A comparative analysis of oil content and fatty acid in different varieties of *Arachis hypogaea* L. from turkey

**Zeynep ERGUN**¹, **Mozhgan ZARIFIKHOSROSHAHI**²

¹Department of Bioengineering, Faculty of Engineering, Adana Alparslan Turkes Science and Technology University, Adana, Turkey  
²Department of Horticulture, Faculty of Agriculture, University of Cukurova, Adana, Turkey

**Abstract**

The aim of the study is to investigate the composition of the oil content and the fatty acids in different varieties (i.e. NC-7, Batem-5025, Osmaniye-2005, Sultan, and Halisbey) of peanut (*Arachis hypogaea* L.) grown in the province of Osmaniye in Turkey. Batem-5025 provided the greatest percentage of oil with 50.30%. Higher concentrations in oil specimens were found for oleic and linoleic acids. The fatty acids in the all varieties were oleic (51.32-62.43%), linoleic (18.27-27.54%), palmitic (8.35-9.69%), stearic (2.64-3.36%), behenic (2.56-2.85%), arachidic (1.43-1.62%), and lignoceric (1.15-1.53%) acids were listed in order of concentration. The saturated fatty acids were observed to be far less than the unsaturated ones (80.07-81.88%) in any of the varieties. The varieties of NC-7 and Osmaniye-2005 had oleic and linoleic acids at the highest concentrations and stearic and palmitic acids at the lowest, respectively. NC-7 showed the best oleic-to-linoleic (O/L) ratio with 3.41.

**Key words:** Peanut (*Arachis hypogaea* L.), fatty acids, varieties, Turkey

**Introduction**

Humans like tropical inhabitants have ever required nutritive value for feeding the world (Nwokolo, 1996; Tai and Young 1975; Higgs, 2003; Akhtar et. al., 2014; Gulluoglu et. al., 2016). As a rich mineral source including Na, Cu, Fe, Zn, Ca, Mg and K; peanut varieties offer quality nutrition with their characteristics of full of energy with protein (25-30%), carbohydrate (9.5-19%), and oil (35-56%). This feature makes the peanut plant indispensable for mitigation of the protein-energy malnutrition (Ahmed and Young, 1982; Yav et al., 2008; Atasie et al., 2009; Ayoola and Adeyeye, 2010; Ingale and Shrivastava, 2011; Chowdhury et al., 2015; Gulluoglu et. al., 2016). In addition to protein, either human or animal diets certainly have fats and oils as key nutrients because these are bountiful sources of energy (9 cal/g) and besides can help to regulate physical systems in the body by providing essential fatty acids which are the building blocks for the required hormones and containing oil-soluble vitamins A, D, E, and K.

