Pea and Lentil Flour Quality as Affected by Roller Mill Configuration

Background

Pulse flours are gaining traction as functional ingredients in a wide range of food applications including baked goods, pasta, noodle, snack and meat products. Studies have shown that pulse flour functionality varies as a result of its chemical composition and physical characteristics such as the degree of starch damage or particle size distribution. While the impact of milling on pulses has been demonstrated using an array of techniques (hammer mill, impact mill, roller mill, etc.), there is limited information on the extent to which the milling process can be used to alter flour performance and thus its ability to consistently achieve desired flour specifications for any one food application. The following study was conducted at IMPROVE (Dury, France) and was intended to examine the effects of roller mill configuration on pea and lentil flour quality.

Key Results

It is possible to produce pulse flours with targeted physical and chemical characteristics by either altering the milling process or blending flours. In addition, quality variation that occurs as a result of milling will influence the functional characteristics and thus end-use applicability of pulse flours. This would imply that specialized flours could be made with the intention of being used for a defined food application.

- Changes in milling configuration produces flours with a wide range of physical and functional properties (Table 1).
- Flour streams from the same milling configuration produced flours with a wide range of physical and chemical characteristics, for example, starch damage (Figure 2) and protein content (Figure 3).
- Smaller particle size resulted in flours with higher protein content and level of starch damage (Figure 4).
- Variations in chemical and physical characteristics of streams produced from the same milling configuration were related to differences in functional properties of flour (Figure 5).

Methodology

Yellow peas and green lentils were dehulled and ground to flour using a laboratory roller mill (MLU 202, Buhler). The roller mill was selected due to increased flexibility in adapting rolls and sieves that will facilitate greater control in particle size reduction. The diagram length (long 6 passes vs. short 4 passes) and sieve sizes (300 µm vs. 180 µm) were altered for a total of four milling configurations in order to understand their effect on flour quality (Figure 1).

