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Quality indices of crude sunflower oil obtained by different methods

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Abstract

The main objective of this study was to obtain and characterize in terms of physicochemical indices the crude oil obtained by cold and hot pressing and extraction of sunflower seeds from two consecutive harvest years (2012, 2013). The results were discussed depending on the method of crude oil technology (pressing or extraction).

Quality indices were referred to moisture content, refractive index, acid value, saponification value, unsaponifiable matter, iodine value and iodine color using standard methods.

The values of the quality parameters varied with the oil processing method. So, acid value of the crude sunflower oil obtained by cold pressing was smaller than the value obtained by hot pressing. Saponification value increased from crude sunflower oil obtained by cold processing to crude sunflower oil obtained by extraction. The results indicated that cold pressing oil method to be better than other methods (hot pressing and extraction with solvent).

Keywords: sunflower seeds, cold and hot pressing, extraction, quality indices

1. Introduction

The sunflower plant originated in western North America. Sunflowers are botanically classified as *Helianthus annuus* L. Sunflower oil accounts for 8% of the world consumption of vegetable oils, and 10% of global food consumption of vegetable oils. The sunflower oil is used for home cooking oil and margarine and for industrial use (paint, cosmetics) and other purposes [1].

The oil obtained by mechanical expelling or solvent extraction is termed „crude" oil, as it contains a number of impurities. Some of the impurities, such as seed fragments and meal fines, are oil insoluble and thus can be readily removed by filtration. Others, including free fatty acids, hydrocarbons, ketones, tocopherols, glycolipids, phytosterols, phospholipids, proteins, pigments, and resins, are soluble or form stable colloidal suspensions in the oil. Most of these have unfavorable effects on the flavor, odor, appearance, and shelf life of the oil, and therefore have to be removed from the vegetable oils by chemical or physical refining processes [2].

Acceptable quality characteristics of crude vegetable oils processed by refining methods are of crucial importance in order to obtain such refined vegetable oils. Most crude vegetable oils conventionally have been obtained from oilseeds by either mechanical pressing or solvent extraction methods. Solvent oil extraction is usually applied to seeds with low oil content (<20%) [3].

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Oils are extracted mechanically either cold pressed or hot pressing (with or without a solvent). Using hydraulic presses at a maximum temperature of 172^0F performs cold pressing. Cold extraction requires that the material being pressed have a minimum fat content of 30%. Cold-pressed oils are not subject to further treatment (only filtering). The process of cold pressing leaves over in the pulp close to one third of the oil, while heat pressing will limit the loss to about 5%, and the addition of a solvent lowers it even further to 1% [4]. The most common solvent used is a solution of hexane [1]. Heat pressing is a process by which the pulp is passed through heated screw presses at a temperature of between 208-280^{0}F. The resulting oil is called by different names mainly, crude oil, raw oil, or unrefined oil. Crude oil pressed using the heat method must be subjected to several treatments before it can be used [4].

Pressed oils are sometimes commercialized separately from solvent extracted oils [5].

Cold-pressed crude oil is light yellow, hot-pressed crude oil has a brown color and refined oil is colorless. Sunflower oil is a high-quality edible oil [6].

2. Material and methods

The sunflower seeds were obtained from Romanian Western Plain area. Sunflower crude oil was obtained by cold pressed using hydraulic presses and hot pressing without a solvent. Sunflower oil manufacture involves cleaning the seeds, grinding them, pressing and extracting the crude oil from them, and further refining [1]. This method is relatively less efficient as it recovers only 70-80% of the available oil depending on the oilseed and pressure employed [7]. The sunflower extracted oil samples were obtained using an automated extractor (Velp Scientifica, Italy) with petroleum ether (1:5) by A.O.A.C. (1999) methods [8].

The following chemical determinations were carried out according to the methods described in the A.O.A.C. [8]: moisture, refractive index, acid value, unsaponifiable matter and iodine color. Weighed samples for moisture determination are placed in an oven for a specified time and temperature and are dried until they reach constant mass. Refractive index was determined using DR 301-95 Digital Handheld Refractometer by A. Krüss Optronic–Germany. Measurement of saponification value is performed according to official test methods [9]. The Wijs method was used for the determination of the iodine value [10].

All tests were performed in triplicate.

