

# Beans and lentils: providing cardiovascular health benefits beyond nutrition

Peter Zahradka

- Besides being environmentally friendly and nutritious, pulses exhibit properties that could be helpful in the prevention and/or treatment of certain acute and chronic conditions.
- With respect to cardiovascular disease, pulses have been shown to lower low-density lipoprotein (LDL) cholesterol levels, but recent studies indicate certain pulse varieties can directly improve the functional properties of blood vessels.
- The lack of availability for consumers of ready-to-serve products containing an adequate amount of pulses, as well as the lack of information regarding the effects of processing methods on the beneficial health effects of pulses makes it difficult for the general public to utilize these foods.
- Our work indicates there is no magic bullet, and to get the maximum cardiovascular benefits from eating pulses you should include a mixture of different varieties in your diet, since each produces a different effect on the cardiovascular system.

In agriculture, the term “pulse” refers to plants belonging to the legume family that are cultivated for their seeds and harvested once they have dried. The typical North American crops are dried beans, dried peas, lentils, and chickpeas, which are primarily used as human and animal food. While pulses are utilized as a major food source in the Middle East, Central and South America, and Asia, there is limited inclusion of pulses in the diets of persons living in Europe, Japan, Australia, and North America. Historically, pulse crops were first domesticated about 5,000 years ago. Their cultivation has been a boon in arid regions, since these plants do not require as much water as many other food crops. Furthermore, their agronomic profile is excellent, as the plants belong to the legume family and thus are nitrogen-fixing and less dependent upon fertilizers. Another added benefit of pulses is their nutrition profile, which includes a high protein and fiber content, a low amount of fat, and essential micronutrients, such as folate and iron.

In addition to providing a basis for the preparation of nutritious foods, including pulses in the diet can be beneficial to health. For example, the abundance of complex carbohydrates rather than simple sugars means pulses have a low glycemic index and are therefore suitable for persons with diabetes. Similarly, pulses can be eaten by individuals trying to lower their cholesterol levels and those who have celiac disease or are gluten-sensitive. The nutritional properties of pulses make them ideal for the preparation of functional foods designed to combat certain acute and chronic diseases. However, to date, the development of commercially available food products containing pulses has been limited—even though there are many articles, both scientific and general, that advocate greater inclusion of pulse foods as part of our regular diet.

The preparation of functional foods with specific health benefits, or the formulation of a natural health product, is usually based on information about the proposed functional ingredient. For functional foods, two of the critical elements are the disease condition being targeted for improvement, and the amount of the ingredient per serving required to elicit a benefit. In selecting a target condition, verbal or written folklore or descriptions of herbal medicines utilizing the ingredient can provide some direction. It is interesting to note that while pulses have been a staple food for thousands of years, their use for medicinal purposes has been fairly limited, which contrasts markedly from many other plants found in the traditional pharmacopeia. While this is mostly the case for beans, which have received scant attention as a medicinal because they originated in South America (*Encyclopedia of Folk Medicine: Old World and New World Traditions*, ed. Hatfield, G., ABC-CLIO, Santa Barbara, California, USA, 2003; Camara, *et al.*, *Agriculture 3*: 90–111, 2013), the reported health improvements ascribed to the better-known lentil are likewise very general and apply to diabetes as well as skin infections and burns (Faris and Atlee, In *Exploring the Nutrition and Health Benefits of Functional Foods*, eds. Shekhar, *et al.*, IGI Global, Pennsylvania, USA, 2017).

To rectify this situation, in 2005, Pulse Canada put out a call for proposals to investigate the health benefits of pulses in a more systematic fashion, with the expectation that these studies be performed in humans. Based on reports in the scientific literature that soybeans, a non-pulse legume, contain phytochemicals that could decrease arterial stiffness, a key feature of atherosclerotic disease, my collaborator Carla Taylor, a professor in the Department of Foods and Human Nutritional Sciences at the University of Manitoba and Director of the Canadian Centre for Agri-Food Research in Health and Medicine, Winnipeg, and I proposed that a diet rich in pulses would reduce the stiffness of blood vessels. We were very appreciative when Pulse Canada awarded us the funding to perform this study.