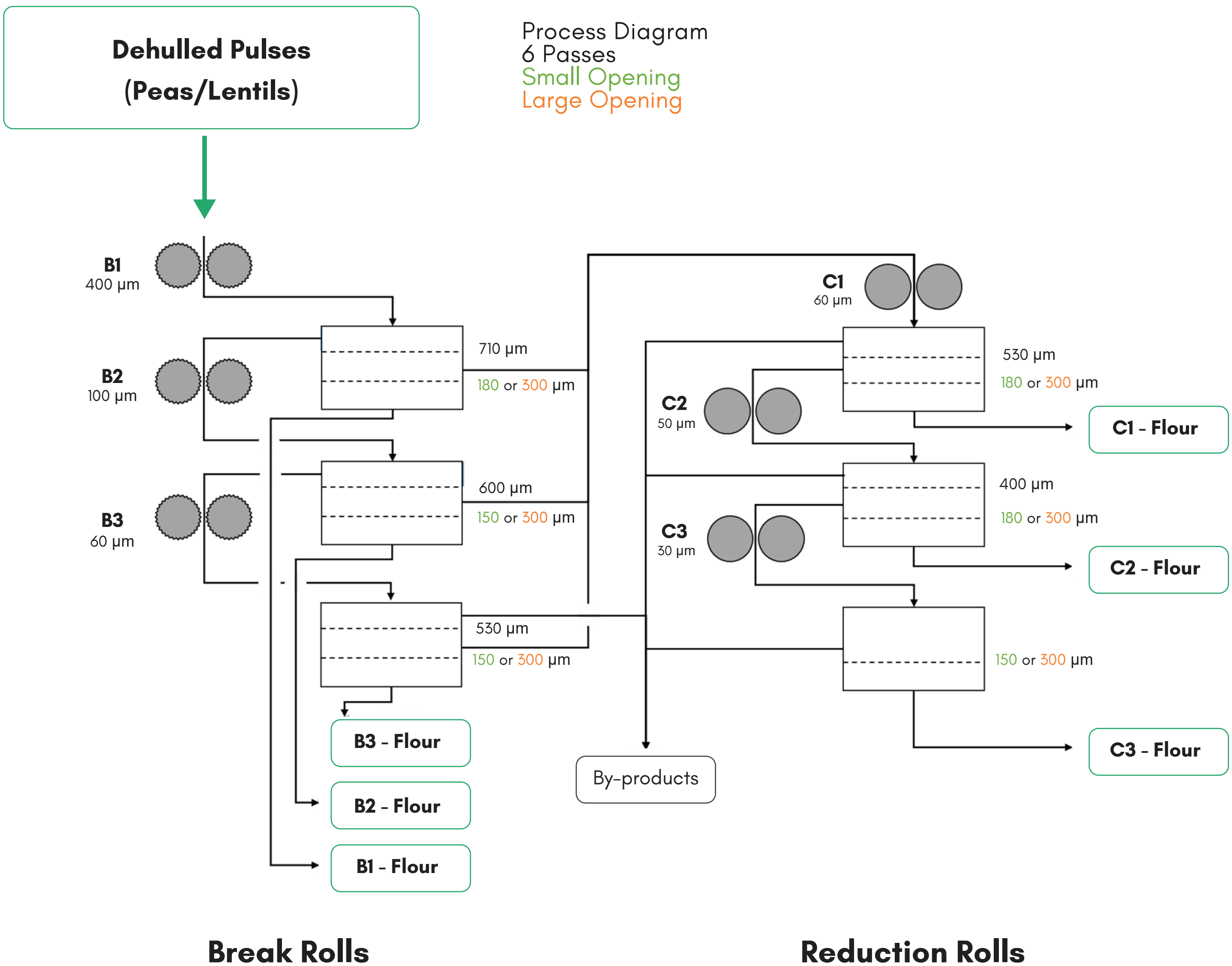

Figure 1. Example of long roller mill diagram. Six flour streams were collected following sieving after each set of rolls for a total of 3 break (B1-B3) and 3 reduction rolls (C1-C3). During the short milling process four flour streams were collected for a total of 1 break (B1) and 3 reduction rolls (C1-C3).

Results

Changes in milling configuration produces flours with a wide range of physical and functional properties.

Parameter	Pea		Lentil	
	Minimum	Maximum	Minimum	Maximum
Damaged Starch (%)	2.60	16.0	1.90	15.4
Laser PSD (d50)	23	158	22	169
Emulsion Stability (%)	24.1	176	50.6	112
Foam Stability (%)	0.08	79.4	0.00	92.7
Final Viscosity (RVU)	172	300	180	313
Aerated Density (g/mL)	0.397	0.554	0.401	0.574

Table 1. Ranges in the physical and functional properties of pea and lentil flour produced with various milling configurations.

Flour streams from the same milling configuration produced flours with a wide range of starch damage.

