Benefits and challenges associated with 'raising our daily pulses'

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EDITORIAL

Nutrition Bulletin

Benefits and challenges associated with 'raising our daily pulses'

Transitioning towards more sustainable diets and exploring alternative protein sources have become priorities to improve human health and help mitigate the adverse effects of food production on the environment. This generally means moving towards a more plant-based diet, but not necessarily excluding meat. FAO and WHO define sustainable diets as 'dietary patterns that promote all dimensions of individuals' health and well-being; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable' (FAO & WHO, 2019). Sustainable diets should include a variety of unprocessed or minimally processed foods, mainly wholegrains, pulses, fruits and vegetables, with moderate amounts of eggs, dairy, poultry and fish and modest amounts of ruminant meat (FAO & WHO, 2019). These diets are consistent with current UK dietary guidelines as described in the Eatwell Guide (PHE, 2016).

While less than 0.1% of the UK population currently comply with Eatwell guidance, if this adherence was to increase from 'very low' to 'intermediate-to-high', it has been estimated that this would reduce the risk of mortality by 7% and dietary greenhouse gas emissions (GHGE) by 30% (Scheelbeek et al., 2020). Furthermore, adherence to recommendations for the intake of fruit and vegetables, and red and processed meat, was associated with the largest reduction in total mortality relative risk (about 10%) and environmental footprint (-1.48 $kgCO_2eq$/day), respectively, compared with other components of the Eatwell Guide (Scheelbeek et al., 2020).

The recommendation for fruit and vegetable intake varies considerably across the world, with guidance for consumption of at least five portions (80 g) a day of a variety of fruits and vegetables in the UK (PHE, 2016). This compares with, for example, at least four servings (150–200 g) of vegetables and three servings (120–200 g) of fruit each day in Greece (Ministry of Health, 2014). There is limited specific guidance on the types of fruits and vegetables. However, in the UK, it is recommended that 80 g (cooked weight) of legumes daily count as one of your five a day (PHE, 2016). This is in line with the Eat-Lancet Commission's guidelines for sustainable and health-promoting diets, which recommends the consumption of 50 g of dried beans, lentils and peas per day (Willett et al., 2019). This virtual issue brings together recent articles published in the *Nutrition Bulletin* looking at the benefits and challenges of increasing the consumption of pulses (Bayindir Gümüş et al., 2024; Coe & Spiro, 2022; Elliott et al., 2022; Ferreira et al., 2023, 2024; Haydon et al., 2020; Lonnie & Johnstone, 2020; Lovegrove et al., 2023; Pereira de Melo Vila-Real et al., 2022; Robinson et al., 2019; Spiro et al., 2024).

The terms legumes and pulses are often used synonymously, although there are important differences. Legumes are plants from the Leguminosae (Fabaceae) family characterised by having pods and root nodules where nitrogen-fixing bacteria reside. Whereas, pulses are dried seeds harvested from leguminous plants, and so exclude fresh peas, green beans, soya beans and peanuts. Pulses are a rich source of proteins (21%–25%), complex carbohydrates (60%–65%), dietary fibre (10%–20%) and micronutrients such as folate, thiamine, riboflavin, vitamin B6, niacin, iron, zinc, magnesium and potassium (Singh, 2017) and are a key component of proposed sustainable diets. Diets rich in pulses and legumes are generally of higher nutritional quality, lower in saturated fats and sugar and higher in fibre and micronutrients (Kaimila et al., 2023; National Diet and Nutrition Survey [NDNS], 2008–2019; Olotu et al., 2023). These benefits can be improved through the development of their nutritional content, as for example, the protein and resistant starch content of peas being improved by selective breeding and genetic manipulation (Robinson et al., 2019). However, research on pulses has been neglected compared with cereal crops such as wheat, and further investment into pulse breeding programmes would lead to further improvements in the nutritive value of pulses (Robinson et al., 2019).