To do it properly, we asked Randy Guzman, a vascular surgeon at St. Boniface Hospital, Winnipeg, to join us. He generously assisted with recruitment of patients from his clinic



who had been diagnosed with peripheral artery disease (PAD), one of the complications of atherosclerosis. The main feature of PAD is a decrease in blood flow to the foot because of lesions present in the blood vessels of the leg. This can lead to the onset of pain when walking, because the muscles do not receive enough oxygen to meet their needs during periods of exertion. The 26 study participants were provided with foods that contained one half cup of a mixture of cooked pulses (beans, peas, chickpeas, lentils), with one item to be eaten each day for a period of 8 weeks. Two significant changes were observed. First, the LDL-cholesterol of the participants was reduced, which is commonly seen with most pulses because of their high fiber content. Second, the ankle-brachial index (ABI),

### Keep your finger on the pulse

The author of this article, Peter Zahradka, was one of 18 experts to present the latest advances in the analysis, nutrition, and applications of pulse proteins at the inaugural Pulse Science and Technology Forum (November 5–7 in Toronto, Canada). This unique forum was offered by the American Oil Chemists' Society (AOCS) in cooperation with the Global Pulse Confederation, Protein Highway, Protein Industries Canada, and Pulse Canada. The presentations will be made available on the AOCS website ([aocs.org](http://aocs.org)) so that busy professionals can keep up with the rapid developments in the science and technology of alternative proteins.

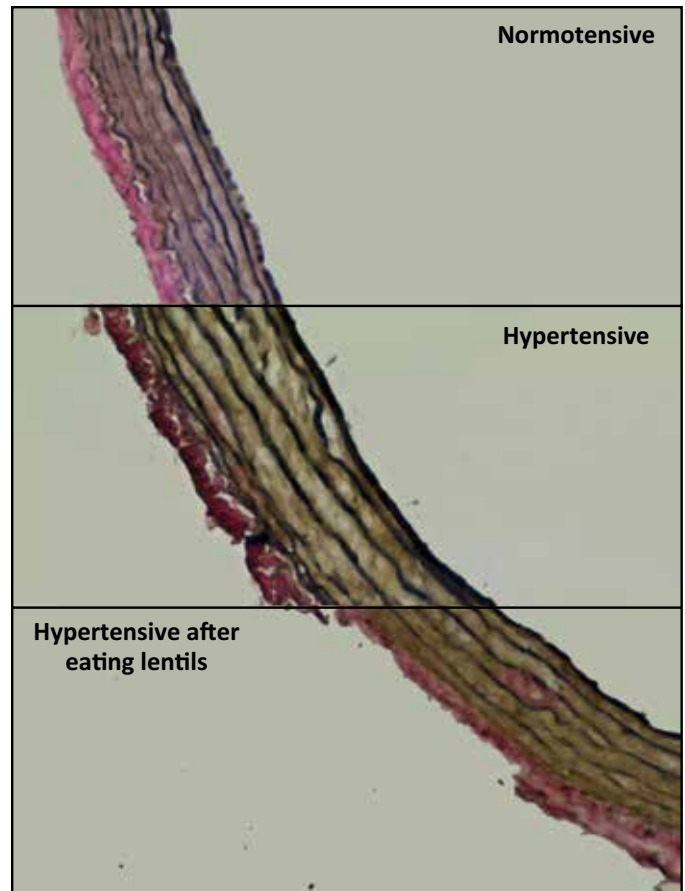
which is the gold standard for diagnosis of PAD, was improved. While no change in arterial stiffness was detected, the higher ABI indicated there was greater blood flow in the limbs (Zahradka, *et al.*, *Atherosclerosis* 230: 310–314, 2013), and this was supported by anecdotal comments made by some of the participants indicating they were able to walk further. Overall, it was concluded that pulses could provide a medicinal benefit for a disease that is currently not well managed by pharmacological means.