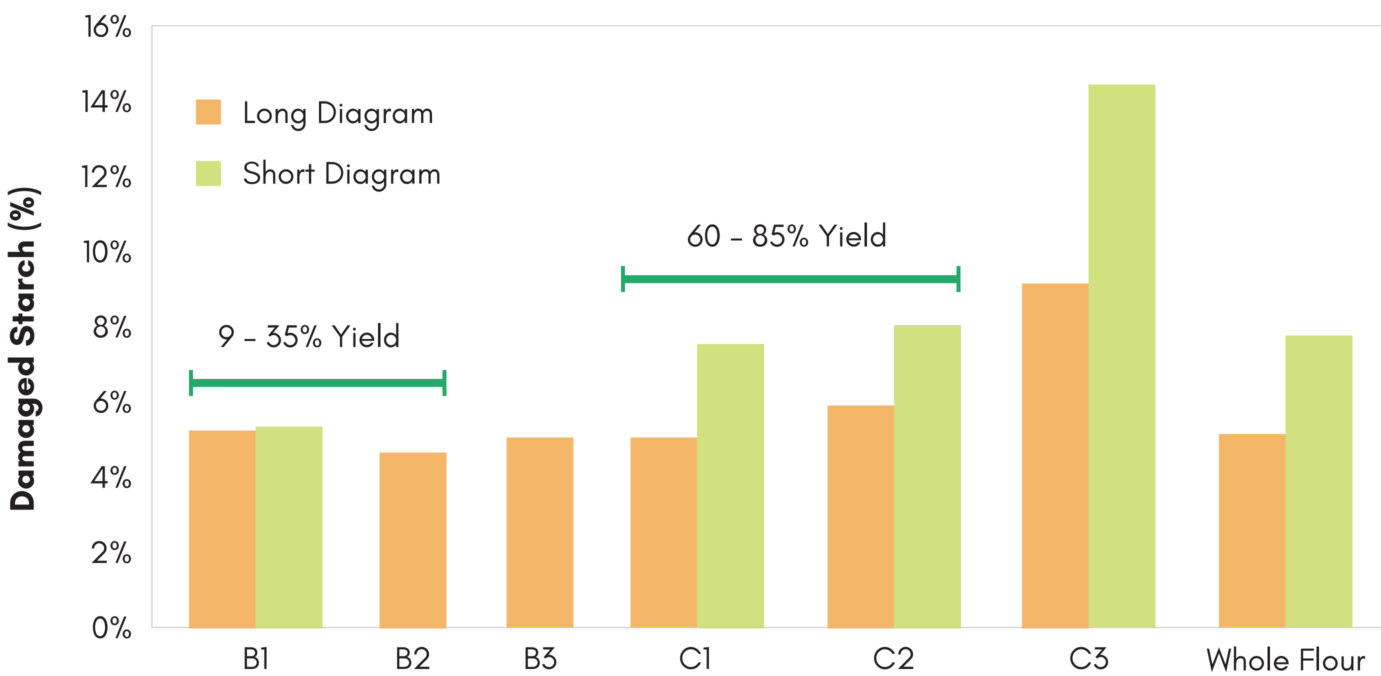

Figure 2. Damaged starch for lentil flour streams produced using long (6 passes) and short (4 passes) milling diagrams with 180 µm sieves.

Flour streams from the same milling configuration produced flours with a range of protein content.

