Recommended Best Practices for Pulse Processing Related Pre-Competitive Research

In recent years, the use of pulse-derived ingredients, such as flours, protein concentrates/isolates, fibres, and starches has become quite popular in the food industry, for enhancement of both the nutritional and sustainability profiles of processed food products. Pre-competitive research provides an important source of information regarding the quality attributes of the ingredients made from different pulse types/varieties, as well as the impacts of production practices and processing on pulse ingredient quality and performance in food formulations. In fact, in a 2017 survey of 30 processors and food manufacturers, 77% of respondents indicated it was extremely valuable to have pulse industry associations facilitate pre-competitive research on pulse nutrition, health, sustainability, processing and utilization.

In an effort to ensure that pre-competitive research on pulses can be fully utilized and applied by industry stakeholders, and serve as a foundation and baseline for the pulse industry, Pulse Canada engaged an independent scientific consultancy to identify best practices for pre-competitive research planning and technical reporting of publicly available data. A literature search of nine databases was conducted on January 9, 2020 to identify studies that demonstrates a comprehensive level of reporting related to material source, processing conditions, and quality of final ingredient or food product. The search included research published since 2000 that focus on peas and pea-derived ingredients (i.e., pea protein, pea fibre, pea flour, and pea starch). These served as examples that could apply to all pulse types and their ingredient derivatives. Subsequently, additional publications which provided missing or supplemental information also were included, in order to provide the most robust information from which to derive "best practices" for project planning and technical reporting.

Through this systematic evaluation of existing scientific literature, recommended best reporting practices were developed for the following 4 areas of interest:

1. The sourcing of raw materials, and the reporting on use of commercially available pulse ingredients;
2. The processing parameters applied to produce the pulse-derived ingredients;
3. The methods used to characterize the physical, functional, and nutritional quality parameters of the pulse-derived ingredients; and
4. The performance of the pulse-derived ingredients in the formulation of foods.

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These recommended best practices are meant to support the development of a strong foundation of research for the pulse industry, as a whole. Pulse Canada and Member Associations encourage the research community to refer to these recommendations when developing projects, writing and reviewing scientific publications. Adherence to these recommended best practices will increase the utility and value of published research for industry stakeholders.

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TABLE 1. RECOMMENDATIONS FOR TECHNICAL REPORTING IN PRE-COMPETITIVE RESEARCH RELATED TO PULSE-DERIVED INGREDIENTS

Reporting on the origin and characteristics of whole pulses as source material

- Farm/market name and location
- Number of samples (batches or field replicates)
- Description of cultivation year and harvest conditions (e.g., year, environmental condition)
- Degree of maturation
- The starting material should be documented as fully as possible (i.e., scientific name, breed of pea, physical characteristics) and should include but not limited to:
- Nomenclature: scientific name, variety
- Cotyledon/seed colour
- Market class
- Seed shape

Reporting on the production and processing parameters applied to produce the pulse-derived ingredients

Relevant to all pulse-derived ingredients:

- Materials including amount of starting material (e.g. flour for extraction purposes)
- Condition details and yield of the process
- Equipment model and manufacturer, if applicable
- Reagents (including water and/or enzymes)
- Description of process
- Storage conditions

Specific to Pulse Flours:

- Apparatus used, feed rate, temperature, rotor speed, size of mesh sieves

Specific to Pulse Proteins:

- Pore size, molecular weight cut-off, pH, centrifugation speed, duration, temperature, flour:water ratio, drying technology
- Where applicable, results should be presented as % protein available in the flour, % protein from flour that was retained in the extracted isolate, and % protein content in the extracted product; significant differences between samples (i.e., if assessed between different locations) should also be included, where possible.

Specific to Pulse Fibres:

- Temperature, duration of heating, stirring, centrifugation, and boiling

Specific to Pulse Starches:

- Duration, filter/mesh screen size, temperature, pH, centrifugation: speed, duration, temperature, gelatinization process
- Results should be presented in terms of proportion of each fraction (i.e. prime or tailing starch or water-soluble fraction) or % yield of processing.

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Reporting on characteristics of pulse flour when used as starting material to produce fraction ingredients
• Composition of the starting and ending material • Results (i.e., composition) should be presented (mean±SD); whether results were derived on a wet or dry basis should be specified. • Methods to produce should include, but are not limited to: • Apparatus or machine used • Amount of sample tested • Reagents • Description of process conditions (i.e., temperature, centrifugation, drying, or incubation) • Nitrogen conversion factor (for protein)
Reporting on physical, functional, and nutritional attributes of pulse-derived ingredients
• Composition (e.g., protein, fat, moisture), as well as properties of the pulse products determined or confirmed prior to further processing • Amount of sample tested • Apparatus model and manufacturer • Reagents • Description of analytical conditions [e.g., temperature, pH levels, centrifugation: speed, duration, temperature, drying; staining duration (granule size) and temperature, absorption wavelength measured, size of filtration sieve, chromatography procedure, concentration/volume of glucose solution)] • Nitrogen conversion factor (for protein) • Formula used, if applicable • Process details (pressure applied, software used, temperature, feed rate) • Molecular weight cut-off, if applicable • Number of replicates • Software used for analysis, if applicable • Results should be presented in terms of mean±SD or as a % ratio (e.g., amino acid profile) or as proportions (i.e., protein secondary structure proportions, proportion of each sugar in terms of monosaccharides or the degree of polymerization) • Whether the values were on a wet or dry basis should be specified. • Morphology results can be presented in the form of a figure in which a scale and the magnification factor are reported.

Reporting on the performance of pulse-derived ingredients in food formulations
Raw Materials • Source and amount of raw materials • Compositions & properties of raw ingredients accompanied by description of analytical procedures • Number of replicates • Calculations and/or software used Preparation & Processing • Formulation/recipe and amount of sample used • Description of control and/or parameters assessed • Sample preparation procedure • Equipment model/make and applied settings (e.g. feed rate, mixing speed, dimensions, input requirements) • Process conditions (e.g. temperature, duration, pH, moisture content, cooking parameters) End Quality Testing • Storage conditions • Equipment model/make • Procedure description • Final product condition and composition (e.g. moisture content, bacterial load, pH, enzyme activity, colour) • Physical Properties (e.g. weight loss, expansion ratio, specific volume, density, viscosity, textile properties, microstructure) • Sensory/subjective analysis (e.g. palatability, acceptability, chewiness)
SD = standard deviation