

Vegetable oils / fatty acid composition, hexane residues, declaration, pesticides (organic culinary oils only)

Joint campaign Basel city (specialist laboratory) and Basel country

Number of samples tested: 41

Objected to: 20

Grounds for objection:

Fatty acid composition (4), declaration (16)

Background

A wide variety of vegetable oils of varying quality are available on the market. Oil production involves pressing or extraction from chopped or crushed seeds and fruits. Pressing without heating results in vegetable oils which are then marketed without further refining as cold-pressed or native oils. Extraction with hexane results in increased yields compared to pressing and is particularly suitable for seeds or fruits with little easily extractable fat. After vaporisation of the solute, undesirable components (fibrils, free fatty acids, unwanted volatile chemicals) and flavouring components are removed by refining; this also leads to a further reduction in the amount of remaining hexane. In comparison to the rather neutral flavour of refined oils, native oils have a pronounced, typical seed or fruit flavour. In addition, most are also more intensely coloured.

Like all culinary fats, vegetable oils consist predominantly of triglycerides; that is glycerol bound to three fatty acids. The relative proportion of different fatty acids in the mixture (known as the fatty acid composition) is characteristic to each vegetable oil. The labelling of many vegetable oils indicates the fatty acid composition of the oil in a simplified form, such as the proportions of saturated, monounsaturated and polyunsaturated fatty acids and, if appropriate, draws attention to a particularly high concentration of essential fatty acids such as linoleic acid (omega-6) or linolenic acid (omega-3).

Aims of the investigation

The following questions were addressed:

- Do the vegetable oils contain the characteristic fatty acid compositions typical for the oil?
- Are the values for fatty acid composition stated in the declaration accurate?
- Are the relevant tolerance values for hexane in refined oils adhered to?
- Are the general declaration rules observed?
- Are there residues of organochlorine pesticides present in oils which claim to be organic?

Statutory basis

Culinary oils are outlined in articles 98 to 100 of the Swiss Food Ordinance (LMV). The general regulations regarding declarations, outlined in articles 19 to 36 of LMV apply to culinary oils, as to all foodstuffs. Labelling of nutritional values, and in particular declaration of the contents and type of fatty acids is subject to article 4 of the Ordinance on Nutritional Value (NwV). The addition of vitamins to improve nutritional value and the declaration thereof is subject to articles 9 and 11 of NwV. It is self-evident that factual declarations used for foodstuffs must be correct, and must not be deceptive (Article 19 of LMV).

Regarding residual hexane, which is used as a solvent in oil extraction, the Ordinance on Contaminants and Ingredients (FIV) sets a tolerance value of 1mg/kg for culinary fats and oils.

The use of the pesticides tested for is not permitted in organic agriculture (Ordinance of the Federal Department of Economic Affairs (EVD) on organic farming, appendix 1).

Sample description

Forty-one vegetable oils were collected from 7 shops in the cantons of Basel City and Basel Country. The samples consisted of both cold pressed and refined oils originating from Switzerland, Italy, Spain, Greece, Portugal, Germany, Hungary, Austria and New Zealand. Thirty-seven samples were unblended vegetable oils, one of which was flavoured. Two oils contained added vitamins A, D and E to improve nutritional value. Two Greek olive oils, one sunflower oil, one sesame oil and one pumpkin seed oil were organic.

Type of vegetable oil	Number of samples
Olive oil	15
Sunflower oil	6
Vegetable oil (blended)	4
Rape oil	3
Peanut oil	2
Grape seed oil	2
Avocado, Walnut, Thistle, Pumpkin seed, Maize seed, Macadamia nut, Sesame, Wheat seed oils	1 of each
<i>Flavoured vegetable oils:</i>	
Sunflower seed oil with Herbes de Provence	1
Total	41

Test method

Method 3.7 from chapter 7 of the Swiss Food Manual (as of July 2000) was used to determine fatty acid composition in percent. The fatty acid esters present in the foodstuff were modified to fatty acid methyl esters by transmethylation, and these were determined by GC/FID.

Determination of hexane and other volatile components was carried out by Headspace GC/MS in scan mode.

Organic vegetable oils were examined for organochlorine pesticide residues. Briefly, the oils were processed over a solid phase and analysed using twin-column GC/ECD. Positive results were confirmed using GC/MS.

Results

- The fatty acid composition of all samples was found to be typical for the type of oil declared. Within each type of vegetable oil, only minor variations in fatty acid composition were found.
- Declarations as to the fatty acid composition were made on the labels of 36 of the 41 samples. The investigation found that, in four cases (11%), the actual values varied from those declared by more than an acceptable amount. These samples were therefore objected to.
- No samples were found to exceed the tolerance value of 1mg/kg for the solvent hexane. The highest concentration was found in a macadamia nut oil, nevertheless, at 0.13mg/kg it was much lower than the tolerance value. No hexane was detected in 88% of the samples. The limit of detection for hexane is about 0.01mg/kg.
- Sixteen samples (39%) were objected to because of inadequacies in the declaration. In many cases this was due to a minor inadequacy in the description of nutritional value. For example, the declaration of fatty acid composition often failed to mention the glycerol component of the fat. Other grounds for objection were for incorrect technical designations, failure to declare country of origin or non-permitted claims about the product.
- No organochlorine pesticide residues were found in four of the five organic samples. However, residues of hexachlorobenzol (0.02mg/kg) and dieldrin (0.03mg/kg) were found in a sample of organic pumpkin seed oil which, according to the declaration, was made in Austria. The use of these pesticides has been forbidden in the country of origin for a long time. Uptake of these substances from treated soils, and their concentration in seeds of pumpkin plants has been established. As a result, tolerance values and limit values for pumpkin seed oil have been set. The relevant tolerance values of 0.10mg/kg for hexachlorobenzol and 0.05mg/kg for dieldrin were not breached. However, as the product is organic, those responsible were asked for their opinion.

Somewhat surprisingly, this pumpkin seed oil was also found to contain methyl chloride. Quantification revealed a content of about 1mg/kg. Methyl chloride is a gaseous chemical which occurs in nature. Annual production from natural sources such as algae and fungi is about 5 million tonnes. In contrast, the technical relevance of methyl chloride is relatively low. As a result, we investigated three marketed pumpkin seed oil products, and found methyl chloride in two. The origin of methyl chloride in pumpkin seed oil is not yet clear, nor have we

found, to date, any reports in specialist literature of the production or enrichment of methyl chloride in pumpkin plants. Nevertheless, it currently seems more likely that it originates from a natural source, rather than from contamination.

Conclusions

The high number of objections (49%) is largely due to minor problems with declarations. This indicates the need for a repeat of this investigative campaign.

The declared fatty acid compositions only varied excessively from the measured values in a handful of cases. The fatty acid composition of a culinary oil can vary considerably from year to year because of different climatic conditions or a change in the variety of plant cultivated. In such cases, amendment of the labelling by the responsible manufacturer or retailer in the light of analytical results is necessary.

Fortunately, the use of hexane as an extraction solvent does not seem to lead to any noteworthy residues in vegetable oils, so repeating this investigation does not seem to be necessary.