Cold-pressed edible rapeseed oil production in Germany

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In most European countries cold-pressed edible rapeseed oil is not a topic, because rapeseed oil is produced and consumed mostly as refined oil. In Germany the situation is a little different. Here the production of edible oils usually takes place as refined oils in some large centralized facilities, which are able to process more than 4000 tons of oilseeds per day. While the sales of refined edible oils remain stagnant or show only very small increases, cold-pressed edible oils are becoming more and more popular in Germany.

Cold-pressed edible oils have been available for some time, among which cold-pressed edible rapeseed oil shows the highest growth rates on the market. The impetus for this development came from knowledge of extra virgin olive oil and its pleasant taste and aroma as well as its perceived nutritional benefits.

Two important reasons are responsible for this development. Rapeseed oil has been shown in several studies to have excellent nutritional properties based on its fatty acid composition with a high content of oleic acid (nearly 60%) and a well-balanced ratio between n-3 and n-6 fatty acids. In addition, consumers have expressed desires for edible oils with a typical, characteristic taste, a specific aroma and an intensive color. The German report of Nutrition 2000 gave special mention to rapeseed oil, as being particularly favorable for human nutrition, even better than olive oil, comments that are valid for both cold-pressed and refined edible rapeseed oil. The use of rapeseed oil in the preparation of food is highly recommended.

Sensory aspects

The sensory aspect is relevant for only cold-pressed oils. While refined oils have wider applications because of their bland and neutral taste, the use for cold-pressed oils is more focused on the preparation of salads and similar applications, where the taste of the oil results in an improvement in the taste of the food.

In Germany the production of cold-pressed oils often takes place in small and medium-sized facilities, where processing simply involves selection of the best seed batches, pre-treatment of the seeds, oil pressing, oil cleaning and storage of the oil. Nowadays about 200 small and medium-sized oil mills are located all over Germany, most of them being in Baden-Württemberg and Bavaria (Fig. 1). Due to the fact that the major processing facilities are found mostly at the great rivers in the northern and eastern part of Germany, farmers in the southern area had searched for local alternatives to process their oilseeds.

The most important factor for successful processing in these small facilities is an increased value for the end-products. Higher quality oil and press cake with larger oil residue due to the simplified processing both command higher prices. In contrast to large centralized factories, these small and medium-sized plants are available locally; therefore transportation costs are lower. Thus these plants are in the position to supply an immediate, but quantitatively limited, market with high-quality cold-pressed edible oils.

The pressing process is carried out in most cases by a screw press in small plants with capacities ranging between 0.5 and 25 metric tons/day. After pressing, the recovered oil is purified either by filtration using different techniques or by a stepwise sedimentation. Further treatment of the oil is not carried out to avoid any potential problems. It is very important for the production of high-quality cold-pressed edible rapeseed oil to pay attention to careful selection of the raw material, gentle pressing process and immediate cleaning of the crude oil as well as appropriate storage of the oil. If any of these factors is not followed, a drastic loss of quality will result.

This loss of oil quality is determined from different parameters. The most important factor is sensory impression, because

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Figure 1. Locations of centralized and decentralized oil press facilities in Germany (Source: Technology and Support Centre for Renewable Raw Materials, Straubing, Germany.)
more than any other parameter the appearance and the taste of a product deeply influence the buying decision of the consumer. Cold-pressed rapeseed oils have typically seedlike and nutty aroma attributes, which are positive impressions in contrast to rancid, strawlike, woody, fried, burnt, dusty, musty, bitter or astringent characteristics associated with off-flavors arising from formation of volatile degradation products or development of aroma active compounds during faulty processing.

The evaluation of the sensory quality of cold-pressed rapeseed oil has to be carried out by a trained panel. At the Federal Research Center for Nutrition and Food at Münster, Germany, panelists are trained with rapeseed oils from all over Germany and neighboring countries. In addition oils are produced with known defects in order to become familiar with the most common defects and their bases. However, panel testing is a time-consuming and training-intensive evaluation procedure, where skilled staff are needed. To support the panel sensory evaluation a purge-and-trap analysis of the volatile compounds in cold-pressed rapeseed oils has been set up. With this technique, key volatiles for some of the most common defects can be detected with an objective analysis method. For example oils with a rancid attribute show compounds like hexanal, heptanal, octanal, nonanal, trans-2-heptenal, trans-2-octenal, trans-2-nonenal, trans-2-decenal and trans2-undecenal, and trans-cis-2,4-heptadial and trans-cis-2,4-decadial at elevated levels. For musty attributes the branched alcohols 2-methylpropanol and 2- and 3-methylbutanol are characteristic key compounds. However, this method will only be able to detect known defects.

**Cold-pressed oil quality**

In addition to sensory evaluation, some other parameters are suitable to describe the quality of cold-pressed oils. Such characteristic features are oxidative stability (Rancimat test), tocopherol content and composition, amount of free fatty acids or stigmasteradienevidence of heat-treatment during production—as well as the content of chlorophyll—a measure for the maturity of the raw material, but also as indicator of improper pressing conditions.

