of bile acids or cholesterol (Leterme et al., 2002). Saponins are essential components of our diets because they lower plasma cholesterol levels, which lowers the risk for coronary heart disease (Oakenfull & Sidhu, 1984). By generating an insoluble compound with cholesterol, saponins directly interact via it & reduce its intestinal absorption. According to Papanikolaou & Fulgoni (2008), controlling cholesterol levels & nutritional absorption can have a significant positive impact on a person's health.

Pulses	Cardiovascular Disease
Legume	blood pressure was lowered along with total cholesterol, LDL-C, and HDL-C reductions (Jenkins et al., 2012); (Hermsdorf et.al., 2011)
Lentil	not evaluated as the only dietary component
Yellow Split Pea	not evaluated as the only dietary component
Chickpea	decreased LDL-C and total cholesterol (Zhang et al., 2010).
Kidney Bean	after a second meal, there was a decrease in inflammatory markers and increase in the concentration of short chain fatty acids (Nilson et al., 2013).
Mungbean	decreased LDL-C and total cholesterol (Winham and Hutchins, 2007)
Lupin Seeds	Blood lipid levels remain unchanged and blood pressure is lowered (Belski et al., 2011).

Table 2. *Major Pulses and their Impact on Cardiovascular Diseases*

Pulses & Weight Management

To be important, pulses' capacity to boost satiety & cut back on food intake should also be capable to result in an improvement to body weight control (Jenkins et al., 2012). The impact of pulse consumption in body weight has been studied in numerous human intervention studies (Jenkins et al., 2012). For instance, Abete et al.'s (2009) eight-week randomized parallel-arm, 35 obese adult males participated in a trial that looked at the impact of various energy-restricted diets (high in protein, high in fatty fish, & legume-rich) on body composition. All four diets resulted in a significant loss of body weight, with the high-protein & legume-rich diets showing the biggest drops. Individuals consuming beans have a lower average body weight, lesser waist circumference, & a decreased risk from obesity as compared with non-bean consumers, in accordance to a data from the United States National Health & Nutrition Examination Survey (NHANES) (Papanikolaou & Fulgoni, 2008). It has been demonstrated that pulse-rich, energy-restricted diets promote weight loss. Pulses consumption might be useful in aiding, weight loss, according to a comprehensive review & meta-analysis of the 21 trials involving 940 overweight and obese middle-aged people (Kim SJ et. al., 2016). Reduced digestion & macronutrient absorption may be the cause of weight maintenance or loss linked to the ingestion of pulses. According to de Almeida Costa GE et al. (2006), some part of the starch in pulses is resistant starch (RS), which is not digested & absorbed in the small intestine. The colon ferments pulse starch, which is resistant to digestion, to create short chain fatty acids (SCFA). Compared to the 4 kcal/g of energy provided by digestible starch, SCFA offer about 2 kcal/g of energy (Elia & Cummings, 2007).

According to Howarth NC et al. (2001), high fiber foods are believed to improve satiety in part because the longer chewing time stimulates early satiety signals. Furthermore, the soluble fiber included in pulses may help to increase luminal viscosity, which in turn may result in a slower rate of gastric emptying & less physical contact between nutrients & intestinal villi, slowing the rate at which food is absorbed by the digestive system (Howarth NC et al., 2001). Consuming pulses is linked to satiety & aids in weight management as a result (Marinangeli et al., 2012). According to a recent study (Lunde et al., 2011), bread made by pea fiber prolonged satiety in individuals longer than ordinary bread did.

Pulses & Blood Sugar Control

Pulses are the best meal option for diabetics due to their low GI & high fiber content. According to Jenkins et al. (2002), the resistant starch present in pulses helps to enhance insulin sensitivity & glucose tolerance, which lowers the risk of complications from diabetes. It has only recently been proposed that whole-grain diets may help treat type II diabetes mellitus (T2DM) patients as well as serve as a preventative against the onset of the disease (Venn & Mann, 2004). According to recent studies, eating mung beans causes a negligible rise in a person's blood glucose index, making it a desirable alternative for diabetics. It is claimed to alter lipid & glucose metabolism in rats favorably (Lerer-Metzger et al., 1996). Particularly, it has been demonstrated that consuming high-fiber, low glycemic index carbohydrates lowers the risk of acquiring type 2 diabetes (Ley SH, 2014). Pulses, which are classified as edible, dry leguminous plants that include beans, chickpeas, peas, & lentils are one of the source of carbohydrates (American Diabetes Association, 2016).

It is crucial to balance the effects of whole pulses in context of mixed meals because pulses are typically ingested in combination with foods from other dietary groups. In order to investigate this, Mollard et al. (75) offered healthy

individuals varied meals of various pulses (at its 44% energy density) together with a control dinner of macaroni pasta & tomato sauce. They discovered that all pulses caused lower peak blood glucose levels than the control. Significantly less PBGRs (35%) were created by chickpeas, lentils, & navy beans than by pasta. People with type 2 diabetes who ingested meals of both white rice alone or mixed meals including rice & either pinto, black, as well as red kidney beans which were standardized for availability or glycemic carbohydrate experienced similar benefits (Hutchins AM et. al., 2012According to a meta-analysis of 10 prospective studies comprising participants from both European & non-European countries, high adherence to the Mediterranean diet is related with a 23% lower risk of type 2 diabetes (RR 0.77, 95% CI 0.66-0.89) (Koloverou E et al., 2014). In comparision to a wheat-based diet consisting of whole meal bread, high-fiber wheat breakfast cereals, along with shortbread biscuits, consumption of
diets containing chickpea bread, canned chickpeas as well as chickpea shortbread biscuits for 5 weeks caused significant reductions in both total cholesterol & LDL cholesterol by 3.9% & 4.6%, respectively (Pi). However, it had no significant effect on HDL cholesterol or TG.