Despite their high nutritional value, pulse crops are currently underutilised and play only a small role in human diets in the UK. The daily intake of pulses is far below recommendations, with estimates of 11 and 15 g in UK children and adults, respectively, and 'baked beans' (processed tinned navy beans in tomato sauce) being the commonest pulse consumed (Kaimila et al., 2023; Olotu et al., 2023). This is reflected in the low compliance with the fruit and vegetable recommendations, with less than a quarter of the UK population meeting the 5 A DAY guidance (Scheelbeek et al., 2020). Vegetable consumption follows a strong

social gradient for numerous reasons, including cost, availability in local shops and out of home catering outlets (Lonnie & Johnstone, 2020). Urbanisation in many developing countries is hastening the transition from traditional food habits to less healthy diets. This is supported by findings in a Kenyan population ($n = 486$) in Nairobi, in which 'legumes, seeds and nuts' contributed to 16.4% and 15.4% of folate and iron, respectively, higher than the contribution from 'meat and eggs', but lower than in previous cultural dietary patterns (Pereira de Melo Vila-Real et al., 2022).

There is growing evidence to support the health benefits of pulses, with pulse-rich diets being associated with favourable effects on blood lipids, glycaemic control, inflammatory status, oxidative stress and gut microbiota (Ferreira et al., 2020). Moving towards a more plant-based diet, which invariably means substituting some animal- with plant-based foods, has been linked with health benefits. Modelled substitution of unprocessed red meat with pulses was associated with a lower risk of colorectal cancer, type 2 diabetes and ischaemic heart disease in a Danish population (Fabricius et al., 2021). In a small Portuguese pilot study ($n = 19$), the substitution of a meat-based lunch with a legume-based lunch for 8 weeks, resulted in beneficial lower serum total and low-density lipoprotein cholesterol, but raised serum triacylglycerol and worsened glycaemic control (Ferreira et al., 2024). More evidence for the specific effects of substituting animal-based foods with pulses using a whole diet approach is needed to inform effective strategies for increasing the intake of pulses in population groups.

Replacing meat with pulses can compromise the intake of some essential micronutrients including vitamin B_{12} (Fabricius et al., 2021; Ferreira et al., 2023; Pellinen et al., 2022). In a randomised, controlled intervention study ($n = 136$), those consuming a high pulse- compared with an animal-based diet for 12 weeks had lower vitamin B_{12} and iodine intake and status, yet a higher iron and folate intake and status (Pellinen et al., 2022). Reductions in the intake of meat (rich in vitamin B_{12}) and dairy (rich in iodine) can lead to a lower intake of micronutrients, which needs to be appropriately managed. In addition to quantifying intakes of specific nutrients, bioaccessibility (proportion of nutrients released from food matrix during digestion and accessible for absorption), bioavailability (proportion of nutrients absorbed and available for metabolism systemically) and ultimately nutritional status are important to assess in order to evaluate the overall impact of dietary transition. The need for diverse strategies to achieve a reduction in high red and processed meat consumption and an increase in nutrient-dense plant foods such as pulses, while simultaneously safeguarding the nutritional and environmental needs of the UK population was the topic of a roundtable discussion organised by the British Nutrition Foundation (Spiro et al., 2024).

Pulses are rich sources of micronutrients, the bioavailability of which can be reduced from the presence of 'anti-nutrients' which bind minerals such as iron, calcium and zinc, lowering their overall nutritive value. Phytic acid is an example of one such compound that is abundant in pulses, though lower in younger seeds such as fresh peas (Elliott et al., 2022). These 'anti-nutrients' can be reduced by genetic selection and seed processing, and there is evidence of human adaptive mechanisms such as upregulation of micronutrient absorption in the long term (Hambidge, 2010), which can reduce the overall impact of these compounds on micronutrient status. A traditional method used to improve the nutritional value of cereals and legumes is sprouting, since this activates the enzyme phytase which degrades phytate, thereby improving mineral bioaccessibility and bioavailability (reviewed by Elliott et al., 2022). Specific to faba beans is the presence of (con)vicine, which can cause haemolytic anaemia in those suffering from favism (lack of the enzyme glucose-6-phosphatase dehydrogenase, required for the metabolism of [con] vicine). Recent advances in genetic manipulation have led to low (or free) (con)vicine faba bean varieties which are fast becoming the favoured choice of faba bean variety for human consumption (Skovbjerg et al., 2023). Cooking and processing can also have desirable and undesirable impacts on the bioavailability and quantity of nutrients in certain types of food. In the case of pulses, cooking can reduce some anti-nutrient effects, improving micronutrient bioavailability, whereas prolonged boiling of pulses can increase the loss of some water-soluble micronutrients (Coe & Spiro, 2022). Furthermore, plant-based meat alternatives may have undesirable nutritional attributes, such as higher glycaemic loads compared with meat (Bayindir Gümüş et al., 2024). Awareness of optimum cooking, processing and preparation methods is important to consider when moving forward to a more plant-based diet.

