PULSE INGREDIENTS FOR HEALTHY DIETS AND A SUSTAINABLE WORLD: MAXIMIZING QUALITY PROTEIN USING COMPLEMENTARY PLANT PROTEINS

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PLANT PROTEINS ARE GAINING TRACTION

More than half of Americans say they are making an effort to consume "a certain amount" or "as much as possible" of protein, fiber and whole grains (Table 1).

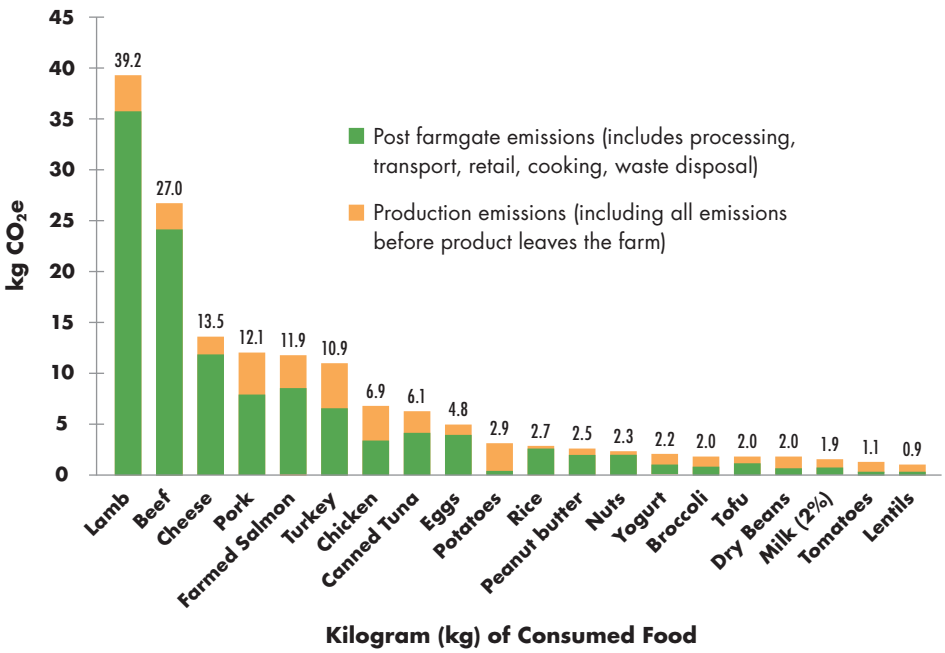
TABLE 1. THE INTERNATIONAL FOOD INFORMATION COUNCIL FOUNDATION 2012-2014 SURVEYS ASKED: "TO WHAT EXTENT DO YOU TRY TO CONSUME THE FOLLOWING?"

	2014	2013	2012
Protein	**50%**	**57%**	**48%**
Fiber	53%	62%	56%
Whole Grains	53%	62%	57%
Calcium	36%	45%	40%
Omega-3	21%	25%	25%

Moreover, consumers in North America are increasingly seeking plant protein as an alternative to meat (Hartman Group, 2013). Diets with less meat have been shown to offer significant health benefits including weight loss, lower cholesterol and blood sugar levels, and reduced cardiovascular and cancer risk (Mayo Clinic, 2014).

Additionally, plant-based foods offer environmental benefits, since they use less land, water and energy than meat-based food systems (Pimentel, 2003; Sabate, 2014; Soret, 2013). For example, a life-cycle analysis of common proteins revealed that beans and lentils create less than 10% of the greenhouse gas emissions associated with beef and lamb production (Figure 1).

FIGURE 1. LIFECYCLE GREENHOUSE GAS EMISSIONS FROM COMMON PROTEINS AND VEGETABLES



Source: Environmental Working Group, 2011.

WHAT IS PROTEIN?

Protein is a macronutrient that plays a vital role in building and maintaining muscles, organs and other tissues. Protein also supplies energy to the body, and is used in making enzymes, hormones and antibodies.

Proteins are composed of chains of 'amino acids' (AAs). Of the 20 AAs found in the body, nine are considered 'essential', which means they cannot be made by the body and must therefore be obtained directly from food.