Pulses & Chronic Disease Prevention
Currently, World Cancer Research Fund (WCRF), Canadian Cancer Society, & the United States FDA (Food & Drug Administration) all advise eating pulses to lower cancer risk (Guenther et.al., 2006). A recent case control study discovered an inverse relationship inbetween the incidence of endometrial cancer & vegetables, in particular dark green or dark yellow vegetables, allium vegetables & legumes (Tao et al., 2005). A higher intake of the legumes was linked to a lower risk of developing breast cancer in significant prospective cohort research(Velie et al., 2005). According to another research, eating legumes e.g. dried beans, lentils & split peas increases your risk of developing colorectal adenoma (WCRF/AICR, 2010). Consuming beans is likely to lower the risk for development of colon & rectal cancer, according to a thorough review done by WCRF/AICR that evaluated the strength of evidences linking diets & cancer at 19 different locations withinin the body. This review found that the diet high in fiber significantly reduced the risk of colorectal cancer (WCRF/AICR, 2010).
Pulses may also have other components besides fiber that have anti-cancer properties. Additionally, zinc, which has been linked to lowered oxidative stress in cells, is present in pulses (Eide & D.J., 2011). & enhanced immune cell performance (Ibs & Rink, 2003). Due to its capacity to stop the growth of tumor cells in mice with tumors, selenium has also been proposed for playing a role in the prevention of breast, stomach & esophageal cancers (Greeder & Milner, 1980). There is substantial proof that eating foods that are rich in dietry fiber helps prevent weight gaining, being overweight, & being obese—all of which are linked to cancer (WCRF/AICR, 2018). This shows it is extremely feasible that eating of pulses daily might lessen chance for getting different type of cancer, especially in combination with the animal studies providing strong supporting evidences.

Culinary Uses & Incorporation of Pulses
According to research by Aberman NL et al. (2014), poorly nutritioned diet is risk factor in developing of Human Immunodeficiency Virus (HIV) & Acquired Immunodeficiency Syndrome (AIDS) in many underdeveloped nations. Due to the reliance on starchy foods & the lack of animal-sourced foods in 66 families afflicted by HIV/AIDS in some African nations, dietary diversification poses a significant issue (Bukusuba J et. al., 2010). The nutritional health of people with HIV/AIDS can be improved by incorporating pulse foods into meals to increase protein consumption & diversify diets (Odendo & Kimani, 2011). According to Hong SY et al. (2013), adding pulses to other foods can increase their nutrient density & possibly slow the rate at which HIV develops into AIDS.
In order to improve digestibility, dried pulses can either be taken whole or subjected to decortication (dehulling) removing seed coat (Siegel & Fawcett, 1976). With the possible exclusion for split seeds & whole lentils, most pulses are soaked before hand to hydrate also soften the seeds & shorten time for cooking. According to Wang N et al. (2003), soaking also lowers levels of chemicals that are harmful to nutrition, such as trypsin inhibitors. Pulses are most frequently processed through canning, especially in developed nations. According to Miller et al. (1973), canning might result in the loss of up to 50% of the thiamine. It should be noted, though, that the loss of vitamins is mitigated by the removal or decrease of anti-nutritional substances during the canning process.

Anti-nutrients in pulses
Legumes' antinutritional constituents may have an impact on their nutritional value. These phytochemicals slow down nutrient digestion & absorption or obstruct their activity. Some may also be poisonous. According to Kalogeropoulos N et.al., (2010), anti-nutritional variables can reduce palatability, protein digestibility, & mineral bioavailability. Consequently, it is not advisable to ingest raw legumes (apart from sweet lupin). Additionally, to enhance the flavor & deliciousness of legumes, traditional food preparation methods including soaking, boiling, sprouting, & fermenting also increase bioavailability of nutrients by inactivating anti-nutritional elements (Xu & Chang, 2008). Despite the possible health benefits of some anti-nutrients (Campos-Vega et al. 2010), for example substances including saponin, polyphenols, phytate & protease inhibitors can have an impact on nutritional value of pulses (Hall et al., 2017). The 'raffinose family oligosaccharides', commonly known as -galactosides, are the subject of debate. Due to their capacity to generate flatulence, they are typically regarded as antinutrients or non-nutritive factors (Wang et al., 2004). Inhibition of food intake, formation of the less digestible tannin-dietary protein complexes, , digestive tract malfunctions inhibition of

digestive enzymes, toxicity of the absorbed metabolites or tannins & increase in the excretion of endogenous proteins are just a few of toxic & anti-nutrional effects of phenolic compounds, tannins in particular (Jansman & Longstaff 1993).

Conclusion

The health benefits obtained from the inclusion of Pulses in our diet have long been neglected. This is mainly due to inadequate knowledge about the nutritional profile and phytochemical composition which the Pulses provide. Pulse seed act as cheap source for vital proteins and essential carbohydrates for populations are malnutritioned. Incorporation of Pulses in our daily diet can provide immunity against many cardiovascular diseases, reduces the risk for obesity and regulated blood pressure. Proper knowledge and guidance about the comprehensive nutritional profile of pulses will increase the trend for consumption of pulses as an essential diet component.

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