# IMPACT OF HOLL RAPESEED OIL DURING FRYING ON PRODUCT QUALITY DURING STORAGE

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**Abstract**
Frying of food is a huge market and the oil used for frying is one of the most sensible components in the preparation of fried food, since the frying medium becomes part of the food. The paper shows the behaviour of Berlin doughnuts and potato crisps being fried in high-oleic, low-linolenic (HOLL) rapeseed oil in comparison to products being fried in high-oleic sunflower oil, palm olein and different types of partially hydrogenated oils.
During storage the quality of products being fried in HOLL rapeseed oil was comparable to products being fried in other common used oils with regard to the chemical parameters. The sensory evaluation of potato crisps being fried in HOLL rapeseed oil was also comparable to other oils over the storage period. The results for the sensory evaluation of Berlin doughnuts being fried in HOLL rapeseed oil was comparable to doughnuts being fried in partially hydrogenated oils but worse to doughnuts being fried in palm olein.

**KEY WORDS:** deep-fat-frying, food quality, high-oleic, low-linolenic rapeseed oil

## Introduction

Frying is one of the most important methods for the preparation of foodstuff, because it is fast and it results in tasty food with a typical flavour and yellow brown products accepted by the consumer. An important influence on the result of the frying process has the frying medium. It mainly serves as medium for the heat transfer from the heating source to the food, but additionally the oil is important as enhancer of flavour, responsible for the typical smell and taste of fried products. Last but not least it has to be taken into consideration that the frying medium becomes a significant part of the food which can deeply influence the quality of the whole product even if the product has to be stored over a longer period of time. During the frying process a lot of oil is taken up and the fatty acid composition of the food being fried strongly depends on the fatty acid composition of the frying medium. Another important aspect is that fats and oils low in *trans*-fatty acids come more and more into the focus of interest, because of a strong correlation between the intake of *trans*-fatty acids and the risk of coronary heart diseases (Ascherio et al., 1999; Willet et al., 1993). The main source for *trans*-fatty acids is partially hydrogenated fat. Today palm olein, hydrogenated peanut oil or other hydrogenated oils are principally used for the industrial preparation of fried food, but also at home hydrogenated fats and oils are in use. These oils are characterized by a high smoke point and oxidative stability during the thermal treatment of deep-fat frying, a low amount of polyunsaturated fatty acids, but also by a high content of saturated fatty acids or *trans*-fatty acids with all the described nutritional disadvantages.
Meanwhile different investigations have shown that oils with reduced levels of linolenic acid result in improved quality and stability of the oil and comparable results in frying (Warner and Mounts, 1999; Warner et al., 1994, Warner et al., 1997; Xu et al., 1999; Xu et al., 2000; Gertz, 2006; Matthäus, 2006). Additionally to a high thermal stability of the frying medium it also has to be taken into consideration that the sensory quality of products produced with oils high in linolenic acid become bad very fast during storage (Weber and Putz, 2004). That means that frying with conventional rapeseed oil results in tasty food which consists of healthy oil, but during storage the product becomes inedible in a very short time. In that case oils low in linolenic acid and high in oleic acid could improve the storage stability of the products remarkable.

## Storage experiment

In a storage experiment the behaviour of Berlin doughnuts and potato crisps being fried in HOLL rapeseed oil at 170 °C or 180°C and 175°C, respectively, was compared over a storage period of 12 weeks and 24 weeks, respectively, with products being fried in high-oleic sunflower oil (HOSO), palm olein (PO) and different types of partially hydrogenated fats (PHF (high-oleic, low-*trans* (HOLT); high-palmitic, low-*trans* (HPLT), high-*trans* (HT)). Berlin doughnuts were stored at -18°C in plastic bags, while potato crisps were stored at room temperature under nitrogen and normal atmosphere, respectively.

**Results**

The totox value describes the development of the primary and secondary degradation products by calculating two times the peroxide value plus the anisidine value. Thus, this value is giving sufficient information about the oxidative state of a product and is a suitable indicator for the deterioration of the products during storage. A totox value of 30 has been suggested by industry and official authorities as a maximum limit. All samples of potato crisps stored under nitrogen came out below this value after 24 weeks of storage (results not shown). Samples stored under normal atmosphere had totox values that exceeded the limit during storage. For all samples stored under nitrogen, the totox value was comparable in the range between 26 (HOSO) and 30 (PO). Only the totox value of potato crisps fried in HOSO was significantly lower than the totox values of the other samples ($P = 0.01$). The differences between the different oils were a little higher for storage under normal atmosphere. These differences were statistical significant ($P = 0.01$) and were found in the range between 31 (HOSO) and 47 (PHF (HOLT). The totox value for potato crisps fried in HOLL rapeseed oil was the lowest just after preparation.