The nine essential AAs are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. The AAs cysteine and tyrosine are considered semi-essential, since they must be synthesized from essential AAs if insufficient amounts are ingested (Wardlaw, 1999).

Animal and plant proteins differ in the proportion of essential and nonessential AAs. Animal proteins contain all nine essential AAs, whereas most plant proteins are limited in one or more of them.

Proteins may be classified as complete, incomplete or complementary (Institute of Medicine, 2002/2005). Complete proteins are animal-based foods (meat, poultry, fish, milk, eggs, cheese and whey) that provide all of the essential AAs. Incomplete proteins are plant-based foods that are low in one or more of the essential AAs. For example, cereals are deficient in lysine and either threonine or tryptophan, while pulses are low in the sulfur-containing AAs methionine and cysteine (Abdel-Aal, 2002). Complementary proteins are incomplete protein sources that are combined in order to improve the overall AA profile and hence the protein quality.

Most diets provide high-quality protein because a variety of foods are consumed over the course of a day (American Dietetic Association, 2003). However, recent research has highlighted the importance of consuming high-quality protein throughout the day, since enhanced muscle protein synthesis lasts for only about three hours after the time of consumption (Phillips, 2014).

PROTEINS ARE COMPOSED OF CHAINS OF AMINO ACIDS AND PLAY A VITAL ROLE IN BUILDING AND MAINTAINING MUSCLES, ORGANS AND OTHER TISSUES.

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(Wardlaw, 1999)

In the US, the 'daily recommended value' (DRV) of protein is based on the principle that 10 percent of calories should be derived from protein. It equates to 50 grams for a 2,000-calorie diet, and 65 grams for a 2,500-calorie diet. However, recent research has concluded that the optimal protein intake per meal is 25-30 grams, which would suggest a higher daily requirement (Phillips, 2014).

WHY PULSES?

Pulses (peas, beans, lentils and chickpeas) are a valuable source of plant protein. With typical levels of 22-26%, they contain nearly twice as much protein as wheat, and three times more than white rice (Table 2).

TABLE 2. NUTRITIONAL PROFILE OF PULSES AND CEREAL GRAINS
(g/100g DRY WEIGHT BASIS)

	PROTEIN	FAT	CARBOHYDRATE	FIBER
Peas[1]	23	1	60	16
Beans[2,3]	23-26	1-2	67-71	17-28
Lentils[4]	26	1	60	14
Chickpeas[2]	22	7	69	19
White rice[2]	8	1	90	1
Brown rice[2]	9	3	85	4
Wheat[5]	15	3	83	13
Oats[2]	18	8	72	12

1. Wang and Daun (2004)
2. USDA National Nutrient Database for Standard Reference (2012)
3. Includes kidney, black, cranberry, pinto, and navy beans
4. Wang and Daun (2006)
5. Health Canada Canadian Nutrient File (2010)

Because pulses are rich in lysine but low in methionine and cysteine, they are an ideal protein to combine with cereal grain, such as wheat, rice and corn, to create a more balanced protein. Traditionally rice and beans are served together at a meal (Duranti, 2006), and it turns out there are sound nutritional reasons for doing so.

Pulses are also high in dietary fiber, both soluble and insoluble. They are low in fat and have a low glycemic index when compared to other carbohydrate-rich foods. Pulses are an excellent source of B vitamins and iron, and a good source of zinc, magnesium, calcium, selenium, potassium and phosphorus. Pulses also have low allergenicity and are non-GMO and gluten-free when properly cleaned by the supplier to remove any non-pulse seeds and plant material.

According to 'My Plate', the US Department of Agriculture's 2011 recommendations for the five food groups that build a healthy diet, fruits and vegetables should fill at least half the adult plate. However, overall consumption in the US is low, with adults consuming fruit about 1.1 times per day and vegetables 1.6 times per day (Centers for Disease Control, 2013). In fact, most adults in the western world are consuming less than the required amount of vegetables (Murphy, 2014). Since pulses are categorized as both a vegetable and a protein, there is an added advantage of increased vegetable consumption when including them in food formulations.