3. Results and Discussion

The seeds used to make oil are inspected and graded after harvest, and the fat content of the incoming seeds is measured. For the best oil, the seeds should not be stored at all, or for only a very short time, since storage increases the chance of deterioration due to mould, loss of nutrients and rancidity. Seeds to be stored must have low moisture content (around 10%) [1]. The moisture content of our sunflower oil seeds was 8.65% in 2012 and 8.57% in 2013.

In Figure 1 were illustrated all values of quality indices of crude sunflower oil (CSO) obtained by different method of oil technology from two consecutive harvest years (2012, 2013).

The refractive index were 1.4782 and 1.4793 from CSO obtained by cold pressing respectively 1.4821 and 1.4819 from CSO obtained by hot pressing. The refractive index from CSO obtained by extraction in 2012 and 2013 are very close values (Figure 1a).

The acid value of an oil may be used as a measure of quality. However, the acid value of the oil must not be too high, as this denotes an excessively high content of free fatty acids, which causes the oil to turn sour [11]. The acid value of CSO obtained by cold pressing was smaller than the value obtained by hot pressing because with increasing temperature increases the amount of free fatty acids extracted from oleaginous material. CSO obtained by extraction presented a very higher acid value than oils obtained by pressing (Figure 1b). These results are in agreement with the literature data [12]. The acid values of CSO are comparable for two consecutive harvest years (2012, 2013).

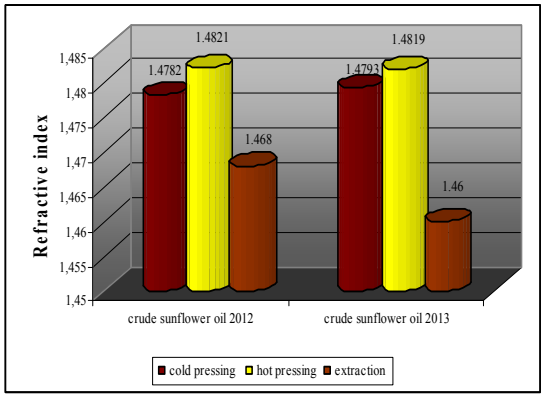
The major differences between CSO obtained by extraction and cold pressed or hot pressed oils were determined by saponification value. In the case of hot pressing, the saponification value was smaller than in the case of cold pressed thanks a higher amount of undesired substances extracted from the press, which

will be subsequently removed in the refining operation. The saponification value result (Figure 1c) was 190.4 and 193.8 mg KOH/g CSO samples obtained by extraction. This high value is an indication that the oil will not be good for soap making [6].

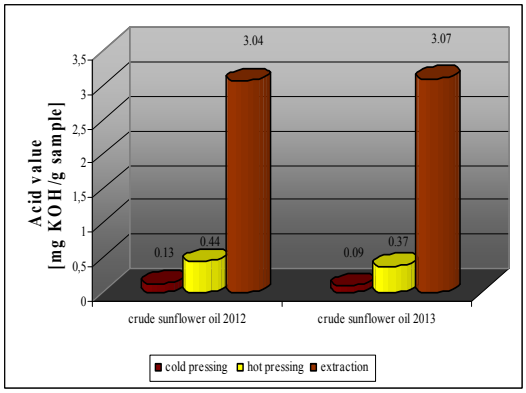
The unsaponifiable matter content in CSO is high (5%) in the case of hot pressing to cold pressing (4%) and low to solvent extraction (6%) (Figure 1d). Several studies showing that the index value is < 10% [12] or < 15% [13].

Karleskind (1992) [13] reported that iodine value in CSO varies between 118-141 g I_2/100 g, which is in agreement with our results. With an iodine value of 120 g I_2/100 g (Figure 1e), crude sunflower oil is a drying oil, which means that it is subject to severe drying on contact with atmospheric oxygen. This value is owing to the fact that the oil contain unsaturated hydrocarbon [5]. The iodine value for CSO obtained by hot pressing was slightly smaller than CSO obtained by cold pressing regardless of the harvest year.

