Characteristics of Pumpkin Seed Oil

V.V. MARKOVIC and **L.V. BASTIC**, Center for Fats and Oils,
Yugoslav Institute of Meat Technology, Kacanskog 13, 11000 Belgrade, Yugoslavia

ABSTRACT

Eighteen samples of pumpkin seed oil were examined and the following indices determined: specific gravity, refractive index, saponification number, iodine value, unsaponifiable matter, free fatty acids, and peroxide value.

INTRODUCTION

Among the edible oils produced in Yugoslavia, pumpkin seed oil has a special place. In our country, it is produced only in certain districts—Slovenia, Macedonia, Medjumurje, and Slavonia—and its production is of semi-industrial character. This oil is still highly appreciated in these districts, as is partially confirmed by its high price in relation to other edible oils and by the fact that it has been produced even on private husbandries. According to Schormuller (1), larger quantities of pumpkin seed oil are produced in Austria, Hungary, and southern parts of the USSR.

Raw material for the production of this oil is the pumpkin seed, which remains after the removal of pump from the pumpkin fruit. The pumpkin belongs to the Cucurbitaceae family, which includes *Cucurbita maxima, C. pepo, C. moschata, C. ficifolia,* and *C. turbaniformis.* The first 2 species are cultivated in Europe. It is claimed that *C. pepo* is more persistent and less liable to deterioration, which certainly is reflected in the quality of the obtained oil (2). In Yugoslavia, the pumpkin seed ripening without husk, known as "golica" or "Cermakova beskorka," is also a very important raw material for the production of this oil. Such seed has high oil content, 42-49% (3) vs. 30-40% for ordinary varieties. Its cake remaining after pressing has considerable protein content and low cellulose content and, therefore, is highly valuable as feed.

Besides its application in the production of edible oils, pumpkin seed is recommended in the literature (4) as a protection against colworm, tapeworm, seasickness, and interruption of pregnancy.

The production of pumpkin seed oil is specific and different from the obtainment of oil from other oilseeds, and it will be presented in brief. The first step in the processing of pumpkin seed is cleaning, when all impurities are removed. The pumpkin seed is then husked. In this step, attention should be paid to the complete removal of husk from the kernel, since heated husk renders a very bad taste to the oil. The husked kernel is then ground on cylinder mills to prevent too intensive grinding, which results in more difficult work during further processing operations. The ground material is wetted until the proper consistency of dough is obtained. The dough is then heated for a certain period of time at temperatures established empirically from past practice. Because the entire procedure is empirical, heating time is also left to workers' experience. They determine the necessary time on the basis of the consistency and color of the heated dough. However, we think that attention should be paid to heating temperatures, since oxidation of oil and, consequently, its deterioration can occur. This procedure was not scientifically examined, although, in our opinion, it plays an essential role in the obtainment of oil quality. After heating, the dough is pressed by hydraulic presses which expel the majority of oil. Ca. 12% of oil remains in cakes, which are used for animal feeding and as a substitute for spices (5). The obtained oil is clarified by settling in special tanks.

Raw pumpkin seed oil is green, whereas the color of oil obtained from heated pumpkin seed kernel ranges from dark red to dark brown. In Yugoslavia, the latter is used in unrefined form; however, it is known (2) that lightly colored oil of very good quality can be obtained by modern technological procedures. The dark red to dark brown color of this oil is the result of higher content of chlorophyll and carotenoids, due to which it differs considerably from other oils. It has a characteristic odor and taste, the consequence of its composition and specific method of production. It is used as edible oil, especially in the preparation of some salads, giving them a very agreeable taste. It is used alone or mixed with other edible oils.

The literature data on pumpkin seed oil are not numerous because it is produced only in particular districts. Its characteristics, based on the available literature data (1,6-8), are presented in Table I.

When the Codex Alimentarius Commission prepared standards for all edible oils, it did not include pumpkin seed oil, explaining that countries producing and using this oil did not comply with their request. Consequently, this work represents a small contribution to better knowledge of this specific oil. Until now, published works on the quality of pumpkin seed oil point to the usefulness of such examinations.