Starting with a human study to investigate health benefits is not the usual approach, however the foresight of Pulse Canada led to a finding that could otherwise not be obtained any other way. Furthermore, the information that was obtained this way was useful for guiding the design of additional studies that would examine how pulses produced these benefits. Thus, a series of animal studies were subsequently completed with the intention of defining how pulses caused these benefits (the composition of the blood vessel wall to make it more elastic—Hanson, *et al.*, *J. Nutr. Biochem.* 37: 30–38, 2016), which pulse variety had the greatest potency (green lentil—Hanson, *et al.*, *Br. J. Nutr.* 111: 690–698, 2014), what time frame was required to obtain (one to two months—Zahradka, 2013) and maintain (not yet tested) the positive effects, and what component(s) of the several thousand that can be detected are responsible for the benefits (still uncertain—Hanson, *et al.*, *Eur. J. Nutr.* 57: 297–308, 2018).

While green lentils produced the best result (Fig. 1), red lentils also were found to affect blood vessels (Hanson, 2014), although they did not have the same effect as the green variety. Comparisons of the various pulse varieties were then performed to determine what other medicinal effects they might have. This work has shown that black beans can cause blood vessels to relax over the six-hour period after they are consumed (Clark, PhD dissertation, 2019), while other varieties of beans do not have a similar effect. This contrasts markedly with other foods, such as fats, which induce the contraction of arteries after they are eaten (Vafeiadou, *et al.*, *Br. J. Nutr.* 107: 303–324, 2012). However, more studies are required to understand how pulses can affect blood vessels, and to do so properly requires the right types of equipment (Perrault, *et al.*, *BMC Cardiovasc. Disord.* 19: 190, 2019).

Based on the results obtained through the various studies that have been completed, we have become strong advocates for greater inclusion of pulses in our diets. Overall, pulses can be considered a natural way to prevent or even treat the development of arterial stiffness, which can be considered one of the first changes in our blood vessels leading to atherosclerosis or hardening of the arteries. Since atherosclerosis is the basis for most heart attacks and strokes, greater consumption of pulses may reduce the incidence of these deadly events, thus impacting positively on lifespan and quality of life and, in turn, decreasing the burden on our healthcare system.

The challenge then becomes how to convince more households to serve pulses on a routine basis so they can gain these benefits. Today's lifestyle does not favor longer cooking times; therefore, ensuring greater availability of ready-to-eat food products should be promoted. To achieve this goal, it will be necessary for the food producing and food service indus-



**FIG. 1.** Representative stained sections of rat aorta showing wall thickness, which increases as a result of high blood pressure compared to normal blood pressure, and can be reduced when animals with high blood pressure consume a diet containing green lentils. Further details regarding the study and its findings can be found in Hanson, *et al.*, 2014 and 2016.

tries to see that making these foods will be profitable. At the same time, it may require the pulse industry to benefit from developing local markets rather than exporting most of its product.

While there is strong evidence that pulses have beneficial effects, a variety of issues need to be resolved before pulses can be recommended as a means of controlling cardiovascular disease. For instance, the effect of processing needs to be established no matter what the intended use of the processed material by the food industry. At this time, we have obtained evidence that the ability to lower low-density lipoprotein (LDL) cholesterol levels is decreased by certain processing methods, similarly to what has been reported on glycemic index (Ramdath, *et al.*, *Foods* 7: 76, 2018). Another matter is to determine whether high levels of pulses in the diet might be detrimental.