Influence of the seed material on the quality of a wide range of cold-pressed edible rapeseed oils is available on local markets, whereas some oil mills offer their oils all over Germany. An overview of the market carried out by the Institute of Lipid Research of the Federal Research Center for Nutrition and Food showed that the quality was very heterogeneous (Fig. 2).

The market survey demonstrated that it is possible to produce high-quality cold-pressed rapeseed oils for human nutrition with a pleasant taste, but a number of oils were found to be inedible. Other parameters such as oxidative stability, the content of stigmasteradien, or the content of chlorophyll showed similar results.

One reason for these varying qualities of cold-pressed edible rapeseed oil is the different management procedures used by the processors. In particular, the initial quality of the seed material before pressing has a crucial effect on the quality of the oil, even more than the press process itself. Mistakes such as a high amount of foreign matter or broken seeds in the seed material used for the pressing, but also storage under improper conditions with a high humidity or an intensive drying of the seeds have effects on the oil and lead to a poor quality.

More than 5% foreign matter results in a strawlike aroma, coming from seeds of other plants such as wheat. Stems parts from rapeseed and other plants pressed with the seeds result in extraction of aroma-relevant compounds from these materials. With an increasing presence of foreign matter the intensity of the attribute “seedlike” decreases, while attributes like “strawlike” or “woody” increase.

In broken seeds even at room temperature, but increased at higher temperatures, enzymatic and microbial reactions take place because the substrates, usually separated in the intact seeds, come together. This situation results in degradation reactions of the appropriate substrates, which leads to dusty sensory attributes of the oil. During the storage of seed material with 5% broken seeds at 40°C the attribute “seedlike” has been found to be no longer detectable after 6 day of storage, while attributes like “fusty,” “woody” or “musty” characterized the sensory impression of the cold-pressed oil. In addition, the amount of free fatty acids increases and the composition of the volatile components changes, which shows that the sensory impression of the oils has changed in a negative way. Another important factor that results in a quality decrease of the oil is the dying conditions of seeds before storage, because this pre-treatment can cause a burnt aroma of the oil.

The conditions of the pressing process also influence the quality of the oil, but not to the same extent. As parameters, temperature of the press head, speed of the screw press, diameter of the nozzle and also type of the press can be varied. Not all of these parameters affect the quality of the oil to the same extent and not all parameters describing the quality of the oil are influenced by the press settings. Press parameters have no influence on the fatty acid and tocopherol composition, and also the oxidative stability of the oil is not changed as a result of different press settings. On the other hand the contents of chlorophyll
and phosphorus as well as the amount of free fatty acids are strongly influenced by the pressing conditions. These components are of special interest because they influence the stability of the oil. Chlorophyll is an ubiquitous plant pigment, that is a known photosensitizer for singlet oxygen formation under light resulting in a faster deterioration of the oil. Chlorophyll is also undesirable because it leads to an unpleasant green or brown color of the oil. Phospholipid components are recovered in the pressed oil to a greater extent under harsh pressing conditions, leading to a white precipitate on storage of the oil. Free fatty acids are degradation products of triglycerides, formed either by enzymatic treatment or by heat. They are more susceptible to oxygen that allows faster degradation to undesirable aroma components. Therefore, it is important to avoid the formation of these components during production to improve the quality and to prolong the shelf life of the oil.

An increase in the press head temperature especially leads to elevated levels of these components in the oil. On the other hand, the diameter of the nozzle as well as the speed of the screw press has no influence on the amount of free fatty acids. The use of a small nozzle (6 mm) results in increasing amounts of chlorophyll if the speed of the screw press is reduced from 95 to 20 rpm. The reason is that at a lower speed the seed material remains for a longer time in the screw press; therefore the extraction of components from the seeds with the oil is more effective.

The sensory attribute “seedlike”, typical for the taste of cold-pressed edible rapeseed oil, is hardly influenced by the pressing parameters. Using a small nozzle (6 mm) with a slow speed results in a significant less pronounced “seedlike” impression of the oil. The press parameters have a stronger effect on the sensory attribute “burnt”. Using a small nozzle of 6 mm the intensity of this attribute increases with increasing speed of the screw press, because the temperature stress of the seed material increases. A greater diameter of the nozzle leads to a less pronounced development of this negative attribute, and also an increase of the press head temperature from 60 to 90°C results only in a small increase of the intensity of the attribute “burnt.”

In conclusion, rapeseed oil is distinguished by a well-balanced fatty acid composition which results in important nutritional properties. The prominent feature of cold press edible rapeseed oil is the characteristic “seedlike” and “nutty” smell and taste, which favors its use in the cold kitchen for the preparation of salads. For a high-quality rapeseed oil, a careful choice of high-quality seeds, a gentle oil-pressing process, an extensive cleaning of the oil, and proper storage conditions are necessary. Otherwise, losses of the quality are inevitable.

Background reading


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