

INVESTIGATION OF TURKISH POPPY SEEDS AND SEED OILS

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The oil yields, fatty acid compositions, and total protein contents of three varieties of Turkish poppy were investigated. Solvent extraction of yellow seed gave the highest oil yield (49.2%), while white seed (36.8%) and blue seed (33.6) showed considerably lower yields. Yellow seed was also subjected to mechanical extraction, yielding 32.3% oil. Solvent extraction of the oilcake from the press gave 17.6% additional oil. Fatty acid compositions of the oils were determined by GC/MS and major components were found to be linoleic (56.4–69.2%), oleic (16.1–19.4%), and palmitic (10.6–16.3%) depending on the color of the seeds. The values of proximate analysis, nutritional elements and heavy metals content were also reported for the most widely cultivated yellow seed.

Key words: *Papaver somniferum* L., blue seed, yellow seed, white seed, fatty acid, heavy metals, nutritional elements, seed oil, protein.

Opium poppy, *Papaver somniferum* L., is an annual herb native to Turkey and adjacent countries, having grayish-green leaves and variously colored (white, pink, red, or purple) flowers. Poppy seeds also range over a wide variety of colors, from white, yellow, brown to gray and blue [1].

Most publications refer to the narcotic properties and medical applications of the alkaloids contained in the poppy capsules. However, the utilization of the seeds is traditionally very important for the local people. The poppy has been cultivated for over 5000 years in Afyon province where the soil is not favorable for any other crop.

After lifting the total ban of poppy cultivation in 1974, the controlled production of unincised poppy capsules began with the application of a license system developed with the support of the United Nations. This system provides a very strict control mechanism covering all phases of cultivation. Harvested capsules are separated from the seeds, under inspection, and the entire yield of capsules is purchased by the state owned Opium Alkaloids Plant (20000 tons/year capacity) for the production of morphine and its derivatives.

Because of the economics of poppy cultivation, the seed has also to be utilized. The seeds and oil that can be extracted from the seed have no narcotic properties [1, 2]. They are commonly used in the food industry to decorate breads and baked goods. The valuable seed oil is widely utilized as an edible cooking oil and in the manufacture of high quality artists' paints, varnishes, and cosmetics. Oilcake is used as cattle feed.

Oil contents change considerably depending on the origins and color of the seeds. The reported values of oil contents of the seeds are between 41.4–49.1% in India [3], 47.0–53.0% in Pakistan [4], and 44.0–57.0% in Turkey [5]. Eklund and Agren [6], showed the differences between white- and blue- seeded varieties, which contained 40.0% and 33.0% oil, respectively. The fatty acid compositions of oils also show large variations even in seed samples originating from the same region [7]. The values for the principal fatty acid components (palmitic: 8.9–21.5%; oleic: 13.2–36.8%, and linoleic: 41.0–68.0%) were reported for Indian poppy seed oil [3]. The total protein content of Turkish poppy seed was measured to be 21.1% but the variety was not specified [8]. There is no previous work about fatty acid compositions and protein content of three different colors of poppy seeds grown in Turkey.

TABLE 1. Yield and Fatty Acid Compositions of Poppy Seed (Yellow, White, Blue) Oil

Seed oil	Fatty acids								Oil Yield, %
	16:0	18:0	18:1	18:2	18:3	Σ_{sat}	Σ_{unsat}	Σ	
Yellow									
Solvent ext.	12.8	2.5	17.7	65.8	0.5	15.3	84.0	99.3	49.2
Mechanical ext.	10.0	3.2	24.7	59.4	0.4	13.2	84.5	97.7	32.3
White									
Solvent ext.	10.6	2.5	16.1	69.2	0.6	13.1	85.9	99.0	36.8
Blue									
Solvent ext.	13.0	3.2	19.4	56.4	0.5	16.2	76.3	92.5	33.6

TABLE 2. Physico-Chemical Characteristics of Yellow Poppy Seed Oil

Relative Density (20°C)	0.940
Refractive index (20°C)	1.4709
Saponification value	234.0
Iodine value	139.6
Peroxide value	39.0
Unsaponifiable matter, %	1.03
Solidification point	-4°C to -8°C

In this report the proximate analysis and minor mineral content of poppy seed are presented. Then the results of solvent extraction of three varieties (white yellow, and blue seeds) and mechanical extraction of yellow seed, a widely produced variety extracted using traditional extraction techniques by local people, are reported. Finally, the fatty acid compositions of these oils and some physicochemical characteristics of mechanically extracted yellow seed oil are given.

