Available online at www.sciencedirect.com

ScienceDirect

Agriculture and Agricultural Science Procedia 7 (2015) 255 – 259

Agriculture and Agricultural Science Procedia

Farm Machinery and Processes Management in Sustainable Agriculture, 7th International Scientific Symposium

Effects of thermal treatment of seeds on quality and oxidative stability of oils

Magdalena Kachel-Jakubowska*, Artur Kraszkiewicz, Edmund Lorencowicz, Milan Koszel, Artur Przywara

University of Life Sciences in Lublin, Department of Machinery Exploitation and Management of Production Processes Głęboka 28, 20-612 Lublin, Poland

Abstract

Sustainable development, among other things, means seeking to improve the life quality associated with raising the requirements both for farmers and manufacturers producing and processing the agricultural goods. One aspect of a healthy diet is getting the good-quality agricultural products and their correct processing to maintain the highest quality and nutritional value. For this purpose, an attempt to assess the oxidative stability of cold-pressed vegetable oils, was undertaken. We analyzed two types of oil seeds and the oil produced therefrom. The study involved winter rape seeds and pumpkin seeds. Prior to the study, seeds were subjected to chemical analysis in order to determine the water, fat and protein contents in seeds and then oils were extruded and contents of carotenoids and chlorophylls, as well as acidic and peroxide numbers were determined. Value of the oxidative stability was determined using Rancimat accelerated oxidation test applying Metrohm 670 device. Among the tested varieties of oilseeds, the highest oxidative stability distinguished the oil made of two varieties of both rapeseed (Abakus and Bellevue) and pumpkin seeds (Miranda and Olga).

Peer-review under responsibility of the Centre wallon de Recherches agronomiques (CRA-W)

Keywords: oilseeds; oxidative stability; vegetable oil; carotenoids; fat.

* Corresponding author. Tel. +48 81-531-97-31; fax: +4881-531-97-29.
E-mail address: magdalena.kacheljakubowska@up.lublin.pl

Peer-review under responsibility of the Centre wallon de Recherches agronomiques (CRA-W)
doi:10.1016/j.aaspro.2015.12.041

1. Introduction

Sustainable development, among other things, means seeking to improve the life quality associated with raising the requirements both for farmers and manufacturers producing and processing the agricultural goods. One of the requirements is to search and use the production techniques that can reduce the negative impact of an agriculture on the environment and use the natural resources in a more efficient manner, taking into account the welfare of people and animals. This idea comes not out from fashion, but also an objective economic necessity and the need to preserve life on Earth (Cymerman and Hopfer, 1998; Woś, 1998).

Due to the ever-increasing environmental pollution and ubiquitous processed foods, and fast life pace, people tend towards finding a way of healthy eating. This problem affects both the selection of an appropriate food and its processing methods. Focusing on oil plants and products obtained from them, we can say that there are two ways of their processing, particularly the oil extraction: cold and hot. The oil obtained by cold pressing generally affects better keeping of its properties. This method allows for better performance and availability of desirable nutrients such as phytosterols, carotenoids or tocopherols. Therefore, there is an increasing demand of the market dealing with cold-pressed oil, but this method is less efficient in comparison with the method commonly used in the oleochemical plants (Neđeral at al., 2012). Cold-pressed oils, due to the presence of antioxidants, are characterized by the highest oxidative stability.

The oxidative stability is an important factor affecting the quality of oil and is particularly important in the case of its use for frying due to the temperature and duration of the process. Oxidative changes occurring during frying adversely affect the nutritional value, as well as sensory qualities of a fried product. Each vegetable oil has its characteristic stability to oxidation depending on the content of fatty acids, antioxidants and other minor ingredients (Nogala-Kalucka et al., 2005; Przybylski and Eskin, 2006). The scope of any oxidative conversion in oils also depends on the storage conditions such as temperature, oxygen, light and type of packaging (Szukalska, 2003). Applying an appropriate packaging in a form of metal can or a dark-glass bottle, the access of oxygen and light is limited, which can impair the process of oxidation by singlet oxygen characterizing by extremely high reactivity – 1450 times greater than the triplet oxygen (Bartosz, 2003; Tańska and Rotkiewicz, 2003). Plant oils, e.g. rapeseed oil or pumpkin seeds oil, are the most important plant-origin fats on the global market of edible fats. Seeds of these plants and crude oil contain high amounts of bioactive compounds: polyphenols, phytosterols, tocopherols, and other antioxidants, that play an important role in the prevention and treatment of certain chronic diseases such as heart disease, neurodegenerative diseases, aging, cancer, and arthritis (Caili et al, 2006; Kim et al, 2006; Stevenson et al, 2007; Zuhair et al., 2000; Jian et al., 2005). Their presence gives a protection of the active compounds against destruction of free radicals, that are responsible for the oxidative damage of lipids, proteins, and nucleic acids (Bouzid et al., 2005; Younis et al., 2000; Ghani, 2003). Fats are the most concentrated source of energy delivered to an organism with food, as well as being a carrier of essential unsaturated fatty acids (UFAs) (Kruszewski et al., 2013). Their presence makes the plant oils are relatively unstable products that are subject to oxidation processes. They are readily converted leading to the emergence of significant adverse changes in the quality known as “fat rancidity” (Krygier, 1997; Krygiet et al., 1998).

The purpose of this paper was to compare the impact of cold-pressing oil extraction on the oxidative stability of two types of oils produced from oilseeds. The raw material for the study included three varieties of winter rapeseeds and three varieties of pumpkin seeds. In the first stage, the analysis of physicochemical composition was carried out taking into account the water, protein, and fat contents in seeds, and then the seeds were subjected to “cold pressing” to achieve the edible oil and to determine chlorophyll and carotenoids contents, as well as peroxide and acidic numbers, and to estimate the duration of oxidative stability of these oils due to oxidation.

2. Materials and methods

Experimental material consisted of 2 kg samples of seeds from two oilseed plants such as Winter rape Abakus, Bellevue and Abakus, Seed-less pumpkin Olga, Miranda and Junona. All the plants were grown in South-East Poland in Lublin Province. All the crops were collected in 2014 year. Prior the experiments seeds were dried under natural conditions and stored under laboratory conditions at 20^0C and a relative humidity of 60-70%. Determinations of fat (CLA/GC/3b/2011) and protein (CLA/PSO/13/2013) were carried out at the Central Agro-Ecological Laboratory of University of Life Sciences in Lublin. Seed moisture content was determined using a moisture analyzer Radwag max 50/1/WH (oven-dry test). Analysis of moisture was carried out during drying at the sample load of 4g at 120^0C.