CHEMICAL CHARACTERISTICS OF SOME COMMERCIAL SUNFLOWER AND CORN OILS

CARACTERISTICI CHIMICE ALE UNOR ULEIURI COMERCIALE DE FLOAREA - SOARELUI ŞI PORUMB

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Abstract. *There were studied eight sunflower oils and one corn oil, packed in polyethylene terephthalate (PET) and commercialised in Romania, in supermarkets. The main studied characteristics were saponification, iodine, acid and peroxide values. Although the colourless-transparent PET bottle allows photo-oxidation phenomena, the analysed oils presented good and very good quality, in concordance with the standards. The analysed parameters support the information marked on labels, as composition in unsaturated fatty acids.*
Key words: refined sunflower oils, cold pressed corn oil, saponification value, iodine value, acid value, peroxide value

Rezumat*. Au fost studiate opt tipuri de ulei de floarea-soarelui şi unul de porumb, ambalate în polietilentereftalat (PET) şi comercializate în România, în supermarketuri. Principalele caracteristici studiate au fost indicii de saponificare, iod, aciditate şi peroxid. Deşi ambalajul din PET incolor-transparent permite fenomenele de foto-oxidare, uleiurile analizate au prezentat calitate bună şi foarte bună, în concordanţă cu standardele. Parametrii analizaţi susţin informaţiile de pe etichete, cum ar fi compoziţia în acizi graşi nesaturaţi.*
Cuvinte cheie: uleiuri de floarea-soarelui rafinate, ulei de porumb presat la rece, indice de saponificare, indice de iod, indice de aciditate, indice peroxidic

INTRODUCTION

Edible oils are widespread because of their traditional use in different food preparation, and also, being a valuable source of essential macro and micronutrients. They are recommended by nutritionists as substitutes of animal fats, because of their unsaturated character, in order to avoid some diseases as atherosclerosis. Most vegetable oils are predominantly composed of triacylglycerols (98–99%) and a small percent of phospholipids and micronutrients. Their unsaponifiable matter contains tocopherols, sterols and waxes (Gunstone, 2011).

Sunflower oil is preferred by most consumers in the countries without olive plantations, because of its taste, price and physicochemical properties. There are other sources for vegetal oil, as corn, pumpkin, soybean, palm, coconut, peanut, rapeseed.

Sunflower oil has a light amber colour (or pale yellow if refined) and a mild and pleasant flavour, possessing good preservation qualities. It contains 9-13% saturated fatty acids, 80-90% unsaturated fatty acids (a mixture of mono- and

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polyunsaturated, in ratio depending of the type of sunflower oil: traditional or standard, high-oleic, mid-oleic), and appreciable quantities of vitamin E, phosphatides (0.1-0.2%) - represented by lecithin and cephalin, sterols, carotenoids, waxes, squalene, and other aliphatic hydrocarbons (Balmey *et al.,* 1997).

Corn oil has a yellowish-red colour, with a typical, fresh milled corn smell and is appreciated for its role in reducing cholesterol (Howell *et al.,* 1998). It contains 12-13% saturated fatty acids, 85-90% unsaturated (25-30% monounsaturated, 57-62% polyunsaturated), vitamins: A, D, E and lecithin (Firestone, 1999).

The crude oils are usually refined in order to improve some properties (especially the smoke point) and to obtain the final product, yellow-type coloured, clear, with specific taste and smell. The smoke point is the temperature at which, under specific conditions, the oil begins to produce a visible bluish smoke and transforms into toxic compounds. Refining increases the smoke point of sunflower oil from about 107ºC to 227ºC and of corn oil from 160ºC to 236ºC (American Oil Chemists' Society, 2011).

The objective of present study was to characterize vegetable oils commercialized in Romania, in order to improve understanding of the oil quality, stability and applicability.