The situation was different for the storage of Berlin doughnuts. During storage for 12 weeks, only products fried in PHF (HT) at 170° and 180°C and HOLL rapeseed oil at 170 °C were below a limit of 30 for the totox value (results not shown). All other oils reached the limit in a very short time. In the case of PHF (HPLT) and PO used at 180°C, the limit was already exceeded directly after preparation of Berlin doughnuts. The result also shows the negative effect of a high frying temperature. While the increase of the totox value was moderate when using a temperature of 170°C, the increase was more pronounced at 180°C, because of a higher initial formation of oxidation products during processing.

The highest amount of tocopherols/tocotrienols was found in Potato crisps fried in PO, while the concentration in the products fried in other oils was significantly lower ($P = 0.01$), but quite similar to each other. After 24 weeks of storage of potato crisps, the highest degradation of tocopherols/tocotrienols was found for products being fried in PO, but about 30 mg/100 g tocopherols/tocotrienols were still detectable in all the products. The reduction came to about 50%, while the rate of degradation in products, being fried in the other oils came to about 25% (results not shown). One reason for the faster degradation of tocopherols/tocotrienols in PO could be that this oil contains mainly tocotrienols. They have a higher antioxidant activity than tocopherols, resulting in a faster degradation during oxidation reactions (Packer et al., 2001).

Products stored over a period of 24 weeks after being fried in HOLL rapeseed oil still contained the highest amount of tocopherols/tocotrienols. Again, a positive effect of a nitrogen atmosphere was found. All samples stored under nitrogen contained slightly higher concentrations of tocopherols/tocotrienols although the difference was only statistical significant ($P = 0.01$) for PO stored under normal atmosphere and nitrogen. No degradation of tocopherols/tocotrienols took place (results not shown) in Berlin doughnuts stored over 12 weeks at -18°C.

The sensory evaluation of the potato crisps appearance, consistence, smell and taste were tested by a trained sensory panel and the results combined to a weighted quality score in the range from 0 to 5. The results show that the sensory quality of potato crisps being fried in HOLL rapeseed oil was comparable to potato crisps being fried in PO and PHF (HOLT) with no significant difference between the different oils ($P = 0.01$) (Fig. 1a) when the samples were stored under normal atmosphere. Under normal atmosphere, the samples were storable for 16 weeks before the quality score fell below 3, which is the limit for product acceptability. The quality score of potato crisps fried in HOSO was significantly better than for products fried in the other oils in the first 8 weeks of storage. After 8 weeks of storage, there was no significant difference between the quality score of all the samples ($P = 0.01$). The storage time was extended up to 20 weeks for HOSO, HOLL rapeseed oil and PO, for sample stored under nitrogen (Fig. 1b). However, sensory scores of samples fried in PHF (HOLT) fell below a score of 3 at the 16 week test. Again, no significant difference was found between samples fried in HOSO, HOLL rapeseed oil and PO after 20 weeks of storage ($P = 0.01$).

