Colour and sensory properties of the mixed edible vegetable oils

Received for publication, February 15, 2007
Accepted, April 5, 2007

JOVANKA POPOV-RALJIĆ[1], KATALIN ŠMIT[2], ALEKSANDAR ŽIVKOVIĆ[2], IVANA LUKIĆ[2]

[1]Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11000 Belgrade, Serbia [2]Factory of Edible Oils and Vegetable Fats "Sunce", Sombor, Serbia and Montenegro
jpopov@agrifaculty.bg.ac.yu

Abstract

The quality of mixed vegetable oils (combinations of the corresponding percentual mixtures of the refined edible sunflower oil and of the extra virgin olive oil) was evaluated from a sensorial point of view. The evaluations were performed by the board of ten experienced evaluators, using the so-called "ranging test" (ISO 8757: 1998 E). The results of the sensory evaluation (appearance – colour, odour and taste) were statistically elaborated using Friedman's test. Having in mind the objectification of colour assessments, colour characteristics were determined instrumentally (lightness, nuance, saturation), and the results were expressed in the forms of CIE, CIELab, ANLAB and Hünter systems.

Keywords: vegetable oils, sunflower oil, extra virgin oil, properties, sensory quality analysis

Introduction

One of the main reasons of mixing of the refined and non-refined edible vegetable oils is the obtaining of the final products having the desirable, mild or reinforced – specific flavour and standard quality. From consumer's point of view, in the overall estimation of quality of edible mixed vegetable oils, as well as of other nutritional products, sensory analysis (appearance – colour, odour and taste) takes the 1st place (1, 4, 6, 7, 8, 9, 11).

According to the Rule Book for the quality of oils (2), the edible vegetable oils must be characterized by attractive odour and taste, which are inherent to the raw materials, or which are neutral, without the off flavours and rancidity.

Having in mind that the mixed edible vegetable oil is obtained by mixing of the cold – pressured nonrefined edible vegetable oils, virgin edible vegetable oils and of the refined edible vegetable oils, the producers have to solve a great claim to produce stable oil, having the high prima quality, especially with respects to their colour, odour and taste.

Colour is the most important quality characteristic, and because of that, it occupies the greatest attention. A number of different factors express their influence on the confidence of the obtained results: training of the evaluators, standardized source of light, corresponding environment of the observed sample, capability of memorizing of colours, repeatability of the measurements, etc. Only the defined and chosen evaluators possess the capability of colour evaluations (4, 6, 7, 8, 9). Generally, all evaluators must have similar levels of the knowledge and all have to pass tests for selection, training and verification of their capabilities (12).

This work included the evaluation of sensory characteristics (appearance – colour, odour and taste) of three best mixed edible vegetable oils, which were accompanied by instrumental determination of colour with the photoelectric three-stimulus colorimeter "MOM – colour 100". With the aim of comparisons at the same time, were assessed the colours of the 100% pressed and refined sunflower oil and of extra virgin olive oil.

Methods

In the oil- and vegetable fats factory "Sunce" – Sombor the following samples were produced:

1 – 100% pressed and refined edible sunflower oil
2 – Virgin olive oil – extra virgin
3 – 90% refined edible sunflower oil + 10% extra virgin olive oil
4 – 85% refined edible sunflower oil + 15% extra virgin olive oil
5 – 80% refined edible sunflower oil + 20% extra virgin olive oil

A methodology of sensory evaluation (colour, odour and taste) was applied in accordance with the "rang test", ISO 8587: 1988E (3).

The obtained results were statistically analyzed according to the Friedman's test (4).

Colours of the analyzed samples were determined on the three-stimulus colorimeter "MOM-colour 100", and the results were expressed in the CIE (Y – average reflectance, %; λ – dominant wavelength, nm; and Č (colour purity, %), as well as in the CIELab (L* - psychometric light, a* - psychometric tone and b* – psychometric chroma) and in the ANLAB and Hünter's (n = 10) systems (5).