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*Corresponding author e-mail: mn_zarifi@yahoo.com*
Our foods with oil are distinguished with texture, softness, taste and satiety (Strayer, 2006). There is plenty of oil in a typical peanut (Grosso et al., 1997; Grosso et al., 2000; Atasie et al., 2009). Peanut oil is shielded from free radicals or other damaging agents because of the ideal composition of fatty acids and antioxidants (Akhtar et. al., 2014). Several extracts from peanut seeds can facilitate medical treatments as they are antioxidative, antibacterial, antifungal and anti-inflammatory (Lopes et al., 2011). The fatty acid concentration may nutritionally enhance peanuts in addition to the advantage of storage (Gulluoglu et al., 2016). The oil quality of each peanut is based highly on its fatty acid composition (Sekhon et al., 1972). To evaluate food products in terms of shelf life, nutrition quality and flavor, the composition of fatty acid is a crucial key (Gaydou et al., 1983; Tang et al., 2013; Norden et al., 1987). For peanut products and its seeds, these criteria are also determined by the combination of fatty acids (FAs) like saturated, monounsaturated fatty acid (MUFA) and polyunsaturated fatty acid (PUFA) included in peanut oil. The high oleic acid (HO) content of peanut oil is nutritionally favored for its best composition and hence so valuable for augmented thermo-oxidative stability in manufacturing as well as health concern. One of the major oilseed crops is peanut (Nawade et. al., 2018). It has been reported that peanut varieties differ significantly in saturated fatty acids contents such as palmitic, stearic, arachidic, behenic and lignoceric acids (Gulluoglu et al., 2016). Oleic, linoleic and palmitic acids were observed to be in high concentrations in peanut kernel oil (Musa, 2010). A negative correlation was found between oleic and linoleic acids (Hammond et al., 1997). The genotypes were not statistically different in the amount of crude oil contained. These fatty acids can be ranked in order of concentrations from the highest to the lowest, as follow: oleic, linoleic, palmitic, stearic and linolenic acids (Kalefetoglu Macar et. al., 2018). The fatty acids of peanut oil varieties have variations in quantity and relative proportions. Nearly 90% of total fatty acids consist of oleic, linoleic and palmitic acids, and the remaining part is stearic, arachidic, 11-eicosenoic, and behenic acids in small quantities (Bansal et. al., 1993; Ahmed and Young, 1982). Oleic acid can be defined as an omega-9 MUFA in peanut oil, and its presence gains seeds better quality with longer shelf life, higher relish, optimized composition of fatty acid, in favor of human health (Barkley et al., 2009; Gundesli et al., 2019). Linoleic acid is an omega-9 PUFA, and it has been tried to obtain low quantities (<10%) in developed peanut varieties, other than higher oleic acids (<74%) (Barkley et al., 2009). Both unsaturated fatty acids comprised approximately three fourth of the peanut oil composition (Ahmed and Young, 1982). O/L ratio increases with higher amount of oil that peanuts contain, or vice versa. Higher concentrations of oleic acid occur with less linoleic acid content (Dwiwedii et al., 1993). Peanuts are more tradable thanks to health benefits when O/L ratio is higher (Andersen and Gorbet, 2002). The common ratio has mainly trended around 1.5-2.0, and the description of “high oleic-acid" in peanuts refers to what O/L ratio approximates to 9 (Davis et al., 2016). The longevity of preserving peanut oil respected as shelf-life depends on fatty acid concentrations, majorly oleic (C18:1) to linoleic (C18:2) acid (O/L ratio) (Mercer et al., 1990; Ahmed and Young, 1982; Grosso et al., 2000; Nawade et al., 2018; Bansal et al., 1993). Increasing O/L decreases the iodine value of oil, extending its shelf-life (Bansal et al., 1993). Peanut seeds are very useful as flour and oil in a variety of sectors for nutritional, medicinal and industrial purposes, providing that the standard procedures are applied with appropriate supplies. Unprocessed peanuts are most effectively used for nutritional and industrial requirements, whereas roasting process has a positive effect on the amount of mineral elements without risk of reduction and thus roasted peanuts satisfy the oil needs for prophylactic or therapeutic efforts in medicine, particularly to deal with male infertility (Ayoola and Adevyeye, 2010). MUFA concentration is high in peanut oil, known as part of a healthy diet to reduce the bad cholesterol levels (LDL) and not negatively influence the good ones (HDL) (Abrar et al., 2018). Furthermore, PUFAs and MUFBs of peanuts are able to raise the HDL levels when consumed in a diet that is of vital importance to maintain well-being with disease prevention (Chowdhury et al., 2015). In the literature, in vitro or in vivo studies propose peanut oil as an effective agent for tackling cardiovascular diseases, particularly atherosclerosis or cancer cases through several metabolisms in a body. The reason is why it contains a great amount of specific antioxidants to increase in the serum of a healthy man, other than MUFBs and PUFAs. Many trials indicated that extracted from peanut oil, polyphenols and sterols made antiproliferative and proapoptotic contributions to cell lines of prostate and breast cancer so that such conditions as cancer, diabetes, and cardiovascular diseases are more likely to be cured (Akhtar et. al., 2014). Throughout a growing season, a group of factors may influence the oil amount and fatty acid concentrations of peanut varieties, including the environmental conditions (growth habit), soil types, seed maturity, and genetic factors. The fatty acid content of peanut oil depends on growth habit (Bansal et. al., 1993; Gulluoglu et al., 2016; Ahmed and Young, 1982; Nawade et al., 2018; Grosso et al., 1994; Dwivedi et al., 1993). There is evidence that the season of produce is significantly different from and even interactive with the growing area, besides yearly variations in oil production (Holaday and Pearson, 1974). The aim of study was to determine the oil contents and the fatty acid compositions of several peanut varieties (NC-7, Batem-5025, Osmaniye-2005, Sultan, and Halisbey) grown in Osmaniye/Turkey and harvested in the year of 2018.

Materials and Methods
We studied the seed kernels of Peanut (Arachis hypogaea L.) varieties (NC-7, Batem-5025, Osmaniye-2005, Sultan, and Halisbey). In this study, all the cultivations were made in the same year (2018) and the region (the province of Osmaniye, Turkey).

