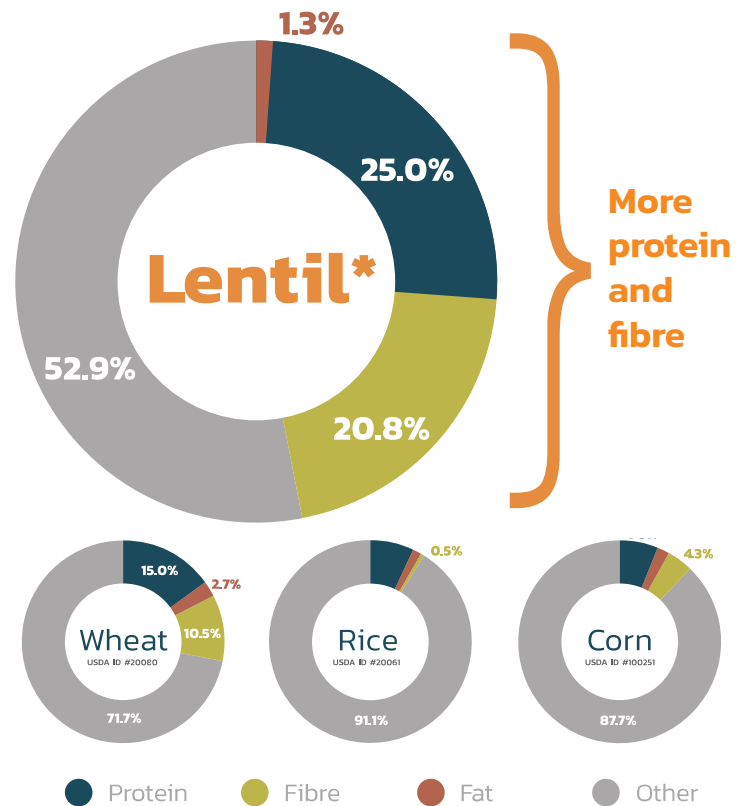


CANADIAN LENTIL FLOUR IN BAKERY

Lentil flour is a sustainable, nutritious ingredient created from grinding the whole lentil seed or following the removal of the outer seed coat. Including lentil flour in bakery products can increase the fibre and protein content, improve protein quality, and lower the carbon footprint of baked goods.

BOOST PROTEIN AND FIBRE

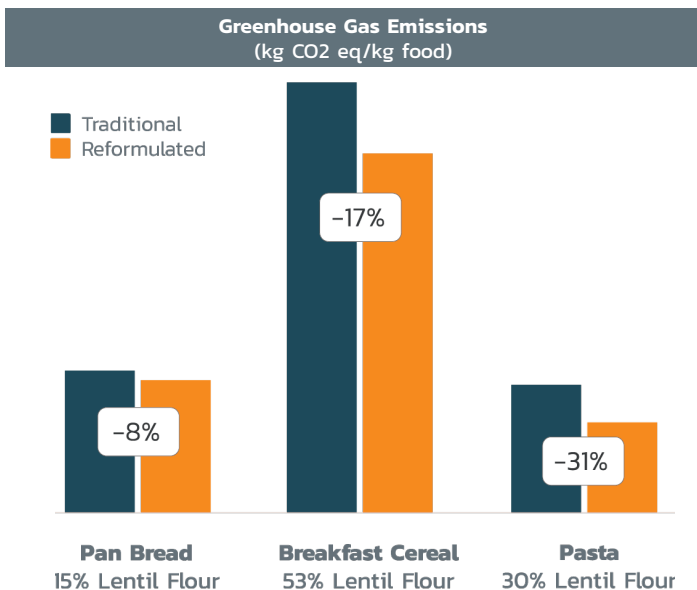
Lentil flours have more protein and fibre than cereal flours and replacing a fraction of the formulation with lentil flour can significantly increase these nutrients. For example, reformulating pan bread with 53% red lentil flour can increase the protein content by 78%¹. In addition, the amino acid profile of lentil complements cereal grains, boosting protein quality and potentially allowing for a protein claim on the finished product.



MARKETING APPEAL

- Clean label
- Sustainable
- Gluten-free
- Low glycemic index
- High protein
- High fibre

*Numbers are based on whole red lentil flour. All values reported on a 10% moisture basis. Internal analysis conducted at Merieux Nutriscience, 2014.