Results

The "rang test" is most frequently applied in the situations where samples, in frames of the analyzed serried, have to be ranged, i.e. distributed according to the level of distinction of one or of several properties, or, according to the overall sensory quality (appearance – colour, odour and taste). The more important characteristics and the possibilities of application of this method are defined by the international standard (3). First, the results of all evaluators are by the organizer (board manager) inscribed into "non-coded" and after that, in the "decoded" summary list, which is shown in the Table 1.

Table 1. Ranging method – "DECODED" list of results of evaluation of the mixed edible vegetable oils

Panel member:	Sample code			Sum of ranges with respect to number of samples
	3	4	5	
1	1	2	3	6
2	3	2	1	6
3	1	2	3	6
4	2	1	3	6
5	1	2	3	6
6	2	3	1	6
7	1	2	3	6
8	3	2	1	6
9	1	2	3	6
10	3	1	2	6
Sum of ranges for a sample	18	19	23	60

On the bases of ranging of the samples of mixed edible vegetable oils (i.e. of the combinations of the corresponding percentual mixtures of the refined sunflower oil and of the virgin olive oil – extra virgin), Friedman's value F (Friedman, 1937; cit. ISO 8587:1988E) (3) was calculated as:

$$F = \frac{12}{JP(P+1)}\left(R_1^2 + R_2^2 + \ldots + R_p^2\right) - 3J(P+1)$$

where J represents a number of evaluators (panel members), P means a number of samples, and R1, R2, …Rp are sums of the corresponding ranges.

Accordingly: J = 10; P = 3, $R_1 = 18$, $R_2 = 19$ and $R_3 = 23$

With this data, the calculated Friedman's value is

F = 1.40

Respecting the fact that the calculated F value was bellow the corresponding table values (3, 4), one could make a conclusion that the differences between the analyzed samples of the edible vegetable oils were not statistically significant, neither on the level of $p < 0.05$, nor on the level of $p < 0.01$.

The second part of the experiments included the evaluations of colour with the three-stimulus photoelectric colorimeter "MOM – colour 100".

The results of the experimental determinations of colours are given in the Table 2.

Table 2. Results of the instrumental determination of edible oil samples characteristics obtained by the "MOM – colour 100"

System of the colour defining	Colour quality parameter	The examined groups of samples				
		1	2	3	4	5
CIE	Y (%)	26.57	17.92	25.92	19.47	19.44

	λ (nm)	567	571	569	570	572
	Č (%)	16.84	69.56	21.28	35.48	43.48
CIELab	a*	-5.63	-9.76	-7.18	-8.29	-8.35
	b*	13.80	46.74	19.47	23.75	28.83
	L*	58.37	57.96	57.96	51.23	51.19
	ΔL_{ab}	-33.68	-34.29	-34.29	-41.02	-41.05
	ΔH_{ab}	3.28	4.05	4.05	4.56	5.18
ANLAB	A	-5.22	-8.86	-6.64	-7.56	-8.35
	B	12.70	42.21	17.83	21.42	25.97
	L	52.91	44.55	52.35	46.20	46.17
	ΔE_{AN}	34.26	58.30	37.05	44.22	46.67
Hünter	a_{Hu}	-4.63	-7.41	-5.86	-6.42	-7.08
	b_{Hu}	10.38	23.67	13.93	15.34	17.76
	L_{Hu}	51.54	42.33	50.91	44.12	44.09
	ΔE_{Hu}	39.96	53.43	41.68	48.59	49.48

Discussion

Based on the sensory analyses of the colour quality, by ranging procedure, as sensorially most acceptable sample, sample coded as 3 could be considered.