Oil extraction
To study the sample seeds were preserved under dry and cool conditions. The soxhlet extraction method was used with an automatic device to get fresh oil from peanut seeds and tubers (9 g each) in order to analyze fatty acids. The used solvent was hexane. The oil content refers to the gram weight of oil extracted from 100 g of the sample.

Determination of fatty acids
Gas chromatography (GC; Perkin Elmer, Shelton, USA) was used to profile the fatty acids included in the oils. The chromatographic column had an inner dimension of 30 m ×
220°C for 10 min; the varieties studied in this study are seven (Table 1). The oil contents of the peanut varieties were as follows: 81.88% (NC-7), 81.33% (Halisbey), and 78.86% (Osmaniy-2005). The highest ratio of O/L was observed in the peanut variety of NC-7, Sultan, Halisbey, and Osmaniy-2005 with 27.54%, 27.54%, and 27.54%, respectively. However, this study showed that the relative proportion of oleic and linoleic acid of the peanut varieties depended on the environmental factors at the growing season. The oil composition of the peanut varieties varied from 46.62% (NC-7) to 78.86% (Osmaniy-2005) by the linoleic acid content. Similar findings have already been reported by Gulluoglu et al. (2016). The recent studies have mainly focused on value peanut oil with cultivating new peanut lines by increasing oleic acid and necessarily decreasing linoleic acid in their content for health and industrial concern (Nawade et al., 2018). In the current study, approximately 90% of total fatty acids in the oil composition of all the peanut varieties studied accounts for oleic, linoleic and palmitic acids. The results are parallel with the study of Kalefetoglu Macar et al. (2018). By O/L ratio, the peanut varieties ranked from 1.86 to 3.41. The highest ratios are in NC-7 (3.41) and Batem-5025 (3.03). It has been determined that the relative proportion of oleic and linoleic acid of the peanut varieties depends on the environmental factors at the growing season (Gulluoglu et al., 2016). Higher ratio of O/L may lead to very longer shelf life (Mercer et al., 1990; Ahmed and Young, 1982; Grosso et al., 2000; Bansal et al., 1993). Thus, NC-7 and Batem 5025 varieties are important materials among the analyzed varieties in terms of shelf life.

The peanut economy has widely experienced HO varieties in recent times for higher storage quality than traditional ones. When O/L ratio is equal to or exceeds 9, the variety is normally categorized under HO peanuts, whereas the most conventional varieties can reach only up to 1.5-2.0 (Davis et al., 2016). However, this study showed that two varieties (NC-7 and Batem 5025) from Osmaniye/Turkey had higher O/L content than varieties from previous studies. The content of saturated fatty acids (palmitic, stearic, arachidic, behenic, and lignoceric acids) had statistically significant variations among the analyzed peanut varieties (Table 1). The O/L calculations from the lowest to the highest values as follows: 8.35 to 9.69% for palmitic acid, 2.64 to 3.36% for stearic acid, 1.43 to 1.62% for arachidic acid, 2.56 to 2.85% for behenic acid, and 1.15 to 1.53% for lignoceric acid. Out of the saturated fatty acids, palmitic acid had the highest percentage for all the peanut varieties (Sogut et al., 2016; Gulluoglu et al., 2016).
Different letters stated in the same row are statistically important. N.S: non-significant, *, p<0.05; **p>0.01.
SFA: Saturated Fatty Acid, MUFA: Mono Unsaturated Fatty Acid, PUFA: Poly Unsaturated Fatty Acid

### Conclusion

In this study, the unsaturated fatty acids in the extracted oil from the studied peanut (*Arachis hypogaea* L.) varieties (NC-7, Batem-5025, Osmaniye-2005, Sultan and Halisbay) were found to be much higher than the saturated fatty acids. The highest ratio of oleic to linoleic (O/L) was observed in the variety of NC-7 and Batem 5025. Furthermore, the seed kernels of the sample varieties produced higher content of monounsaturated fatty acids (MUFA). The obtained results in this study are essential to assist the researchers and the manufacturers in future works regarding the peanut plant.

### Conflict of Interest

The authors declare that they have no conflict of interest.

### Author Contributions

Z.E. and M.Z. contributed equally to this manuscript. The authors contributed to the discussion of the results and all of them read and approved the final manuscript.

### References