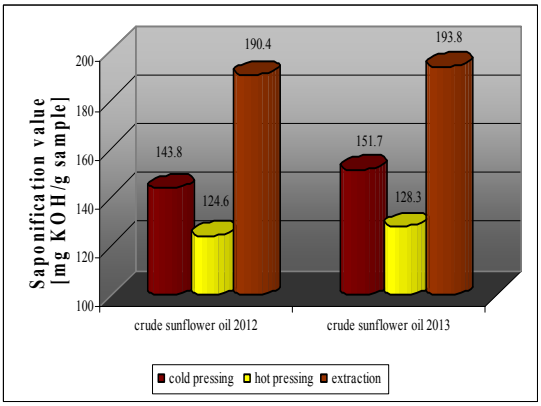
Crude vegetable oils contain various natural color substances. Color is divided into several aspects: red, yellow, green-blue (chlorophyll), and b-carotene. Darkening of the crude sunflower oils could be due to the oxidation of colorless compounds and the existing color pigments becoming fixed by overheating, depending on the extraction methods [3]. The iodine color (Figure 1f) varies between 6-11 and 8-12 mg I_2/100 mL oil for crude sunflower oil obtained by pressing, which is in agreement with other results [14].



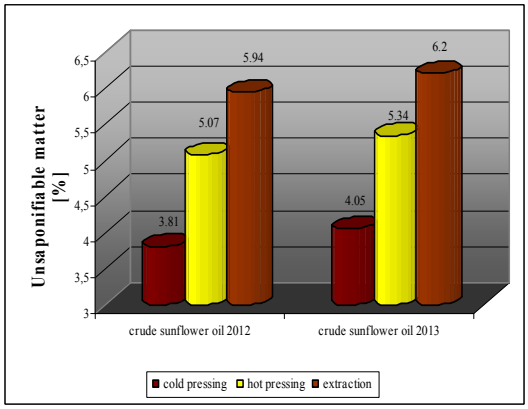
a.



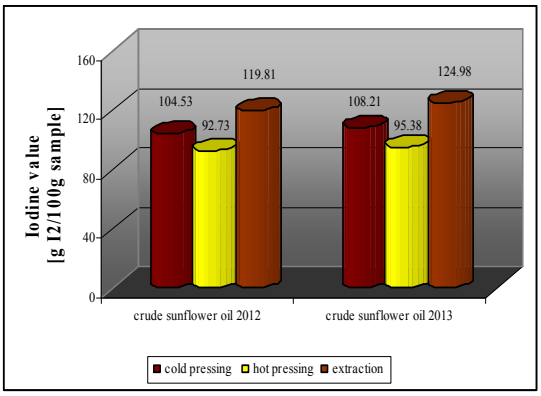
b.



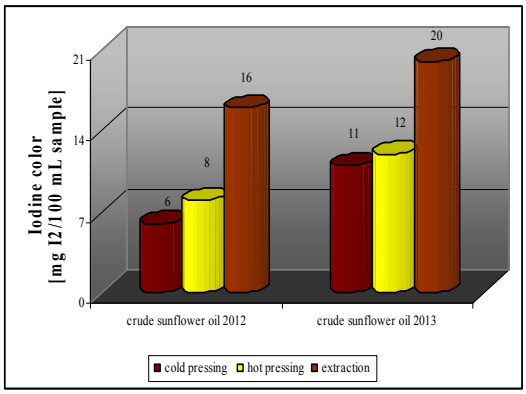
c.



d.



e.



f.

Figure 1. The evolution of quality indices of crude sunflower oil according to the method of oil technology (pressing and extraction): **a.** refractive index; **b.** acid value; **c.** saponification value; **d.** unsaponifiable matter; **e.** iodine value, **f.** iodine color

4. Conclusion

Regardless of the harvest year, all the quality parameters of the crude sunflower oil obtained by cold pressing are high than crude sunflower oil obtained by hot pressing except two indices: the saponification and the iodine values. The saponification value was 190 mg KOH/g for crude sunflower oil obtained by extraction to the 125-130 mg KOH/g for crude sunflower oil obtained by pressing. The iodine values for all samples of crude sunflower oil obtained by pressing is lower than in the case of obtained by extraction (120 g I_2/100 g) due to the accompanying substances extracted from the pressing which leading to a lower unsaturated fatty acids.

The results indicated that cold pressing oil method to be better than other methods (hot pressing and extraction with solvent).

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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