According to the results obtained by the instrumental measurements, we can conclude that between the samples 1 and 2 exist distinctive differences with respect to colour lightness, as well as with respect to the colour nuances and colour purity, i.e. saturation of colour. These results were expected, bearing in mind the fact that the sample 1 was whole (100%) pressed and refined sunflower oil, and the sample 2 – virgin olive oil "extra virgin" (1, 2). Therefore, the sample 1, based on the calculated value of the dominant wavelength belonged to the yellow-green part of the spectrum, and the sample 2 – to the greenish-yellow one [all based on the chromaticity diagram (4)]. According to the literary data (1, 11), colour of the vegetable oils depends on several factors, primarily on the kind and quantities of pigments. Exactly this statement was confirmed with the calculated values of the psychometric tone (a*) and chroma (b*). Considering the characteristics of the colour quality of the mixed edible vegetable oils, we can freely say that the sample 3 had approximately similar calculated and recorded values in all the four systems of defining of colour (CIE, CIELab, ANLAB and Hünter) as the sample 1. Therefore, the analyzed sample of the mixed edible vegetable oil 3 belongs to the same part of yellow-green part of the spectrum, having the similar colour brightness, but the greater colour saturation, if compared with the sample 1. Samples 4 and 5 are, based on the defining of colour characteristics, i.e. of colour lightness, similar: Y = 19.47% and Y = 19.44% respectively. Based to the calculated values for the dominant wavelength, they belong to the same region of spectrum – greenish-yellow, and with respect to colour saturation, the sample 5 had the greater colour purity. If compared with the sample 2 (virgin olive oil "extra virgin"), mixed edible vegetable oils 4 and 5 possessed the greater colour brightness, similar colour nuances, but colour saturation, i.e. colour purity, was less for the sample 5. For the better illustration of the just described results of the instrumental measurements of the refined, as well as of the non refined and of mixed edible vegetable oils, complete results are shown graphically, figure 1, 2, 3 (CIE) and 4 (CIELab system).

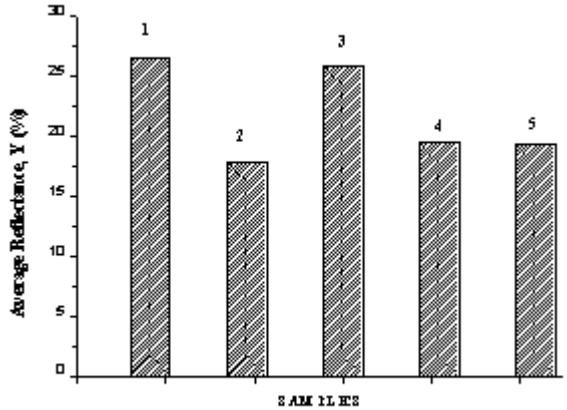

Figure 1.

Conclusions

In industrial conditions ("Sunce" – Sombor) a new product – mixed edible vegetable oil, was produced, having desirable mild, or enhanced flavour and standard quality, what was one of primary goals of the development of mixing of the refined and of non refined edible vegetable oils. Based on the results of sensory analyses, as the sensory most applicable sample was determined a sample coded as 3, followed with sample coded by 4, and at last, with sample coded as 5. Results of instrumentally determinations of colour characteristics (brightness, nuance and saturation) confirm this, just quoted remark. Namely, very similar colour characteristics had: analyzed control sample 1 (100% pressed and refined sunflower oil) and the sample 3 (a combination of 90% of refined sunflower oil and 10% of virgins' olive oil "extra virgin"), as well as the sample 2 (virgins' olive oil "extra virgin") and samples 4 and 5.

As it can be seen, the use different systems of colour characteristics evaluations, enables retaining of principally similar results, that are in close mutual correlations and correlations with the results of sensorial analyses.

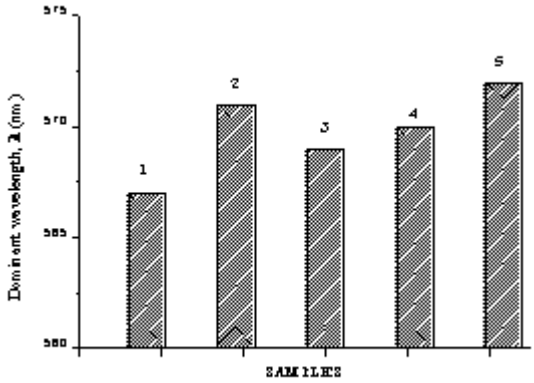

Figure 2.