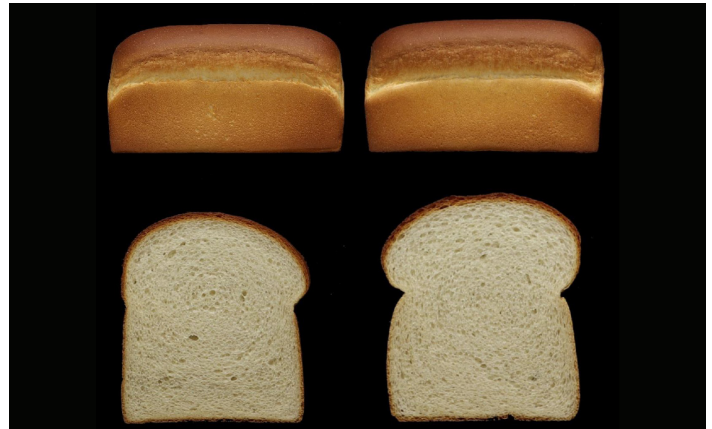
REDUCE THE CARBON FOOTPRINT OF YOUR PRODUCTS

Lentils require little to no fertilizer to grow, reducing their environmental impact. The production practices used by Canadian growers also sequester large amounts of carbon into the soil, making Canadian lentils a carbon-neutral or even carbon-negative crop². This can have a big impact on the final footprint of food products.

WORKING WITH LENTIL FLOUR

Because the functional properties of lentil flour differ from wheat, some optimization of inclusion rates, formulation and processing conditions may be needed to achieve the desired final product quality. An example of optimizing lentil flour in bread is shown on the right.

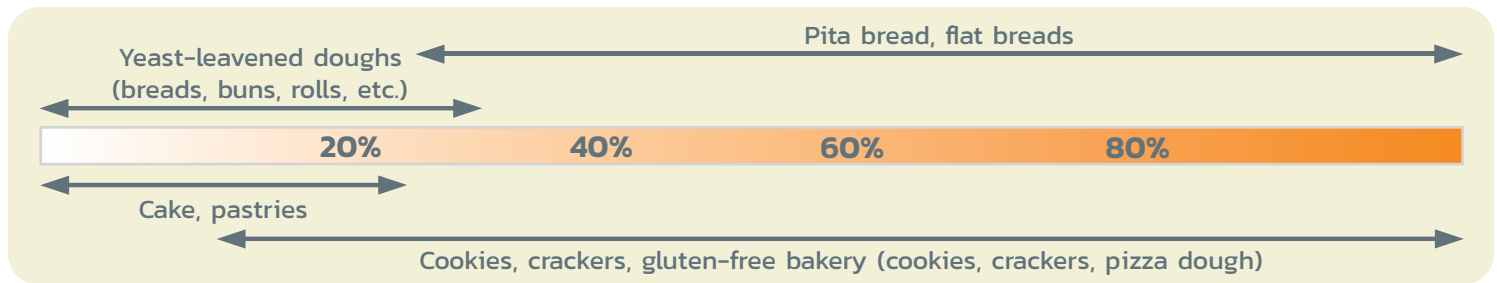
	LEFT	RIGHT
Water Absorption	71%	75%
Low Mixing Time	4 minutes	4 minutes
High Mixing Time	2.5 minutes	2.2 minutes
Proof Time	60 minutes	65 minutes



Prepared at Cereals Canada pilot bakery substitution 20% of CWRS wheat flour with de-flavoured red lentil flour. Base formulation (in baker's percent) contained 8% vital wheat gluten, 4% sugar, 4% shortening, 1.3% salt, 4.5% yeast, 2% milk powder and 2% dough conditioner.

TYPICAL INCLUSION RATES FOR BAKED GOODS

A wide range of inclusion rates have been successfully used in different bakery applications, depending on formulation, lentil flour type and the desired product attributes.



Inclusion rates above indicate Baker's Percentage. Source: Internal communication from Pulse Canada referencing Baik and Han, 2012; Boinanska et al., 2021; Borsuk et al. 2012; Fujiwara et al., 2017; Hajas et al., 2020; Han et al., 2010; Fujiwara et al., 2017; Krause et al., 2022; Ozulku et al., 2017; Tufan et al., 2019; Zhang et al., 2021; Zucco et al., 2011

BREAD

Pulse flours have successfully substituted up to 30% of wheat flour in the formulation of yeast-leavened breads. Typical formulations comprise of simple flour, yeast and salt but many other additional ingredients, including sugars, fats, dough conditioners and improvers, have also been evaluated.

