

Sensory evaluation of virgin or cold-pressed edible oils

Bertrand Matthäus and Ludger Brühl

Max Rubner-Institut, Working Group for Lipid Research, Detmold, Germany

The most important parameter for the assessment of edible oils is the sensory evaluation, because the product has to fit the consumer likes, otherwise the product has no chance on the market. The sensory assessment can be done by a consumer panel with a huge number of untrained consumers which assess the product regarding likes and dislikes. The result says nothing about sensory defects of the oil resulting from deterioration but reflects acceptances and preferences of consumers for the product.

On the other hand the sensory evaluation of edible oils is possible by a trained group of tasters which are familiar with the product and possible perceptions resulting from sound or defective products. In the case of this analytical sensory evaluation the available methods range from simple triangle testing via recognising differences between two samples to the more complex descriptive analyses of edible oils.

The tasters of such a panel should use a standardized vocabulary for the description of the perceptions ensuring that for similar sensations the same term is used. The use of a standardized vocabulary improves the reproducibility and precision of the sensory analysis.

Additionally to the description of the sample this type of sensory evaluation includes a rating system by which the tasters specify the intensity of the perceived sensations. For describing the intensity of the sensations two different systems are available for edible oils: a scale with distinct values like school marks and the use of a continuous scale i.e. a line of 10 cm length where the taster puts his tick mark intuitively on the line. The latter system is used for the sensory evaluation of virgin olive oil according to the regulation (EWG) 2568/91. The first one is in use for the AOCS Flavour Quality Scale with a scale from 1 (repulsive) to 10 (excellent), but this system does not contain special tables for individual oils. The DGF standard method C-II 1 (14) uses for the typical attributes of good quality oils a scale from 0 (not perceivable) to 5 (very strong perceivable), while for the atypical attributes only the presence is decisive, but not the intensity, because the presence of any off-flavour is sufficient to qualify the oil as not suitable for human consumption.

For the sensory assessment according to method DGF-II 1 (14) the oil is filled into special blue coloured glasses typical for the sensory evaluation of olive oils. The blue colour of the glasses avoids that the appearance of the oils influences the decision of the taster. To gather/keep the volatile aroma compounds for the time of the sensory assessment session, glasses are covered by a watch glass. Every glass is filled with the same amount of about 15 mL of oil to ensure that the oil develops an intense headspace aroma and the volatile compounds diffuse in the covered glass. Oils are evaluated at room temperature.

The data sets obtained from the sensory assessments of the individual tasters are statistically evaluated in order to improve the reliability and repeatability of the results. Since the mean value of the results for one attribute is influenced by every single result especially by outliers in the

data set, the median has to be calculated as the best result. Outliers are not influencing the median. In addition the relative coefficients of variation of the results have to be calculated in order to get a rough estimation whether the final result is a unanimous result or a heterogeneous one. The relative coefficient of variation for the different attributes has to be below 15 %.

Rapeseed oil

For good virgin rapeseed oils from high quality seeds the attributes seed-like, nutty, woody and astringent have been found useful and typical as specified in the profile sheet. The first item is also the most difficult attribute for those who are not familiar with rapeseed oil tasting. The attribute seed-like summarizes a sensation resembling asparagus, cabbage, fresh green vegetable, sometimes with a sulphur note. The use of summarising descriptors makes the sensory assessment result less informative but at the same time more reproducible and reliable. If every taster was to use his own descriptors for the taste, it would almost be impossible to get a homogenous evaluation of a panel group. The primary aim of sensory evaluation is to get reproducible and reliable results and not to detect some minimal differences between samples that taste more or less the same. The attribute woody is associated to some sensations that are not pleasant for all people, but do not indicate any fault in the production process. In comparison studies of different varieties grown at different locations in Germany, an accumulation of samples showing a woody attribute was noticed for some regions. However, it is not yet obvious whether this effect is due to regional climate conditions or more due to regional soil properties. The attribute astringent is often perceived after tasting as it is associated with a rough mouth feeling, also perceived after drinking red wine with high tannin content. Some oils might also show off-flavours like rancid, fusty, musty, yeast-like, strawy, roasted, burnt and bitter. The attribute roasted is more pleasant than burnt, the last one is often combined with the attribute bitter. Nevertheless, the attribute roasted should not be detectable in virgin rapeseed oils pressed from high quality seeds without application of heat during processing.

