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Effect of cooking and germination on bioactive compounds in pulses and their health benefits

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ABSTRACT

Pulses supply many bioactive substances, such as enzyme inhibitors, lectins, phytates and phenolic compounds. Phenolic compounds are found in minor amounts in food but have significant metabolic and/or physiological effects. Enzyme inhibitors can diminish protein digestibility, and lectins can reduce nutrient absorption, but both have little effect after cooking. Because bioactive compounds can be beneficial or adverse, depending on the processing conditions, an assessment of their various physiological effects is necessary to determine whether they should be preserved or eliminated. Pulses are normally consumed after processing, which not only improves the palatability of foods but also increases the bioavailability of nutrients and bioactive compounds. Recent findings from the literature published within the last 10 years about the effect of cooking and germination is compiled and summarized.

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1. Introduction

Legumes are cultivated under a variety of growing conditions and regions. They are globally popular and valued for their nutritional and health attributes. The Food and Agriculture Organization (FAO) limits the definition of pulses to crops harvested solely from dry grain, thereby excluding crops harvested green for food, such as green peas, and leguminous crops, such as seed of clover and alfalfa, that are used exclusively for sowing purposes (FAO, 2016). Pulses have been consumed for at least 10,000 years and are among the most widely consumed foods in the world (Leterme, 2002). Pulses are annual leguminous crops yielding 1–12 grains or seeds within a pod. Many staple dishes prepared from pulses are cooked in a variety of ways. Raw pulses are subjected to a variety of processing techniques prior to consumption, including milling, dehulling, soaking, germination, fermentation and cooking. These processing techniques yield edible products with a higher nutritional value and lower levels of anti-nutritional compounds (Khandelwal, Udipi, & Ghugre, 2010). Recently, pulses have been gaining interest because they are excellent sources of bioactive compounds (Table 1) and can be important sources of

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Table 1
Potential beneficial effects of some bioactive compounds in pulses.

Compound	Potential beneficial	Pulse	Reference
Phytates	Managing type 2 diabetes May have health benefits for diabetes patients; lowers blood glucose response by reducing the rate of starch digestion and slowing the gastric emptying	Lupin	López et al. (2004)
	Hypolipidemic effects may reduce cholesterol through the formation of an insoluble complex with cholesterol, thus preventing absorption in the intestine	Lentils	Faris et al. (2013)
	Anti-cancer Suppress cancer by preventing oxidative DNA damage in cells	Dry beans	Chiang, Chen, Jeng, and Sung (2014) Midorikawa, Murata, Oikawa, Hiraku, and Kawanishi (2001)
	Immuno-modulation	Lupin	Sirtori et al. (2004) Hou, Hou, Yanyan, Qin, and Li (2010)
	Enhancing the activity of natural killer cells	Beans	Reddy et al. (2008)
	Antiobesity Could act as a therapeutic agent to stimulate gut function and ameliorate obesity	Beans	Pusztai and Bardocz (1996)
	Hypocholesterolaemic May reduce cholesterol through the formation of an insoluble complex with cholesterol, thus preventing absorption in the intestine	Beans	Pusztai et al. (1998)
	Anti-cancer Limits tumour growth by promoting gut epithelium hyperplasia	Lentils	De Mejia et al. (2005) Faris et al. (2013) (Pryme et al., 1998, 1999)
Amylase inhibitors	Weight control Managing type 2 diabetes		Oneda, Lee, and Inouye (2004) Siah et al. (2012)
	Managing type 2 diabetes	Chickpea	Singh, Kherdekar, and Jambunathan (1982)
Compound	Potential beneficial	Pulse	Reference
Saponins	Hypolipidemic effects Inhibition of platelet aggregation, and antioxidant effects. Increase the excretion of bile acids, an indirect method in decreasing cholesterol	Beans	Shi et al. (2004) Oseni, Patel, Pyle, and Jordan (2008)
	Anti-cancer Inhibit the reproduction of cancer cells and also play a role in suppressing tumour growth in colon and lung carcinoma cells and leukemia cells	Lentils	Faris et al. (2013) Fan, Guo, Song, and Li (2013) Shi et al. (2004)
Phenolic compounds	Anticancer	Faba beans	Siah et al. (2012)
	The mutagenic effects of both direct-acting carcinogens (e.g. benzo(a)pyrene diol epoxide) and carcinogens that require metabolic activation (e.g. aflatoxin B1), and trap nitrite, thereby reducing nitrosating species and preventing endogenous formation of carcinogenic nitrosamines	Chickpea	Murillo, Choi, Pan, Constantinou, and Mehta (2004) and Corbiere, Liagre, Terro, and Beneytout (2004) Xu and Chang (2009) De Mejia (1999)
	Reduce the obesity risk May suppress growth of the adipose tissue through their anti-angiogenic activity and by modulating adipocyte metabolism Possible protection against heart diseases Capacity to exert both estrogenic and antiestrogenic effects and provide possible protection against heart diseases	Beans Lentils	Pedrosa et al. (2012) Kim, Kwon, and Son (2000) Badimon, Vilahur, and Padro (2010) Mulvihill and Huff (2010) Siah et al. (2012) Sharma, Srivastava, and Prakash (2011)
Compound	Potential beneficial	Pulse	Reference
	Reduce the diabetes risk Inhibit autoxidation of unsaturated lipids, thus preventing the formation of oxidized LDL	Lentils	Randhir and Shetty (2007) Siah et al. (2012)
	Modify LDL oxidation	Faba beans	Bhathena and Velasquez (2002)
	Block the angiotensin converting enzyme (ACE) that raises blood pressure	Beans	Sharma et al. (2011) Ranilla, Kwon, Genovese, Lajolo, and Shetty (2008) Sharma et al. (2011) Siah et al. (2012) Mukai and Sato (2009)
	Capacity to exert both estrogenic and antiestrogenic effects and provide possible protection against Heart diseases	Lentils Chickpeas Faba beans Beans	
	Anti-inflammatory responses Regulate Cyclooxygenase-2 (COX-2)	Beans	García-Lafuente et al. (2014) Mukai and Sato (2009)
Trypsin inhibitor		Beans	Yu et al. (2001) Oomah et al. (2010)
	Anticancer Possesses antiproliferative activity *in vitro*	Beans	Chan, Zhang, Sze, and Ng (2013)
	Can suppress the malignant transformation of cells induced by different types of carcinogens act by several anticarcinogenic mechanisms, but their precise target is still unknown	Faba beans	Fei Fang et al. (2011) Clemente, McKenzie, Johnson, and Domoney (2004)

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