TABLE I

Characteristics of Pumpkin Seed Oil[a]

Characteristics	Sample				
	(6)	(6)	(1)	(7)	(8)
Specific gravity (20 C)	0.9159	0.9179	0.903-0.909+[a]	0.919-0.926	–
Refractive index (20 C)	1.4737	1.4714	1.466-1.469+	–	1.4741
Saponification number	174-196.5	189.4-191.5	185-198	195-197.1	190.8
Iodine value	116-120	121-132.6	117-130	133.4	116.4
Unsaponifiable matters	0.6-1.8	0.5-1.06	0.6-1.5	–	0.8
Acid number	4-12	0.5	–	–	0.7
Fatty acid composition					
Palmitic	7-12	12.85	7-13	–	13.1
Stearic	6-7	6.21	6-7	–	3.9
Arachidic	–	0.03	traces	–	–
Oleic	24-41	37.05	24-41	–	26.6
Linoleic	48-57	53.86	46-57	–	56.4

[a]From the literature.
[b]+ 40 C.

TABLE II

Ultraviolet Absorption

Sample number	Peroxide value (mmol/kg)	$E^1_{1\ 232}$[a]	$E^1_{1\ 270}$[a]	$R = \frac{E^1_{1\ 232}}{E^1_{1\ 270}}$
1	4.70	8.25	4.42	1.86
2	4.20	9.00	3.85	2.33
3	2.87	7.08	2.08	3.40
4	4.39	7.74	2.31	3.35
5	3.39	8.00	2.34	3.41
6	3.54	7.46	2.26	3.30
7	1.31	7.00	1.92	3.64
8	1.10	6.90	1.88	3.67
9	1.46	6.41	1.73	3.70
10	1.71	6.17	2.33	2.64
11	1.44	6.50	2.39	2.71
12	1.32	6.63	2.50	2.65
13	0.88	6.23	2.23	2.79
14	1.06	6.20	2.32	2.67
15	5.00	6.67	3.46	1.34
16	5.80	7.15	2.31	3.09
17	1.99	6.96	3.21	2.16
18	3.27	6.32	2.83	2.22

[a]E = Specific extinction at 232 and 270 nm.

TABLE III

Ultraviolet Absorption for Different Oils

Sunflower oil				Olive oil				Pumpkin seed bil			
PV[a]	E_{232}[a]	E_{270}[a]	R[a]	PV	E_{232}	E_{270}	R	PV	E_{232}	E_{270}	R
10.30	4.93	0.51	9.60	9.90	3.32	0.65	5.10	9.60	8.88	1.99	4.40
7.10	4.11	0.71	5.78	8.11	3.24	0.31	10.45	7.20	7.65	2.11	3.60
5.60	4.10	0.43	9.50	5.50	3.15	1.39	2.20	5.60	7.23	2.45	2.90

[a]PV = Peroxide value in mmol/kg; E = specific extinction at 232 and 270 nm; $R = \frac{E^1_{1\ 232}}{E^1_{1\ 270}}$.

EXPERIMENTAL PROCEDURES

Samples for examination were obtained from a commercial center and directly from producers.

The samples from the commercial center are numbered 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 16 and present 5 manufacturers. From the same manufacturers, we requested samples directly from production; these are numbered 1, 3, 15, 17, and 18. All the examined oils were produced in the period January-June, 1972, but we have no data on the seed growth location.

We centered our examinations on the following physicochemical characteristics determined by the methods cited: specific gravity (9), refractive index (10), iodine values (11), saponification number (12), free fatty acids (13), peroxide value (14), unsaponifiable matter (15), and ultraviolet absorption ($E^1_{1\ 270}$ and $E^1_{1\ 232}$ [16]).

RESULTS AND DISCUSSION

The results obtained indicate that characteristics of pumpkin seed oil samples are in agreement with current published values for these indices.

The obtained values for specific gravity (0.9201-0.9210) and refractive index (1.472-1.474) are almost the same as the literature data for pumpkin seed oil of different origin. It is well known that higher deviations from these values point to hydrolytic and oxidative changes. In our results, such differences were not observed and, therefore, it can be presumed that a specific method of production does not have such a high influence on hydrolysis and oxidation of this oil.

The iodine value ranges from 121.0 to 126.0. Such iodine values undoubtedly indicate high unsaturated fatty acid content. The saponification number, varying from 185.5 to 195.3, shows that among fatty acids present in the examined oil, more of them have a higher number of carbon atoms. This fact, connected with the iodine value, shows that more detailed examinations of the composition of fatty acids present in this oil are of interest.

Regarding the content of free fatty acids, which did not exceed 2.07%, and keeping in mind that unrefined oil is in question, it can be said that the quality of oil is satisfactory. The peroxide value (Table II) also ranges within the limits we adopted as satisfactory. According to the proposal of the Codex Alimentarius Commission, peroxide value for unrefined olive oil may be maximum 20 meq/kg. Because the pumpkin seed oil is also an unrefined oil, we believe that analogy here is possible. Our results are far below 20 meq/kg, which is especially characteristic considering the way pumpkin seed oil is producted in our country. The content of unsaponified matters ranged from 0.50 to 0.73%. According to the literature, this value can be considerably higher. In any case, the method of production, as well as the literature data on the use of this oil for therapeutic purposes, suggest the necessity of examining the composition of unsaponifiable part of the oil.