Analysis of the seeds gave the following results: average moisture content: 6.4%, total protein contents: yellow seed 21.8%, white seed 21.9%, and blue seed 22.7%; for yellow seed: ash content 5.7%; nutritional elements (mg/kg): calcium 1.6; sodium 50.9; potassium 5.1; and heavy metals (mg/kg): copper 1.6; iron 44.8; zinc 74.5. There is a minor variation in protein content of the seeds (21.8–22.7%) depending on the color; blue seed has the highest protein content (22.7%).

Solvent extraction of yellow, white, and blue seeds yielded 49.2%, 36.8%, and 33.6% oil, respectively. There is significant difference in oil content of poppy seeds. These values indicate that the oil content of yellow seed is considerably higher than the other two varieties, while blue seed contains the lowest.

The yellow seed was also mechanically extracted, yielding 32.3% oil, and an additional 17.6% oil was recovered from solvent extraction of the oilcake from the press.

The GC/MS results of fatty acid compositions of the seed oils are tabulated in Table 1. It is seen that all three varieties contain much less stearic (2.5–3.2%) and linolenic (0.4–0.6%) acids than palmitic (10.0–13.0%), oleic (16.1–24.7%), and linoleic (56.4–69.2%) acids.

While white seed gave the highest linoleic acid content (69.2%), blue seed gave the lowest (56.4%). Moreover, white seed has the highest percentage of (85.9%) unsaturated fatty acid. Because of the rich oil (17.6%), protein (21.8%), and nutritional elements (57.6 mg/kg) content, oil cake can be used as cattle feed.

The physico-chemical characteristics of yellow seed oil obtained by mechanical extraction are given in Table 2. Our results are in good agreement with the previously reported data [9].

EXPERIMENTAL

Three varieties of poppy seed were purchased from the Afyon region. Since the yellow seed is the most widely produced in Turkey, in this work we mostly focused on the yellow poppy seed.

The moisture content of the seeds was determined by a volumetric apparatus, ash content by standard methods [10], and total protein content by the Kjeldahl method. Heavy metals contents (Cu, Fe, Zn, Cr) were determined by a Varian spectra A 250 Plus Model Atomic Absorption Spectrophotometer, and nutritional elements (Ca, Na, K) by an Eppendorf ELEX 6361 Flame Photometer [10].

Crushed seeds were subjected to Soxhlet extraction using hexane for 8 hours. Yellow seed was also mechanically extracted in a 5.5 L capacity hydraulic press, rated at 60 tons pressure. The amount of residual oil in the pressed oilcake was determined by Soxhlet extraction. All the oil yields were calculated on dry material basis. The data reported are the mean values of three replicates of each color of poppy seed.

Oils were converted to methyl esters using 14% BF₃ in methanol solution [11]. The fatty acid compositions of the seed oils were determined by GC/MS. A library search was carried out using the Wiley GC/MS Library. The mass spectra were also compared with those of reference compounds and confirmed with the aid of retention indices from published sources. Relative percentage amounts of the separated compounds were calculated from total ion chromatograms by a computerized integrator. The GC/MS analysis was carried out using the Hewlett Packard GCD system. An innowax fused silica capillary column (60 m × 0.25 Ø, 0.215 µm) was used with helium as carrier gas (flow rate 1 ml/min), split ratio 1:60. MS were taken at 70 eV. The injection temperature was 250°C and the oven temperature was kept at 60°C for 10 min and programmed to 220°C at a rate of 4°C/min and kept at 220°C for 10 min then increased to 240°C at a rate of 1°C/min.

Various physico-chemical properties of yellow seed oil, i.e., relative density (20°C), refractive index (Abbe's, 20°C), saponification value, iodine and peroxide values, unsaponifiable material, and solidification point, were determined according to the standard procedures [11].

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