A further task for the taster is to evaluate the intensity of the perceived sensation using a scale from 0 to 5. Good virgin rapeseed oil exhibits only a mild aroma of fresh green rapeseed and a nutty after-taste, which normally do not exceed an intensity of 3 and 1, respectively.

Sunflower oil

Virgin sunflower oil produced from high-quality raw material after dehulling of the seeds is characterized by a mild *sunflower-seed-like*, *nutty* and sometimes *fruity* taste. Oils from whole seeds have a stronger taste and especially the sensory attributes *wood-like*, *astringent* and *bitter* are predominant, which is not an off-taste of virgin sunflower oil. The attribute *bitter* is typical for virgin sunflower oil, especially of whole seeds and tolerable up to an intensity of 1. While in virgin sunflower oil from dehulled seeds the attributes *nutty* and *fruity* are perceivable, they are faded into the background in virgin sunflower oil from whole seeds. Sometimes oils from whole seeds also have a weak *pungent* taste.

Definite negative sensory attributes are *roasted, burnt, rancid, fusty* or *musty*. These attributes should not be present in virgin sunflower oil, because the presence of these attributes indicates to failures during storage of the raw material (fusty, musty), during processing (roasted, burnt) or during storage of the oil (rancid).

In order to obtain a more bland aroma virgin oils can be treated by hot steam at temperatures between 120°C and 180°C in the vacuum over a period of several hours. By this treatment strong or unpleasant aroma compounds are removed and these oils are better usable in food processing for different applications like margarines or mayonnaises. By the treatment with hot steam these oils lose their status as cold pressed oils, if the typical smell and taste for sunflower seeds is no more perceivable.

Grapeseed oil

While refined grape seed oil is neutral in taste and smell, high quality virgin grape seed oil is characterized by a pleasant vinous and fruity smell and taste, which also reminds of raisins. This is a very good combination for different dishes like salads.

During storage these pleasant sensations change and more and more degradation products are detectable, which are formed either from the degradation of triglycerides or from microbial degradation. The analysis of the volatile compounds by dynamic headspace analysis revealed that these oils become rancid, but also aroma active compounds like ethanol, ethyl acetate or acetic acid are formed which result in a disagreeable taste and smell of the oil. Such oils cause a burning sensation in the mouth and on the lips. The formation of ethanol and acetic acid lead especially to a smell like glue.

On the market also so-called natural turbid oils are available, which contain small parts of seed material which come into the oil during the pressing process and which are not removed by filtration or sedimentation. During storage this sediment results in a drastic deterioration of the oil. Microorganisms or enzymes included in the seed material enhance the production of degradation products which result in a fast formation of astringent and bitter sensations in turbid grape seed oil, while the attribute raisin-like is less pronounced than in filtered oil.

Filtrated virgin grape seed oil shows noticeable amounts of ethyl acetate and acetic acid and especially ethanol, which indicates degradation by microorganisms. If the oil is stored with turbid matter the formation of these degradation products was significantly more pronounced within seven days of storage. A 10 to 60 fold higher amount of ethanol, ethyl acetate and acetic acid was found. Additionally hexanal as a key compound of the degradation of linoleic acid resulting from oxidation is formed.

Argan oil

Two different qualities of argan oil are available on the market, food grade and for cosmetics. Food grade argan oil is obtained by cold-pressing after roasting the argan almonds. The oil obtained from high-quality almonds after appropriate roasting shows the typical attributes roasted and nutty, while in argan oil for cosmetics obtained from unroasted almonds the nutty smell and taste is only weak perceivable and the attribute roasted is missing. The presence of the atypical attributes cheese-like (Roquefort cheese), rancid, woody, bitter, burnt, fusty, yeast-like or musty indicate mistakes during storage of the raw material, during processing or during storage of the oil.

The perception of cheese-like, fusty and musty taste and smell indicates the use of improper raw material during processing. Especially the use of almonds obtained from kernels collected from the excrements of goats is remarkable noticeable by a strong cheese-like and fusty smell and taste. However, also during long term-storage of the argan oil under improper conditions the pleasant nutty and roasted taste and smell changes towards these unpleasant perceptions.