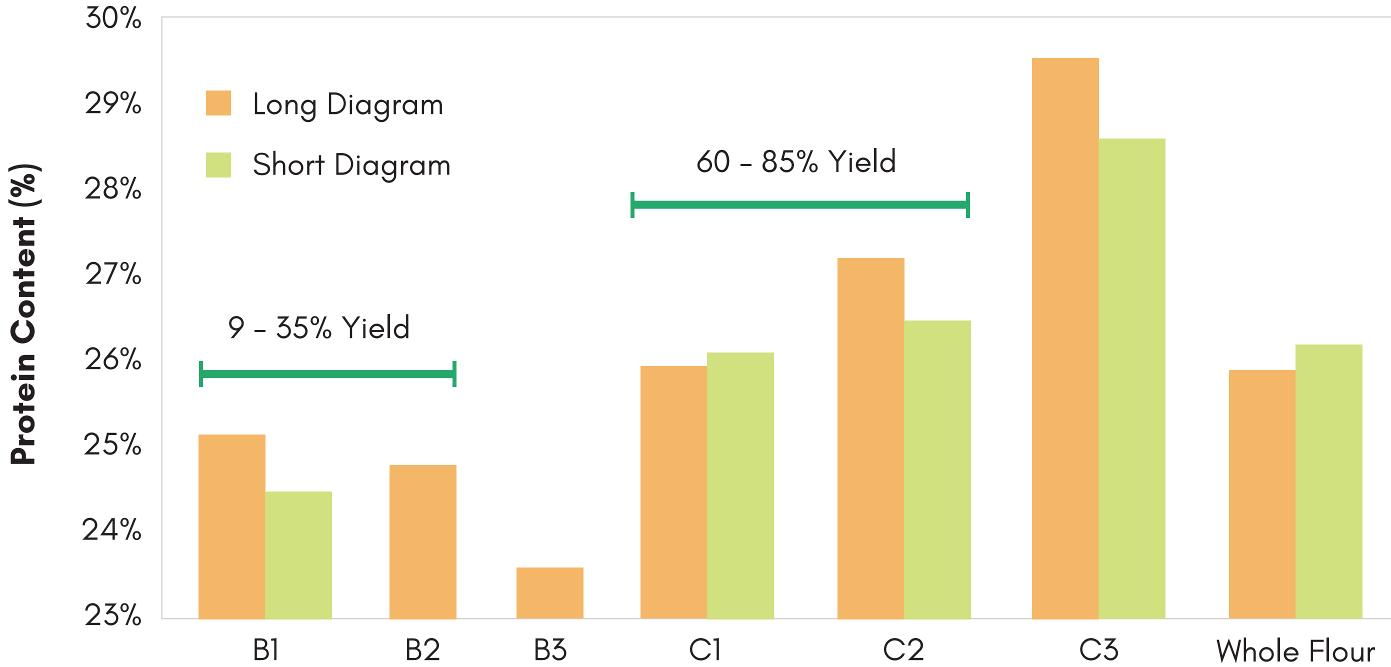

Figure 3. Protein content for lentil flour streams produced using long (6 passes) and short (4 passes) milling diagrams with 180 µm sieves.

Smaller particle size resulted in flours with higher protein content and starch damage.