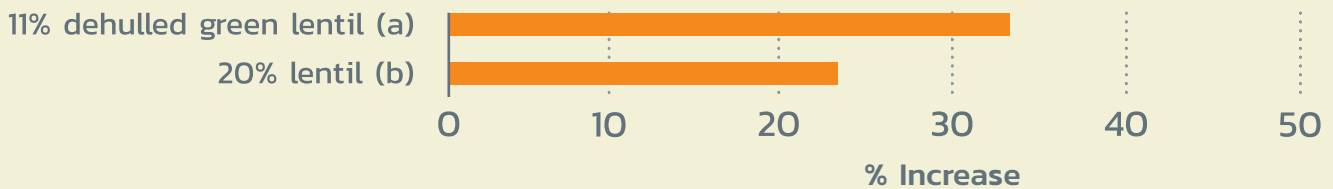
Flour Type	Inclusion Rate (% flour)	Water Addition (%)	Additional Ingredients (per 100g flour)
Raw, whole lentil ⁷	30%	50%	6g sugar, 5g gluten, 5mL malt solution, 4g nonfat dry milk, 3g shortening, 1.8g yeast, 1.5g salt
Cooked, whole lentil ⁷	30%	70%	6g sugar, 5g gluten, 5mL malt solution, 4g nonfat dry milk, 3g shortening, 1.8g yeast, 1.5g salt
Fermented, whole lentil ⁷	30%	63%	6g sugar, 5g gluten, 5mL malt solution, 4g nonfat dry milk, 3g shortening, 1.8g yeast, 1.5g salt
Raw, red lentil ⁸	10%	58.8%	35–50g rye flour, 2g salt, 1.4g yeast
Raw, red lentil ⁸	15%	57.4%	35–50g rye flour, 2g salt, 1.4g yeast
Raw, whole red lentil ⁹	15%	73.5%	6g sucrose, 3g shortening, 2g yeast, 1.5g salt, 0.2g malt flour
Raw, whole red lentil ⁹	25%	72%	6g sucrose, 3g shortening, 2g yeast, 1.5g salt, 0.2g malt flour

COOKIES AND WAFERS

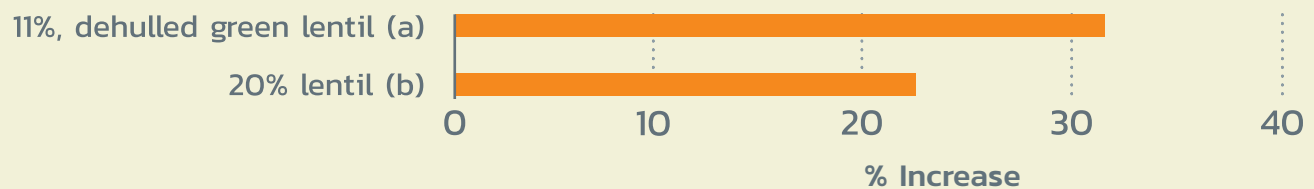
Pulse flours have been incorporated at up to 50% substitution rates in cookie and wafer formulations with significant improvements to the nutritional profile. Flour type, inclusion and particle size have all been reported to significantly affect quality attributes such as cookie weight, thickness, width, and hardness¹⁰.

Flour Type	Inclusion Rate (% flour)	Additional Ingredients (per 100g flour)
Dehulled, green lentil ¹¹	11%	Pastry flour, butter, salt, sugar, dehulled yellow pea flour, pea protein concentrate, vanilla, cocoa powder, baking powder
Lentil ¹²	20%	182g water, 1g hydrogenated vegetable fat, 0.5g lecithin, 0.5% sodium bicarbonate

Protein Content Relative to Control



Fibre Content Relative to Control



PITA BREAD

Research conducted at the University of Manitoba evaluated coarsely and finely ground dehulled green lentil flour at rates of 25–100% in pita bread¹³. Even at 100% inclusion, formulations successfully formed pockets and were deemed suitable for pita processing.

Ingredient	Amount
Flour blend	100 grams
Salt	1.5 gram
Active dry yeast	1 gram
Gum mix (cellulose, guar, and xanthan gum)	0.4 grams

Adapted from Borsuk et al. 2012



FORMULATION CONSIDERATIONS

WATER ABSORPTION & DOUGH HANDLING

Lentil flour generally increases water absorption in baked goods, producing a stickier dough which requires increased mixing times. It's important to review the particle size distribution of the specific flour being used, as it will impact dough handling properties^{3,4}. Because lentil proteins do not share the same viscoelastic properties as gluten, products are often denser, firmer and expand less. However, adaptations to the baking process and the use of dough conditioners, hydrocolloids, vital wheat gluten or heat-treated lentil flour has been shown to improve some of these challenges⁵.

COLOUR & FLAVOUR

Baking with lentil flour often results in a darker exterior colour that will vary based on the original seed colour (e.g. red vs. green lentil). It's recommended to bake products for a longer time at lower temperatures to prevent excessive colour development. Lentil flour often imparts a pleasant, roasted, nutty flavour in baked goods as opposed to the beany-grassy notes sometimes associated with other pulses such as pea⁶.

SOURCING LENTIL FLOUR

There are a variety of lentil flours available on the market and it's important to consider the individual specifications of each. Whole lentil flour will have different properties than its dehulled counterpart. You may also come across specialty milled lentil flour in which treatments are applied to alter the nutritional, sensory or functional properties of the ingredient. A common example are de-flavoured flours which use hydrothermal conditions to reduce enzyme activity associated with off-flavour development.

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WE'RE HERE TO HELP

Increase the nutrient density of your product while lowering the carbon footprint with lentil flour.

For more information, including custom presentations to assisting with sourcing ingredients, contact Janelle Carlin, Director, Quality & Processing, at jcarlin@pulsecanada.com.

