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# OIL AND FATTY ACID COMPOSITION OF PEANUT CULTIVARS GROWN IN PAKISTAN

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**Abstract**

Quality and flavor of edible peanuts and its products are affected by fatty acid composition of oil. The information related to chemical composition of Peanut grown in the country are scarce, therefore, the present investigation was designed to determine the oil and fatty acid composition of some commonly grown peanut cultivars in Pakistan. Seven Peanut cultivars were grown during 2008 in randomized complete block design replicated thrice. The tested cultivars differed significantly for oil content which ranged from 49.83 to 53.06% on dry weight basis, thus showing differences of 7% among cultivars. The saturated fatty acids (Palmatic & Stearic acid) in different cultivars ranged between 9.95 to 10.79% and 1.63 to 2.19%, respectively. Differences among cultivars for oleic acid exhibited significance which ranged between 49.34 to 54.83%. Similarly, cultivars differed statistically for linoleic acid which showed a range of 28.99 to 34.23%, thus depicted difference of 7%. Significant differences among tested cultivars may be attributed to the place of origin of particular cultivar. An inverse relationship was exhibited between oleic and linoleic acid, similar to other edible oils.

## Introduction

Peanut seeds contain 44-56% oil and 22-30% protein on a dry seed basis. In addition, they are a good source of minerals (phosphorus, calcium, magnesium and potassium) and vitamins (E, K and B group). Besides physical (seed mass and shape, integrity of seed testa and blanching efficiency) and sensory (seed color, texture, flavor) factors, nutritional (oil, protein contents, fatty acid and amino acid composition) factors are important in the food trade. The nutritional and storage qualities of peanut depend on the relative proportion of saturated and unsaturated fatty acids in the oil (Savage & Keenan, 1994). However, Win *et al*., (2011) reported higher antioxidants in roasted peanuts. A high proportion of polyunsaturated fatty acid is desirable because it lowers plasma cholesterol and low-density lipoprotein content, which may reduce the risk of coronary heart disease.

The quality and flavor of edible peanuts and peanut products can be affected by the fatty acid composition of the lipid. Although eight major fatty acids are present in peanuts yet four palmitic, stearic, oleic and linoleic acids make up about 90% of total peanut triacylglycerols (Ahmed & Young, 1982). Conflicting trends have been observed for changes in fatty acid profiles as seeds mature. Strong negative correlation between oleic and linoleic acids have been reported in peanut (Dwivedi *et al*., 1993) and other oilseed crops like brassica (Hassan *et al*., 2007) and sunflower (Hassan *et al*., 2011). However, differences in climatic conditions results variations in the oleic/linoleic acid ratio for a given genotype.

The high oleic to linoleic acid ratio characteristic could confer a significant health advantage to the consumer and has the potential to greatly enhance the marketability of peanuts. Nutritional quality of the seed is strongly influenced by production location, cultivar and season, particularly soil moisture and temperature during crop growth and seed maturation. In Pakistan, out of the total area under peanut, approximately 80% lies in Pothwar tract which contributes 92% in the total production of the country (Anon., 2011). The environmental condition (climate and weather) where it is grown (Pothwar) varies too much, particularly the pattern, rainfall distribution/frequency and temperature. Rainfall in the northern parts of the region ranges between 1000 to 1500 mm while in the southern parts only receives 300-400 mm of rain annually. Rainfall pattern in the Western and the Eastern areas (Jhelum & Attock) also varies between 450-750 mm. Temperature fluctuates similar to the rainfall pattern particularly during the showers of rains and thereafter.

Fatty acid contents in a genotype are affected by drought stress particularly end of season drought decreased oil and linoleic acid accumulation (Dwivedi *et al*., 1993). Fatty acid composition of peanut seeds from various maturity classes and varieties have been studied else where in the world (Anderson *et al*., 1998). However, information related to most of the varieties grown in Pakistan are lacking. The major focus of the breeding program has been the improvement in yield and yield related traits. Quantity and quality of oil in term of fatty acid has rarely been studied. With the introduction of WTO regime, it shall not be possible to trade any commodity without all its information. Keeping in view the importance of the crop in rainfed areas, the present study was planned with objective to determine the oil and fatty acid composition of some commonly grown cultivars in Pothwar.

## Materials and Methods

To investigate oil and fatty acid composition of peanut cultivars, field experiment was conducted at PMAS-Arid Agriculture University, Research Farm Chakwal Road, Rawalpindi during 2008, located at longitude of 33°*06*'N and latitude 73°*00*'E, 502 m a.s.l. The climatic conditions prevailed during crop growth period is shown in Fig. 1. The particular piece of land was fallow during winter season. After winter rains field was plowed with ordinary cultivator. Final seedbed preparation was done by giving one furrow turning plow followed by three ordinary plowings along-with planking. Seven cultivars viz. No. 334, Banki, Chakori, BARI-2000, BARD-479, SP-96 and SP-2000 were sown in a

randomized complete block design with three replications in a plot size of 5.5 x 2.7 m on 27th March, 2008. In each plot there were six rows; 45 cm apart each row. Recommended dose of fertilizer 20:80:40 NPK incorporated at time of last plowing. Sowing was done by hand drill using seed rate of 70 kg kernel/hectare. Weeds were kept under control as and when required by manual weeding. At maturity samples of one kg kernel from each treatment were collected from two central rows on 26th November, 2008. Unshelled samples were sun dried for one week. Kernels were shelled by hand. The shelled nuts were again sun dried for two days, thereafter analysed for oil and fatty acid.