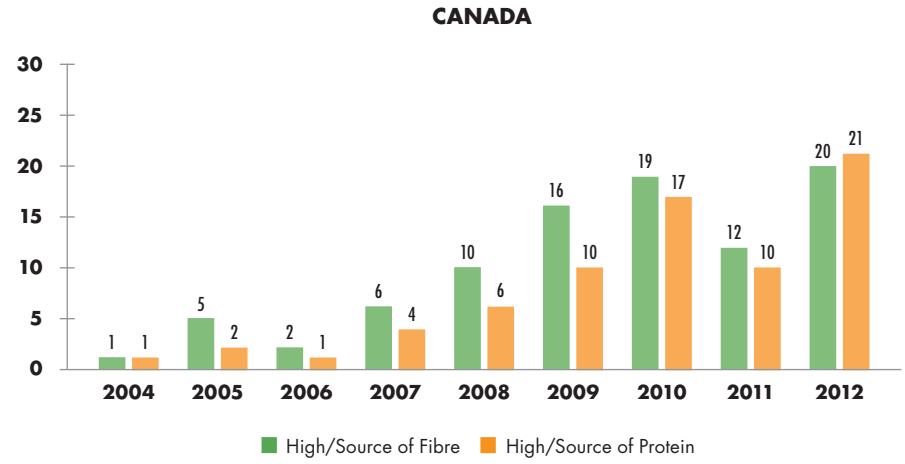
THE PULSE ADVANTAGE

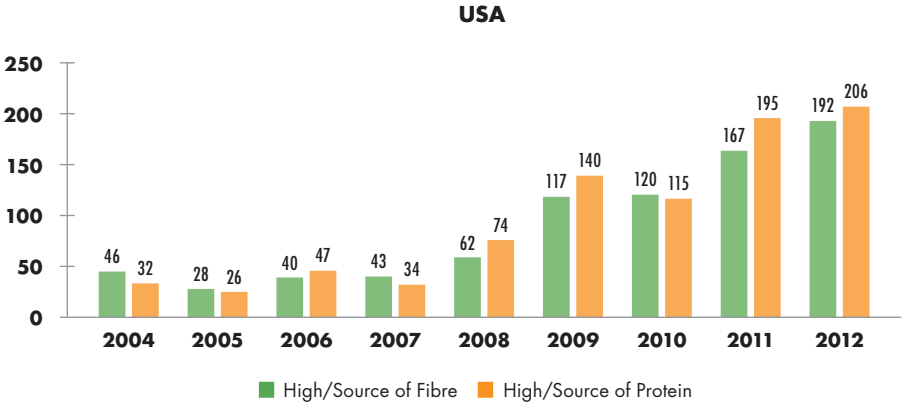
Peas, beans, lentils and chickpeas are a valuable source of plant protein. With typical levels of 22-26%, they contain nearly twice as much protein as wheat, and three times more than white rice

INDUSTRY'S RESPONSE TO CONSUMER DEMAND

In response to the recent demand for vegetable protein, a growing number of food companies are creating new pulse products with fiber and protein positioning. Between 2004 and 2012, the number of pulse products launched with a protein claim grew six-fold (Figure 2).

FIGURE 2. PULSE PRODUCTS LAUNCHED IN THE US AND CANADA WITH FIBER AND PROTEIN POSITIONING





Source: Innova Market Insights Database, 2014.

PROTEIN CLAIMS IN THE USA

In determining whether a protein claim can be made, US companies need to consider both protein quantity and protein quality.

Protein quantity refers simply to the total number of grams of protein per serving. If no protein quality claim is being made, and the product is intended for adults and children over four years of age, then the quantity of the protein must be stated on the nutritional label (US Department of Health and Human Services, 2013).

Protein quality is based on the number of grams of quality protein as determined by the 'protein digestibility corrected amino acid score' (PDCAAS), the currently accepted system, per 'reference amount customarily consumed' (RACC). In the US, the RACC is prescribed by the US Code of Federal Regulations (2012).