In addition to the benefits to human health, increased pulse production and consumption has a number of advantages in terms of its impact on the environment. Pulses are a nitrogen-fixing rotation crop, requiring lower fertiliser use on subsequent crops, reduced GHGE related to fertiliser manufacture and reduced nitrous oxide (the most significant ozone-depleting substance) emissions and runoff from agriculture. Further environmental benefits would result from the use of locally grown pulses, including lower transport emissions and reduced requirement for imported pulses (Lovegrove et al., 2023; Stagnari et al., 2017).

Transition to a more plant-based diet requires a change in dietary behaviour. If this change is to include an increased intake of pulses, it is essential to make pulses available in easy-to-use, sustainable and in low-cost formats that are appealing to all population groups, and to engage in a food-system approach for overall success. One strategy is to incorporate pulses

into familiar, well-liked staple foods that are consumed by the majority of the population to ensure effective market penetration. This is the premise of 'Raising the Pulse of our daily bread', a research project which aims to make it easy for people to consume more UK-grown pulses, by adapting the food system to permit food substitutions that benefit both human and environmental health, without the need for major adjustments in terms of taste or diet, and with minimal extra cost. To achieve this aim, the project is focused on creating staple white bread (which accounts for over 90% of all bread purchased in the UK), with enhanced nutritional and environmental benefits and high consumer acceptability by part-substituting nutrient-poor white wheat flour with nutrient-dense faba bean flour (Lovegrove et al., 2023). It is anticipated that this system-wide approach will increase pulse consumption, cultivation, sales and improve human and environmental health.

An alternative initiative is 'Peas Please', which was launched in 2017 to encourage organisations and businesses across the food system to pledge their commitment to helping the British public to increase their vegetable (including legumes/pulses) consumption. By 2020, 95 organisations pledged to support *Peas Please*, with an estimated additional 89.9 million portions of vegetables grown, served and sold by pledgers at that time (Haydon et al., 2020). Another global campaign, 'Beans is How', is aiming to double the current intake of beans globally by 2028 (Beans is How, 2024). This project, which to date has reported success in the US (Beans is How, 2024), aims to increase the incorporation of diverse bean varieties into everyday meals, emphasising their nutritional benefits and culinary versatility. These initiatives aim to bring about a step change in pulse consumption, by involving all stakeholders in a food system to ensure a tractable long-term, sustainable dietary transition towards a more plant-based, pulse-enriched diet.

Negative public opinion and poor knowledge of pulse crops have previously hindered the popularity of pulses in the Western diet. Public health strategies to facilitate the necessary transition are still in an early stage of development, with little evidence of what approaches might be most effective. However, health promotion and education around the benefits of plant-based protein, and pulses, could be a key strategy to encourage all groups of the population to consider a shift towards a predominantly plant-based diet (Lonnie & Johnstone, 2020). If a transition to a more plant-based diet is embraced and enacted, pulse crops have significant potential to unlock a wide range of benefits for public health, farming, food production and the environment.

CONFLICT OF INTEREST STATEMENT

JAL is Deputy Chair of the UK Scientific Advisory Committee on Nutrition (SACN). This paper represents her own work and is not related to SACN's considerations.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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