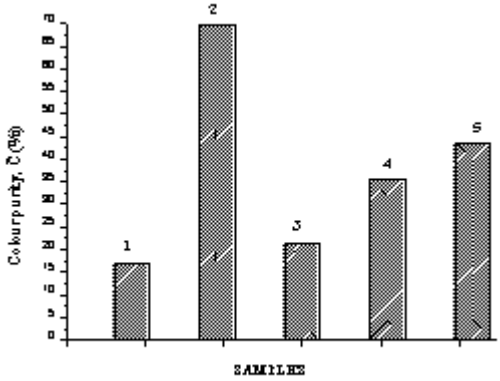

Figure 3.

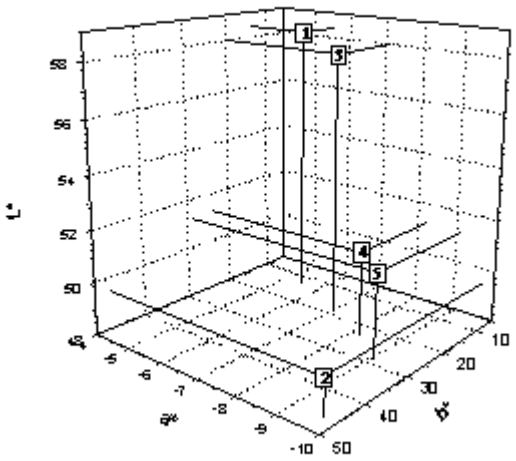

Figure 4.

References

1. DIMIĆ, E., Hladno ceđena ulja, University of Novi Sad, Faculty of Technology, Novi Sad, 2005 (in Serbian).
2. Pravilnik o kvalitetu i drugim zahtevima za jestivo ulje i masti, margarin i druge masne namaze, majonez i srodne proizvode. Službeni list SRJ No. 54/99, 20/2000, Službeni list SCG No. 56/2003, 4/2004 (in Serbian).
3. ISO 8587: 1988 (E) Sensory analysis – Methodology – Ranking.
4. RADOVANOVIĆ, R., J. POPOV-RALJIĆ, Senzorna analiza prehrambenih proizvoda, Poljoprivredni fakultet, Beograd – Zemun, 2000/2001 (in Serbian).
5. ROBERTSON, A. R. Colour Research Applied **2**: /, 1977-
6. POPOV-RALJIĆ, J., RADOVANOVIĆ, R., Senzorni kvalitet hrane in: Kontrola kvaliteta i bezbjednosti namirnica (a Monograph), Banja Luka, 69 – 99, 1999 (in Serbian).
7. POPOV-RALJIĆ J., RADOVANOVIĆ, R. Senzorna analiza prehrambenih proizvoda. A Monograph, Belgrade, 107 – 124, 2002a (in Serbian).
8. POPOV-RALJIĆ, J., RADOVANOVIĆ, R., Osnovi savremene senzorne analize kvaliteta prehrambnih proizvoda, Uljarstvo, Journ. of Edible Oil Industry **33**, 3-4, 25 – 35, 2002b (in Serbian).
9. POPOV-RALJIĆ, J., RADOVANOVIĆ, R., Odabrana senzorna svojstva kvaliteta hrane – Zapažanja pomoću čula, Journal of Edible oil Industry **34**, 1-2, 2003 (in Serbian).
10. ISO 11037.1999 (E) Sensory analysis, General Guidance and Test Method for Assessment of the Colour of Foods.
11. RAVI, R., PRAKASH, M., BHAT, K. K. Sensory Odour profiling and Physical Characteristics of Edible Oil Blends During Frying, Food Research International, **38**, 59 – 68, 2005.
12. ISO 8586-1:1993E: Sensory analysis – General guidance for the Selection, Training and Monitoring of Assessors.