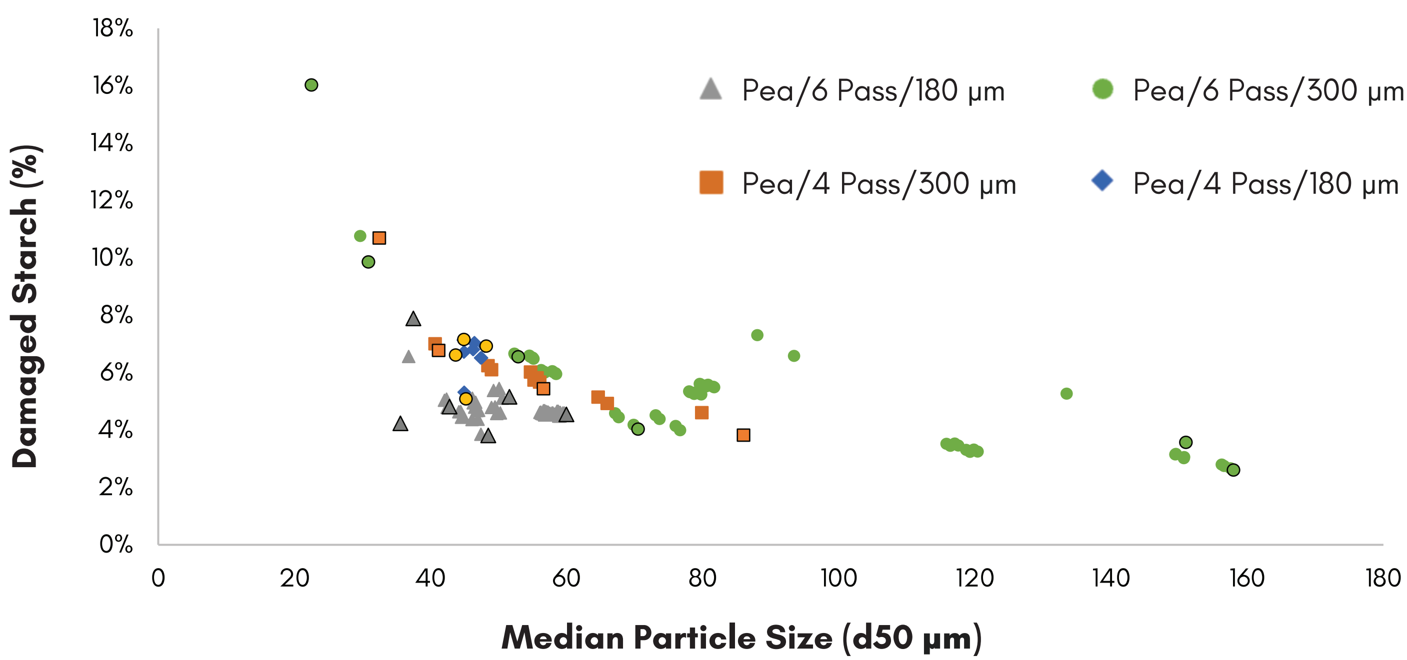

Figure 4. Relationship between damaged starch content and median particle size for pea flours milled using long (6 passes) and short (4 passes) milling diagrams with 180 µm and 300 µm sieves. Data points without a black outline represent blended streams.

The variations in chemical and physical characteristics of streams produced from the same milling configurations were related to differences in the functional properties of the flours.

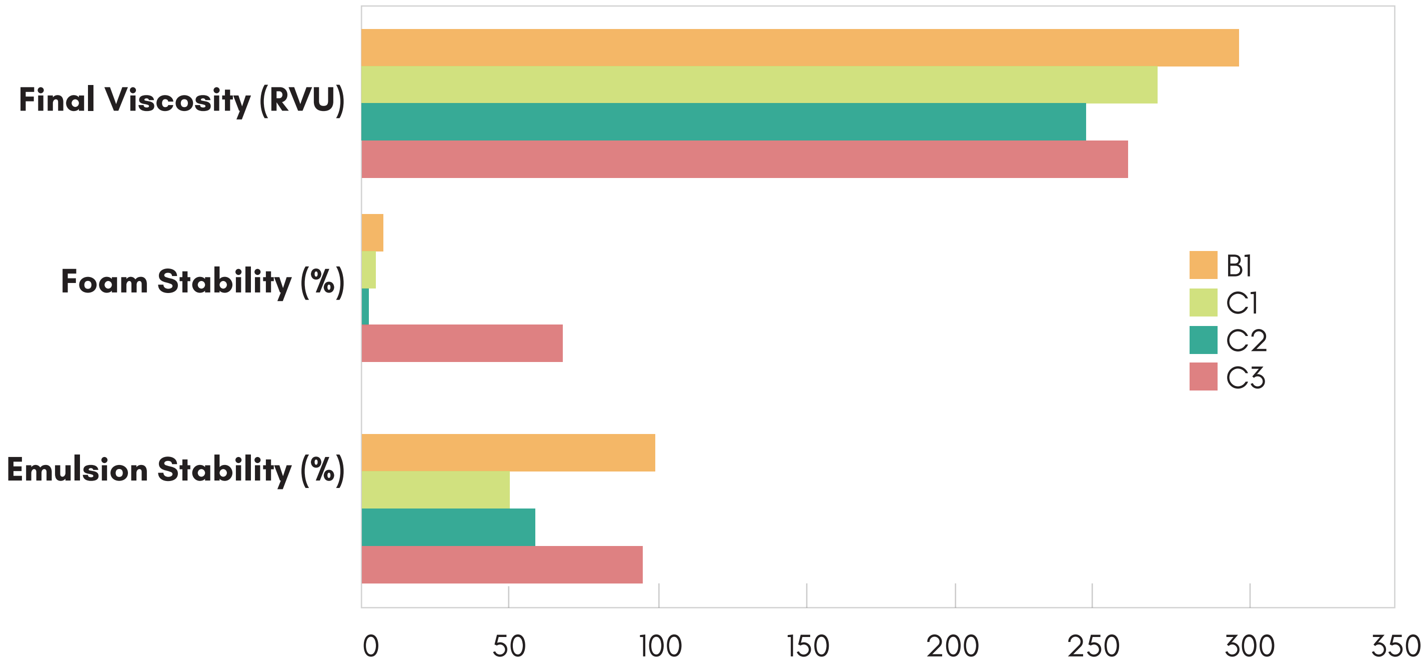

Figure 5. Variation in functional characteristics of flour streams for pea flour produced with a short (4 passes) milling diagram and sieve size of 300 µm.