THE PULSE ADVANTAGE

In response to the recent demand for vegetable protein, a growing number of food companies are creating new pulse products with fiber and protein positioning. Between 2004 and 2012, the number of pulse products launched with a protein claim grew six-fold.

A product that delivers 10 to 19% of the 'daily recommended value' (DRV) per RACC or 5 to 9.4 grams of quality protein as determined by PDCAAS is considered a "good source of protein" whereas one that delivers 20% or more of DRV per RACC or 10 grams or more is considered an "excellent source of protein".

DETERMINING THE QUALITY PROTEIN CONTENT WHEN USING COMPLEMENTARY PROTEINS

Calculating the quality protein content with complementary plant protein sources such as pulses and grains begins by determining the total AA content of the combined protein ingredients. A reputable supplier will be able to provide accurate information on the essential AA content (mg/100g) of their protein ingredients.

The protein content needs to be adjusted according to its percentage by weight in the product formula on a dry weight basis.

The next step is to determine the 'amino acid score' of the protein ingredients. It is critical to use an accepted standard reference amino acid pattern (e.g. WHO/FAO/UN, 2007) which represents the relative amino acid needs of the target population. This makes it possible to identify the lowest amino acid score, also referred to as the 'limiting amino acid' (LAA).

The LAA then needs to be multiplied by the 'true protein digestibility' (TPD) of the protein ingredients. Accurate TPD data is essential. The TPD is determined by fecal nitrogen digestibility.

Under the currently accepted system, the LAA is multiplied by the TPD to determine the 'protein digestibility corrected amino acid score' (PDCAAS) (WHO/FAO,1991) for the 'reference amount customarily consumed' (RACC). The PDCAAS is then multiplied by the total protein in the serving (adjusted for the moisture level in the final food product) to determine the amount of quality protein per serving.

'Protein Quality of Cooked Pulses (PDCAAS method)', published by Pulse Canada, provides useful information on determining the nutritional quality of cooked pulses and includes a helpful example of pasta reformulated with 25% pulse flour. A free copy can be downloaded at www.pulsecanada.com.

SUMMARY

- Consumers are demanding healthier foods that are based on plant proteins. They are also aiming for a diet that contains whole grains and is high in protein and fiber. Foods containing whole pulses and pulse flours can help consumers achieve these goals.
- Pulses are considered both a protein and a vegetable by the USDA, and can therefore contribute to increasing vegetable consumption as well as protein.
- When combined with cereals, pulses improve the amino acid profile and thereby deliver a higher-quality protein.
- By combining pulses with other plant-based proteins, a protein claim may be possible.

THE PULSE ADVANTAGE

Pulses are considered both a protein and a vegetable by the USDA, and can therefore contribute to increasing vegetable consumption as well as protein.

REFERENCES

Abdel-Aal E-SM, Hucl P. 2002. Amino acid composition and in vitro protein digestibility of selected ancient wheats and their end products. J Food Compos Anal 15:737-747.

American Dietetic Association. 2003. Position of the American Dietetic Association and Dietetians of Canada: Vegetarian diets. J Am Diet Assoc 103(6):748-765.

Centers for Disease Control. 2013. State Indicator Report on Fruits and Vegetables. Published online at www.cdc.gov/nutrition/professionals/data.

Duranti M. 2006. Grain legume proteins and nutraceutical properties. Fitoterapia 77(2):67-82.

Environmental Working Group. 2011. Published online at www.ewg.org/meateatersguide/a-meat-eaters-guide-to-climate-change-health-what-you-eat-matters/climate-and-environmental-impacts/.

Hartman Group. 2013. Ideas in Food 2013 - A Cultural Perspective. Published online at www.hartman-group.com/downloads/white-papers/ideas-in-food-2013.

Health Canada. 2010. Canadian Nutrient File. Published online at www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index-eng.php.

Institute of Medicine of the National Academies. 2002/2005. Dietary Reference Intakes for Energy, Carbohydrate. Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. The National Academies Press.

International Food Information Council Foundation. 2012. 2012 Food & Health Survey: Consumer Attitudes toward Food Safety, Nutrition, and Health. Published online at www.foodinsight.org.