Linseed oil

The major part of produced linseed oil is used for industrial purposes. Here also refined linseed oil is used. For human consumption mostly screw pressed linseed oil is offered. The oil yield is often increased by gentle heating of the seeds just before pressing. Therefore many products are not of virgin or cold pressed quality in a strict sense. While the freshly pressed linseed oil provides a delicate seed like, nutty or sometimes bread like flavour (see profile sheet for linseed oil), an unpleasant bitter off-taste starts to develop already after 1 day of storage. This bitter off-taste increases strongly during storage at room temperature for about 20 weeks. Therefore it is highly recommended to use only freshly prepared linseed oil for culinary purposes. In regions with traditional linseed cultivation you will even find a booth with a screw press for fresh production of linseed oil on special markets. It is also recommended to buy only small portions of linseed oil for direct consumption and not to keep in stock. The increase of bitterness can be slowed down by cooling or even better by deep frozen storage. However, it can't be avoided completely.

The development of this bitter off-taste does not occur in refined oils even after a storage period of several months. Stored refined oils develop a rancid off-flavour, but not a bitter taste. Therefore refining is a reliable way to avoid the development of a bitter taste in linseed oil but the typical nutty taste is removed by this procedure, too. However, there are also products on the market, which claim to be cold pressed oils but they have been debittered by an undisclosed procedure.

When stored under appropriate conditions, the oil is rather stable in the intact seed for more than 1 year. But after preparing the linseed oil by pressing, the shelf life of the oil obtained is limited to only about 3–6 months mainly depending on storage and packaging conditions.

It is very difficult to evaluate the bitter intensity of linseed oils due to taste fatigue, which occurs very easily with very bitter oil samples. To avoid sensorial fatigue due to intensive bitterness the sensory evaluation of the bitter taste of linseed oil can be achieved by a dilution test. For this serial dilutions of the oil in odour and tasteless refined rapeseed oil have to be prepared (undiluted, 1 + 1, 1 + 2, 1 + 3, 1 + 4, and so on until no bitterness can be perceived). A portion (15 g) of each dilution is presented in order of ascending concentrations of the linseed oil in coded blue tasting glasses to each taster at room temperature. Using the sip-and-spit method, the panellists proceed with tasting the next higher concentration until the bitter recognition threshold is reached. This dilution is defined as taste dilution (TD) factor. The TD factors evaluated by a sensory panel in three different sessions shall be averaged. The TD factors between individuals and separate sessions should not differ by more than one dilution step. Using this procedure only a minimum of bitterness is perceived in the mouth and the tasting and evaluation capabilities of the panellists can be obtained in good condition for a much longer time.

Tab. 3: Profile sheet of virgin rapeseed oil

date: taster: sample code:

typical attributes	0	1	2	3	4	5
like seed						
nutty						
woody, strawy						
astringent						
atypical attributes	no	yes				
roasted, burned						
bitter						
rancid						
fusty, musty						
others:.....						

Tab. 4: Profile sheet of virgin linseed oil

date: taster: sample code:

typical attributes	0	1	2	3	4	5
like seed						
like bread						
nutty						
bitter						
astringent						
atypical attributes	no	yes				
roasted, burned						
rancid						
scratching						
fusty, musty						
others:.....						

Tab. 5: Profile sheet of virgin sunflower oil

date: taster: sample code:

typical attributes	0	1	2	3	4	5
like sunflowerseed-, kernel						
nutty						
fruity, sweet						
shelly, woody						
astringent						
bitter						
pungent						
atypical attributes	no	yes				
roasted, burned						
bitter						
rancid						
fusty, sour, musty						
others:.....						

Tab. 7: Profile sheet of cold pressed argan oil from roasted seeds

date: taster: sample code :

typical attributes	0	1	2	3	4	5
nutty						
roasted						
Atypical attributes	no	yes				
Roquefort cheese						
rancid						
woody						
bitter						
burned						
fusty, musty						
yeast-like						
others:						

Profile sheets for the sensory evaluation of virgin and cold-pressed oils according to method DGF-C-II 1 (14)