MATERIAL AND METHOD

There were studied 9 samples of oil commercialised in Romania, in supermarkets, eight refined sunflower oils and one cold pressed corn oil: *Unisol* (Us), *Raza soarelui* (Rs), *Vitae d'oro* (Vo), *Natur* (N), *Ulvex* (Ux), *Clever* (C), *Untdelemn de la bunica* (Ubs) – recommended for salad, *Untdelemn de la bunica pentru prăjit* (Ubp) which is a blend of 80% standard sunflower refined oil and 20% high-oleic sunflower oil, and *Ulei de porumb pentru prăjit* (Upp) – produced by Arpis, cold pressed. All oils have a total shelf life of 12 months and the expiry dates are similar among samples. They were purchased from local supermarkets at 4-5 months after production date and were analysed within 2 weeks.

The oils were commercialized in 1L colourless and transparent polyethylene terephthalate (PET) bottles.

In table 1 is presented the oils' composition in fatty acids, as it is shown on the label (only for the oils that have this information on the label).

Table 1

Oils' content in fatty acids (expressed in g/100g)

Oil	saturated	monounsaturated	polyunsaturated	total unsaturated
Unisol	12	26	62	88
Raza soarelui	11	33	56	89
Vitae d'oro	12	26	62	88
Natur	11	27	62	89
Ulvex	12	26	62	88
Ulei de porumb pentru prăjit	12	33	55	88

The saponification value (SV) was determined by AOAC method 920.160 (2000); iodine value (IV), according to Zahir *et al.* (2017); acid value (AV), according to Savu et al. (2000) and peroxide value (PV), according to the official method NF T60-220 of the Association Française de Normalisation (AFNOR, 1988) – French Normalization Association, as described by Sadoudi and Ahmed (2017). Analyses were performed in triplicate and the presented values represent means±SD.

RESULTS AND DISCUSSIONS

Saponification value (SV) of studied oils ranges between 192.2 for Untdelemn de la bunica pentru prăjit and 209.2 for Unisol (fig. 1). SV reflects the composition of the oils. It represents the quantity of potassium hydroxide (mg KOH) required for the saponification of 1g of oil. Saponification process breaks ester bonds of acylglycerols, and since every fatty acid is attached to glycerol with an ester bond, SV reflects the number of ester bonds per gram sample. Saponification value indicates the mean molecular weight of the esterified fatty acids. The smaller the SV, the longer the fatty acids' chain and bigger their molecular weight and contrary, a high SV indicates shorter fatty acids. In our case, Unisol oil contains the smallest fatty acids and the mean molecular weight of fatty acids increases in the order: Unisol, Raza soarelui, Vitae d'oro, Ulvex, Natur, Clever, Ulei de porumb pentru prăjit, Untdelemn de la bunica (Ubs), and Untdelemn de la bunica pentru prăjit (Ubp) contains the biggest fatty acids.

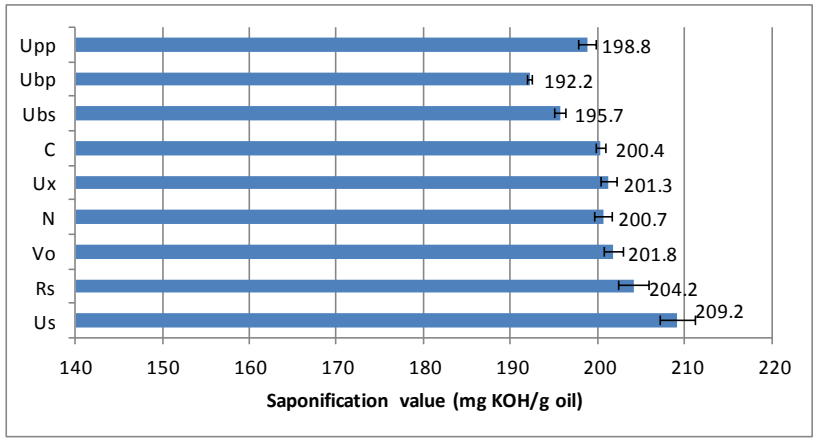

Fig. 1 Saponification values of studied oils

Iodine value (IV) indicates the degree of unsaturation of the oils. It is represented by the mass of iodine (g) absorbed by 100g oil through addition reactions at the double bonds of unsaturated fatty acids. As a measure of oils unsaturation, IV should direct correlate with the content in double bonds of the unsaturated fatty acids. Indeed, from fig. 2 we notice that the highest IVs were registered for Ulvex (127.7 g/100g) and Unisol (127.1 g/100g) and their labels indicate a high content of polyunsaturated fatty acids (62g/100g for both oils) –

