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Viscous behavior of molten pea protein based foods

and

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The development of plant proteins based foods is necessary to overcome the challenges of protein transition from animal sources and of agriculture sustainability. Pulse legumes are an excellent source of protein (20-30% dry basis), starch (40-55%) and dietary fiber (10-30%). Extrusion-cooking is one of the most versatile and efficient food processes and it is extensively used in the starch based food and feed industries. At industry level, the design of high-protein expanded foods is still based on a trial/error approach. The knowledge of the rheological behavior of a molten material, under extrusion conditions, is required to model the extrusion processing and predict the transformation and structure of expanded products. The pre-shearing capillary rheometer (Rheoplast[®]), which combines a Couette system wherein a controlled mechanical treatment may be applied, and a capillary rheometer, is the most suitable technique for determining the viscous behavior of molten products. Furthermore, the elongational viscosity can be determined by applying Cogswell analysis on entrance pressure drop.

In this work, the viscosity of pea based products with different moisture contents (18–28% wet basis) was determined at temperatures 20°C below and above their melting points, by using Rheoplast[®] to stimulate extrusion. For each case, a low and a severe pre-shearing treatments, correspond to Specific Mechanical Energy between 50 and 500 J/g, was applied prior to rheological measurements. Two formulations were studied: the pea flour and the blend of pea starch and pea protein isolate, all had the protein content of 20% wet basis. Products transformation were determined by analysis of protein solubility, residual gelatinization and pasting properties. The viscous behavior was described by power-law expression: $\eta = K \times \dot{\gamma}^{n-1}$. Relationships between thermomechanical conditions and power-law parameters, and product transformation were also discussed. The obtained rheological law would enrich the database of Ludovic[®] software to simulate a twin-screw extrusion process.