Spectrophotometric examination of the behavior of this oil in ultraviolet range of the spectrum gives very interesting data. Since in the available literature we did not find any data on spectrophotometric examination of pumpkin seed oil, we think that it would be especially interesting and could be accepted as orientation data in our further examinations. Table II presents extinctions at wavelengths of 232 and 270 nm, as well as their relation or R-value. In general, pumpkin seed oil has considerably higher values for specific extinction in ultraviolet range of the spectrum, at both wavelengths, than other vegetable oils. In our previous

work (17), we compared the values for specific extinction at 232 and 270 nm and the R-values obtained in pumpkin seed oil, sunflower oil, and olive oil. As an example, some of the obtained values are given in Table III. From this data, it can be seen that oils having ca. the same peroxide values show different values for specific extinction, the highest ones being obtained for pumpkin seed oil. In addition, R-value is higher if secondary oxidative changes are lower, i.e., the value for specific extinction at 270 nm.

In the present work, we have confirmed our previous observations. All of our obtained results indicate applying this method in any evaluation of oil quality. Because of the complexity of fat and oil oxidation, gathering as much data as possible following this phenomenon seems quite justifiable.

Finally, we can conclude that our preliminary examinations suggest the possibility of more universal application of pumpkin seed oil, and our future examinations will be so directed. Determination of fatty acid composition and examination of unsaponified part of pumpkin seed oil will, in any case provide some answer regarding the real quality of this oil.

REFERENCES

1. Schormuller, Y., "Handbuch der Lebensmittelchemie, Band IV Fette und Lipoide," Springer Verlag, Berlin, Germany, 1969, p. 53.
2. Vatta, J.B., "Vpliv proizvodnih postopkov na kvaliteto vucnega olja," Diplomski rad, Univerzitet u Ljubljani, Ljubljani, Yugoslavia, 1958, p. 4.
3. Wachs, "W., "Ole und Fette," Vol. 2, Verlag Paul Parey, Berlin, Germany, 1964, p. 14.
4. Hoppe, H.A., "Drogenkunde," Cram de Grayterslo, Hamburg, Germany, 1958, p. 295.
5. Kaufmann, H.P., "Analyse der Fette und Fettprodukte," Springer Verlag, Berlin, Germany, 1958.
6. Ecky, E.W., "Vegetable Fats and Oils," Reinhold Publishing Co., New York, NY, 1954.
7. Grun, A., "Analyse der Fette und Wachse," Springer Verlag, Berlin, Germany, 1929, p. 164.
8. Popov, A., and A. Dusev, "Isledovanija vrhu blgarskite maznini i drugi lipidi," Otdel za naucnotechniceska, ikonomiceska i patentna informacija, Sofija, Bulgaria, 1972, p. 54.
9. J.P. Wolff, "Manuel d'analyse des corps gras," Azoulay, Paris, France, 1968, p. 219.
10. Ibid., p. 221.
11. "Official and Tentative Methods of the American Oil Chemists' Society" Vol. I & II, Third Edition, AOCS, Champaign, IL, 1964 (revised to 1972), Method Cd 1-25.
12. Ibid., Method Cd 3-25.
13. Ibid., Method Ca 5a-40.
14. "Deutsche Einheitsmethoden Zur Untersuchung von Fetten, Fettprodukten und Verwandten Stoffen," Wissenschaftliche Verlagsgesellschaft, Stuttgart, Germany, 1950, Method C-VI 6a (57).
15. Wolfe, J.P., "Manuel d'anlyse des corps gras," Azoulay, Paris, France, 1968, p. 163.
16. Ibid., p. 259.
17. Markovic, V, and L. Bastic, Bilten – Biljna ulja i masti 9(2) (1972).

[Received May 12, 1975]

ADDENDUM

After completion of the analyses reported in this manuscript, we determined the fatty acid composition of pumpkin seed oil by gas liquid chromatography (GLC), but not with the samples used in the original work. The GLC results are shown in Table IV.

TABLE IV

Composition of Fatty Acids

Fatty acid	Sample (%)		
	A	B	C
Palmitic	11.2	11.2	11.2
Stearic	5.0	5.3	5.0
Oleic	27.1	28.1	30.4
Linoleic	56.7	55.5	53.4

[Addendum received August 28, 1975]