tab. 1. Iodine value also correlates with the stability of oils to oxidation. Our results for IV fall within the ranges mentioned in the specialised literature: 119 – 134 for sunflower oil and 111 – 130 for corn oil (Savu *et al.,* 2000).

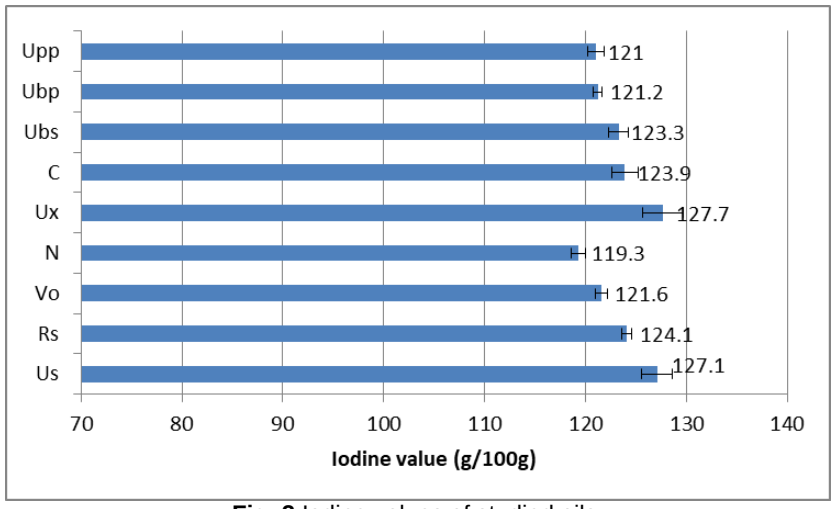

Fig. 2 Iodine values of studied oils

Acid value (AV) is an important indicator of vegetable oil quality, expressing its freshness or rancidity. It represents the weight of KOH (mg) necessary to neutralize free acids contained in 1 g of oil. The main source of free acids is the triglyceride hydrolysis, which releases glycerol and free fatty acids and occurs during processing and preservation, especially in case of high temperature and humidity. This reaction is catalysed by lipase and may be considered an indicator of inadequate processing and storage. Acid phosphates and, eventually, amino acids can also contribute to the AV.

Free fatty acids, especially with long chain, affect the oil quality because of increased susceptibility to oxidation in their free form, and can cause the decrease of smoke point. Also, their breakdown products (aldehydes, aldehydo-acids, organic acids, ketones) provide characteristic flavours and aromas, which are considered defects of oils.

The studied corn oil (Upp), which is a crude oil obtained through cold pressing technique, has AV = 3.188, which indicates its freshness, being an appropriate value for cold pressed oils, which should have AV < 4.0 (CODEX-STAN 210 - 1999). Oil refining process removes most of free fatty acids and decreases the acid value. All the studied sunflower oils, which are refined, revealed AV between 0.09 for Untdelemn de la bunica (Ubs) and 0.195 for Clever (fig. 3). As acid value for refined oils must be less than 0.6 (CODEX-STAN 210 - 1999) and in present cases, AV < 0.2, oils are very fresh and of good quality.