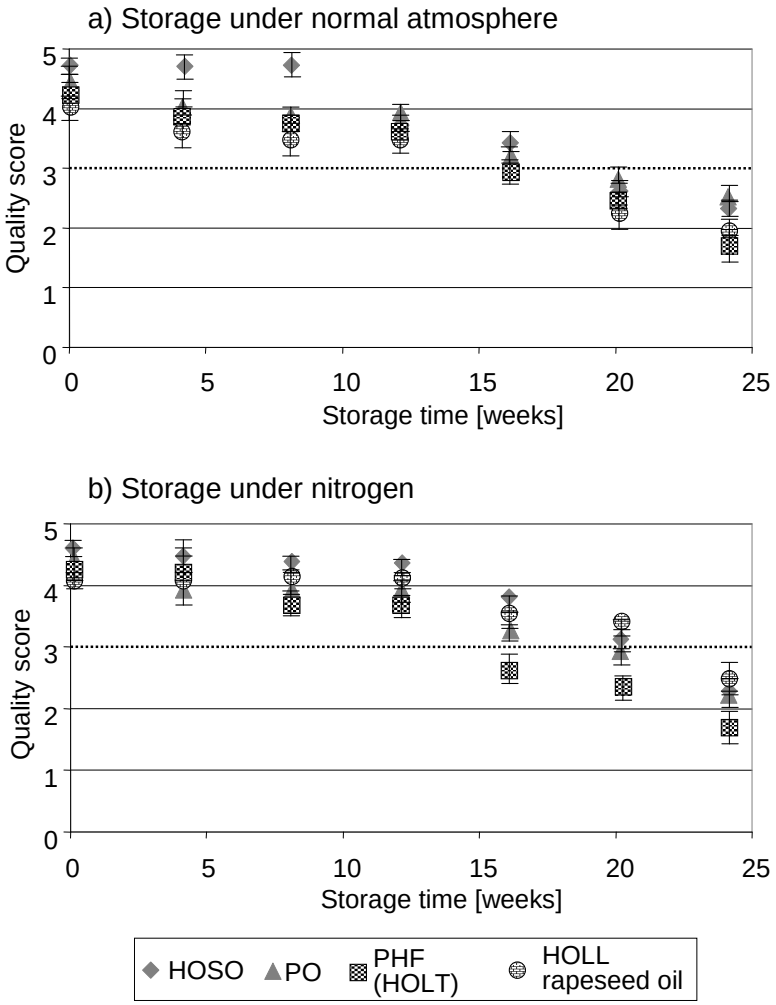


Figure 1: Result of the sensory evaluation of potato crisps stored under normal (a) and nitrogen (b) atmospheres.

Table 1: Result of the sensory evaluation of Berlin doughnuts

| | Taste | | Smell | |
|---|---|---|---|---|
| | **Fresh** | **3 months** | **Fresh** | **3 months** |
| **Frying medium** | **Frying temperature: 170 °C** | | | |
| High-oleic, low-linolenic rapeseed oil | perfect | slight oily, abnormal taste | normal | slight abnormal smell |
| Palm olein | perfect | slight oily | neutral | normal |
| Partially hydrogenated fat (HPLT) | perfect | abnormal taste | neutral | abnormal smell |
| Partially hydrogenated fat (HT) | perfect | slight abnormal taste | neutral | slight abnormal smell |
| **Frying medium** | **Frying temperature: 180 °C** | | | |
| High-oleic, low-linolenic rapeseed oil | perfect | abnormal taste | Slight abnormal smell | abnormal smell |
| Palm olein | perfect | normal | neutral | normal |
| Partially hydrogenated fat (HPLT) | perfect | abnormal taste | neutral | abnormal smell |
| Partially hydrogenated fat (HT) | perfect | slight abnormal taste | neutral | slight abnormal smell |

At the beginning of the storage experiment the taste and smell of all fresh Berlin doughnuts was agreeable, independent of the oil used for frying and the frying temperature (Tab. 1). Only the use of HOLL rapeseed oil at 180°C resulted in a slight abnormal smell, which was different from high quality Berlin doughnuts. At 170°C, this negative smell was not noticeable. During storage over a period of 12 weeks the taste and smell of nearly all products changed significantly. While products being fried in PHF (HPLT) showed an abnormal taste and smell after 12 weeks of storage, products being fried in PHF (HT) only had a slight strange taste. The best results were obtained with palm olein. After 12 weeks of storage no deterioration of the sensory characteristics was detected. HOLL rapeseed oil had a slight abnormal smell after 12 weeks for products fried at 170°C. The products were inedible after 12 weeks when 180°C was used to fry the product.

**Conclusion**

The investigation shows that HOLL rapeseed oil can be a good alternative to other commonly used oils for deep frying even if the products have to be stored over a longer period of time. It has to be taken into consideration that the type of the fried product has a strong influence on the suitability of HOLL rapeseed oil as frying medium. In general, the use of HOLL rapeseed oil resulted in comparable or better results than the common used oils. It is important to mention that the application of HOLL rapeseed oil has also some advantages regarding nutritional aspects in comparison to the other commonly used oils, because of low amounts of saturated and no *trans*-fatty acids.

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