



# Effect of Mill Screen Size, Air Classifier Power and Air Flow on the Yield, Protein Content and Particle Size Distribution of Dehulled Yellow Pea Flours and Protein Concentrates

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## Introduction

Richardson Centre for Functional Foods and Nutraceuticals (RCFFN) is registered by the Canadian Food Inspection Agency for the milling and air classifying of grains and oil-seeds and has considerable experience processing a variety of food ingredients including oats, peas, beans, barley and soybeans. RCFFN is motivated to improve the practical and theoretical knowledge of its pilot equipment and the impact of key processing parameters on flour specifications and yield. To this end, RCFFN undertook a systematic evaluation of the milling and air classifying parameters including mill screen size, air classifier power and air flow settings using dehulled yellow peas.

## Methods

### Milling Parameters

Dehulled split yellow peas were sourced from Avena Foods (Rowatt, SK). A portion of the peas was milled into a coarse pre grind flour with a 1 mm screen using a M-21 Prater-Sterling Impact Mill (Bolingbrook, IL). To determine the optimal particle size distribution for the air classification trials, peas were further milled using either the 0.75 mm, 0.5 mm, 0.3 mm screens. Additional milling trials included the coarse flour double milled through the 0.2 mm screen and a trial where the 0.2 mm screen was inverted.

### Air Classification Trials

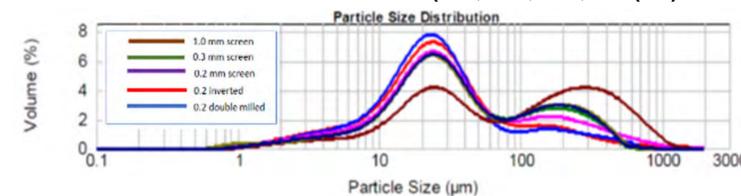
Coarse pre grind pea flour was further milled using the Prater-Sterling Impact Mill outfitted with the 0.3 mm screen connected to a MAC-0 Prater-Sterling air classifier (Bolingbrook, IL). Seven trial runs, each 22.7 kg, were processed using 15, 25, 35 Hz power settings and combinations of either 75 or 100 primary air and/or 20 and 30 secondary air setting on the air classifier. The air classifier generated a coarse and a fine fraction following each trial. Yield of the fine fractions were measured. All fine fractions were assessed for protein content using method AOAC 990.03(M) at Central Testing Laboratory (Winnipeg, MB).

**Table 1. Flour yield and particle size distributions of dehulled yellow pea coarse pre grind flour, milled at 40 Hz and 108 kg/h using various mill screens**

Screen Size (mm)	Flour Yield (%)	Particle Size Distribution (µm)		
		d(0.9)	d(0.5)	d(0.1)
1.0 <sup>1</sup>	96.8	500.7	90.6	11.5
0.75	92.5	253.5	32.9	9.0
0.5	92.5	238.9	31.3	8.5
0.3	91.6	224.1	30.1	7.8
0.2 (2x)	83.7	132.3	23.3	6.3
0.2 inverted screen	91.2	142.0	24.6	6.0

<sup>1</sup>milled at 203 kg/h from dehulled seed

**Figure 1. Particle size distribution of percent particle volume vs particle size as a function of screen size (1.0, 0.5, 0.3, 0.2(2x) and 0.2 mm inverted screen)**



**Table 2. Yield, protein content and particle size distributions of fine fractions milled and air classified<sup>1</sup> using 15, 25 and 35 Hz power settings**

Air Classifier Power (Hz)	Fine Fraction Yield (%)	Protein Content (%)	Particle Size Distribution (µm)		
			d(0.9)	d(0.5)	d(0.1)
15.0	55.1	27.8	37.3	17.4	4.4
25.0	22.3	49.6	37.7	12.5	4.2
35.0	14.7	59.9	19.4	8.6	3.3

<sup>1</sup>mill power 40 Hz, feed rate 85 kg/h, primary and secondary air 75 and 20 respectively

**Table 3. Yield, protein content and particle size distributions of fine fractions milled and air classified<sup>1</sup> using 75 and 100 primary and 20 and 30 secondary air settings**

Primary Air Setting	Secondary Air Setting	Fine Fraction Yield (%)	Protein Content (%)	Particle Size Distribution (µm)		
				d(0.9)	d(0.5)	d(0.1)
75	20	29.3	53.9	24.8	10.2	3.2
75	30	28.5	49.6	25.5	10.6	3.2
100	20	29.0	51.4	24.6	10.3	3.0
100	30	33.5	48.5	26.2	10.9	3.2

<sup>1</sup>mill power 50 Hz, feed rate 85 kg/h; air classifier power at 25 Hz

## Conclusions

- Overall, decreasing mill screen size (porosity) resulted in smaller d(0.9) values of pea flours although differences between the 0.75 and 0.3 mm screens were small
- Double milling through 0.2 mm screen resulted in the smallest particle size of pea flour among all of the screens tested
- Increasing air classifier power increased protein content and decreased the yield of the fine fraction
- Air classifier power setting of 25 Hz generated a fine fraction with acceptable yield and protein content
- Primary and secondary air settings of 75 and 20 resulted in a fine fraction with the highest protein content