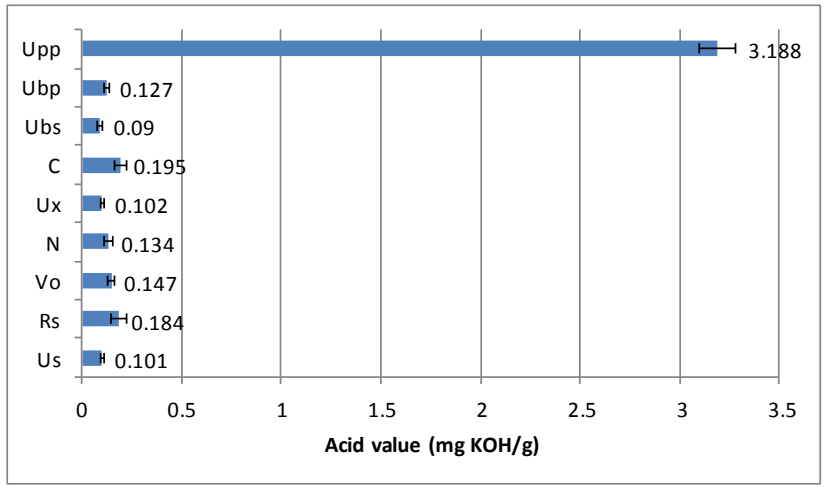

Fig. 3 Acid value for studied oils

Peroxide value (PV) is a measure of concentration of peroxides and hydroperoxides, which are the initial products of lipid oxidation. They can be formed during processing or due to rancidity, by the interaction of fatty acids with atmospheric oxygen. PV is expressed as milliequivalents of active oxygen (peroxides, hydroperoxides) per kg of oil (mEq/kg). PV is an indicator of oils' oxidative changes. The quality of the oil is influenced by the storage conditions and type of package, especially by its transparency and oxygen permeability. Previous studies (Kaya *et al*., 1993) estimated that the shelf-life of sunflower oil in retail store conditions is 10.6 months, while the storage life of sunflower oil in polyethylene terephthalate (PET) under a 10 W fluorescence lamp was 10.4 months at 10°C and 4.8 months at 20°C.

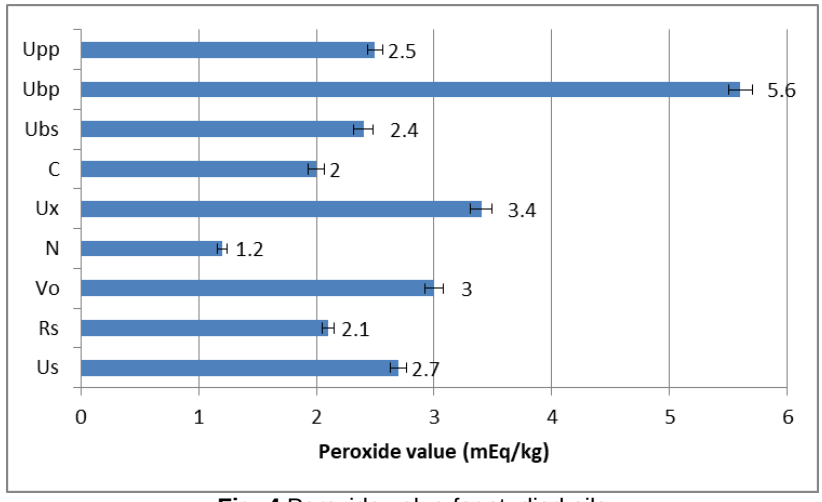

Fig. 4 Peroxide value for studied oils

The standard quality characteristics allow PV up to 10 mEq/kg for refined oils and up to 15 mEq/kg for cold pressed and virgin oils (CODEX-STAN 210 - 1999). The studied oils are in accordance with these limits (fig. 4), as refined sunflower oils have peroxide values between 1.2 mEq/kg - for Natur and 5.6 mEq/kg - for Untdelemn de la bunica pentru prăjit which is the most oxidized. The cold pressed Ulei de porumb pentru prăjit has PV 2.5 mEq/kg, which proves a very good quality.

CONCLUSIONS

1. There are no noticeable differences between cold pressed corn oil and refined sunflower oils regarding saponification, iodine and peroxide values. Only acid value is 16 – 35 folds smaller for refined sunflower oils.

2. The iodine value is in concordance with the oils' composition in unsaturated fatty acids, mentioned on the label.

3. All studied edible oils proved good and very good quality, considering the analysed parameters, which are in concordance with the standards.

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