International Food Information Council Foundation. 2013. 2013 Food & Health Survey: Consumer Attitudes toward Food Safety, Nutrition, and Health. Published online at www.foodinsight.org.

International Food Information Council Foundation. 2014. 2014 Food & Health Survey: The Pulse of America's Diet from Beliefs to Behaviors. Published online at www.foodinsight.org.

Mayo Clinic. 2014. Published online at www.mayoclinic.org/healthy-living/nutrition-and-healthy-eating/in-depth/meatless-meals/art-20048193.

Murphy MM, Barraj LM, Spungen JH, Herman DR, Randolph RK. 2014. Global assessment of select phytonutrient intakes by level of fruit and vegetable consumption. British Journal of Nutrition published online ahead of print http://dx.doi.org/10.1017/S0007114514001937.

Phillips S. 2014. Protein in support of skeletal muscle health: The science behind recommendations for athletes and "mere" mortals. Presentation at 2014 Protein Trends and Technologies Seminar, Global Foods Forum, Arlington Heights, Illinois.

Pimentel D, Pimentel M. 2003. Sustainability of meat-based and plant-based diets and the environment. Am J Clin Nutr 78(3):660S-663S. Sabate J, Soret S. 2014. Sustainability of plant-based diets: back to the future. American Journal of Clinical Nutrition 100 (Supplement 1): 476S.

Soret S, Mejia A, Batech M, Jaceldo-Siegl K, Harwatt H, Sabate J. 2014. Climate change mitigation and health effects of varied dietary patterns in real-life settings throughout North America. American Journal of Clinical Nutrition 100 (Supplement 1): 490S.

US Code of Federal Regulations. 2012. 21 CFR 101.12 - Reference amounts customarily consumed per eating occasion. Published online at www.gpo.gov/fdsys/granule/CFR-2012-title21-vol2/CFR-2012-title21-vol2-sec101-12/content-detail.html.

US Department of Agriculture, Agriculture Research Service. USDA National Nutrient Database for Standard Reference, release 25 (2012), Published online at www.ars.usda.gov/ba/bhnrc/ndl.

US Department of Agriculture. 2011. MyPlate. Published online at myplate.gov/foodgroups/.

US Department of Health and Human Services, FDA, Center for Food Safety and Applied Nutrition. 2013. A Food Labelling Guide: Guidance for Industry, p 30.

Wang N, Daun JK. 2004. Effect of variety and crude protein content on nutrients and certain anti-nutrients in field peas (Pisum sativum). J Sci FoodAgric 84:1021.

Wang N. Daun JK. 2006. Effects of variety and crude protein content on nutrients and anti-nutrients in lentils (Lens culinaris). Food Chem 95:493.

Wardlaw GM. 1999. Perspectives in Nutrition. WCB/McGraw-Hill, Boston, p 160.

WHO/FAO. 1991. Protein quality evaluation: report of a joint WHO/FAO expert consultation. FAO Paper 51. Rome, Italy.

WHO/FAO/UN. 2007. Protein and amino acid requirements in human nutrition: report of a joint WHO/FAO/UNU expert consultation. WHO Technical Report Series 935. Geneva, Switzerland.

PHOTO CREDITS

Page 1: Michael Stringer
Page 3: Canadian International Grain Institute
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CONTACT BEST COOKING PULSES, INC.

Best Cooking Pulses is a Canadian family owned agri-foods company that has been active in the international pulse trade since 1936. BEST pulse ingredients, sustainably milled on the Canadian prairies from North American raw materials, include a range of whole pea (yellow and green), bean (black, pinto and navy), chickpea (Kabuli) and lentil (green and red) flours, split pea flours, proprietary pulse blends, pea fibers, roasted yellow peas, yellow and green split peas, and whole pulses (peas, chickpeas and lentils).

All ingredients are non-GMO, gluten-free (ELISA <5ppm) and available conventional, natural or certified organic (OPAM). Best Cooking Pulses is Canadian Grain Commission HACCP certified, Kosher Check, and WBEN certified.

Partner with us to create tasty, nutritious, functional foods. 'Pulse ingredients for healthy diets and a sustainable world.'

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