Specifically, the US Food and Drug Administration recently decided to investigate reports that the pulses used in certain dog food formulations may be responsible for the development of dilated cardiomyopathy (<https://www.fda.gov/animal-veterinary/news-events/fda-investigation-potential-link-between-certain-diets-and-canine-dilated-cardiomyopathy>). While this story has become of concern

to pet owners, no one has yet questioned whether it is a concern for human health. At this time, however, the overall benefits associated with pulse consumption far outweigh any perceived problems. In my experience, having been involved in the preparation and testing of various foods containing all four of the major pulses, cooking with them is not really a tremendous burden and it is possible to incorporate several servings in a week. Furthermore, they are tasty and can be eaten routinely (Ramdath, 2018; Baldwin, *et al.*, *Can. J. Diet. Pract. Res.* 78: 187–191, 2017; Ryland, *et al.*, *Foods* 7: 129, 2018) if the recipes and the varieties are rotated. To many, this may not seem feasible, but a slight shift in our eating habits to include more pulse-rich foods in our diet can have a major positive impact on our health and well-being even if a suitable pharmacological intervention remains unavailable.

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## AOCS MEETING WATCH

**November 5–7, 2019.** AOCS Pulse Science and Technology Forum. Courtyard by Marriott, Toronto, Canada.

**November 8–10, 2019.** 2nd AOCS China Section Conference: Health, Advanced Processing, and Value-Added Utilization, Zhujiang (Pearl River) Hotel, Guangzhou (Canton), China.

**April 26–29, 2020.** AOCS Annual Meeting & Expo, Palais des congrès de Montréal, Montréal, Québec, Canada.

**May 2–5, 2021.** AOCS Annual Meeting & Expo, Oregon Convention Center, Portland, Oregon, USA.

**May 1–4, 2022.** AOCS Annual Meeting & Expo, Hyatt Regency Atlanta, Atlanta, Georgia, USA.

**November 17–19, 2020.** Fabric and Home Care World Conference, Jing An Shangri-La Hotel, Shanghai, China

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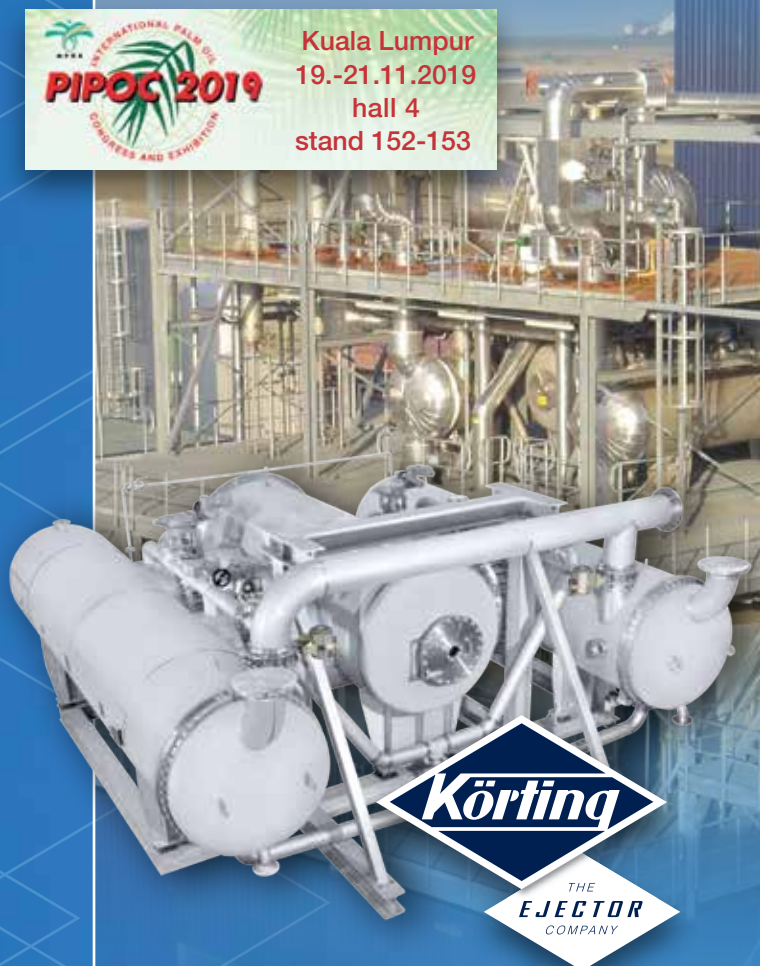
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