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# Use of continuous pressure shockwaves apparatus in rapeseed oil processing

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**Abstract** The aim of this study was to increase the efficiency of rapeseed oil recovery by pressure shockwaves and to asses the changes related to energetical utilization of the seedcake obtained. Mass balances and several design parameters (along with their manifestations on the seedcake) were analyzed to allow further optimization of the technology. It was found that the use of pressure shockwaves, in combination with the mechanical expeller, may increase oil yields up to the theoretical 100 % maximum, or alternatively reduce expeller energy requirements while maintaining the same oil yield. Decreased amounts of oil in the seedcake correlate with reduced amounts of volatile matter, which means lower quantities of hazardous fumes generated during direct combustion. In addition, higher levels of seedcake disintegration accelerated the biogas production.

**Keywords** Pressure shockwaves · Oil recovery · Combustion · Anaerobic fermentation

## Introduction

Demand for rapeseed oil continues to rise especially due to its use for biodiesel production (Santori et al. 2012; Salvi and Panwar 2012). Conventional methods are based on crushing, or alternatively supported by enzymatic processes (Fernández et al. 2012; Newkirk et al. 2009). Also, technologies based on organic solvents, especially hexane, were in commercial operation for a long time (Rosenthal et al. 1996). In recent decades, oil extraction has further advanced in the field of supercritical conditions, like supercritical fluid extraction (Fornari et al. 2012; Reverchon 1997), immobilized lipase in supercritical carbon dioxide (Rezaei and Temelli 2001), high-pressure carbon dioxide explosion (Dong and Walker 2008), or compressed propane (Pederssetti et al. 2011). However, the supercritical conditions make the oil extraction expensive due to increased cost on machinery, energy, and sometimes also additional chemicals. In Germany, there are a large number of small- and medium-sized oil mills, with a capacity of 0.5 and 25 ton $day^{-1}$ with full pressing operations. Using supercritical conditions requires larger facilities, so mills in Germany do not use further solvent extraction (Guderjan et al. 2007). The application of pulsed electric field is a non-thermal food processing technology, which has also received increased recent interest. Once an external electric field can induce critical potential across the cell membrane, this leads to breakdown and local structural changes of the cell walls, which increase the permeability. Application of pressure shockwaves (Ammar et al. 2010; Grémy-Gros et al. 2009; Guderjan et al. 2007; Rizun et al. 2004; Lee et al. 2003; Kotov et al. 2000; Itow et al. 1998) seems to be another promising technology for the forthcoming period, but there is still not enough findings enabling its development in a commercial scale.

It was hypothesized that it would be beneficial to study rapeseed oil extraction processes enhanced by pressure shockwave including various process parameters, mass flow, etc. In addition, it was hypothesized that it would be appropriate to study the possible changes in relation to the most common methods of its use (direct combustion, charcoal production, and anaerobic fermentation).

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