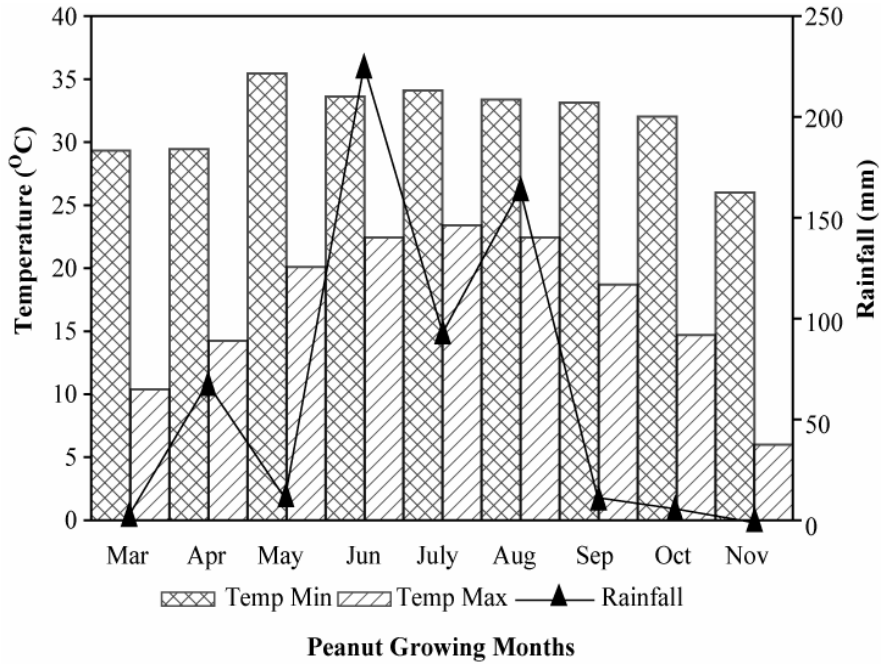


Fig. 1. Climatic conditions of site during peanut growing months.

**Oil and fatty acid determination:** The shelled nuts from each treatment were separately analyzed for oil content with NMR (Nuclear Magnetic Resonance system), Model MQA-7005, Oxford Institute, USA, by standardizing the equipment with six different oil contents having the samples previously analyzed, thus oil content in each treatment was recorded (Warnsely, 1998). The fatty acids in oil were analyzed by a gas chromatograph (AIML-NUCON) after intersterilification with methanolic KOH. In this method, fatty acids were converted to methyl esters prior to analysis by Gas Chromatography (GC). Oil samples (50$_{\mu}$L) were methylated in 4ml 1 M KOH for one hour at room temperature. The resultant fatty acid methyl esters (FAME) were extracted with High Performance Liquid Chromatography grade hexane and analyzed by GC using a fused capillary column (WCOT fused silica 30m x 0.25 mm coating CPWAX 52 CBDF = 0.25 $_{\mu}$M, CP8713, a flame ionization detector (FID) and nitrogen gas as carrier (3.5 ml/min). GC split ratio was 100%. Injector and Detector temperatures were 260$^{o}$C and column oven temperature was 222$^{o}$C for 7.5 minutes. FAMEs were injected manually. Fatty acids were detected by chromatographic retention time by comparison with authentic standards (Paquot, 1988). Recorded data were subjected to standard analysis of variance techniques using computer program M.Stat C (Freed & Eisensmith, 1986). Differences of means were compared for significance at 5% probability (Montgomery, 2001).

## Results and Discussion

Oil accumulation in Peanut is affected by number of factors such as temperature, moisture availability, fertilization and their interaction. In present study, Peanut cultivars differed statistically for oil content (Table 1). The maximum oil content (53.06%) observed in SP-96 which remained significantly higher and different from rest of the tested cultivars. The cultivar No. 334 had the minimum oil content (49.83%). The significant differences among different cultivars was attributed to the genetic make up of a particular cultivar (type bunch or erect), its place of origin and the environmental conditions prevailing during the crop life cycle. The end of season moisture stress has been concluded to decrease oil content (Dwivedi *et al*., 1993). The cultivars tested belonged to diverse origin having different genetic make up. Higher oil content of SP-96 and SP-2000 was related to their place of origin i.e., Swat, having a cooler climate as compared to the production site, thus higher temperature would have enhanced the oil accumulation. Higher oil accumulation with increase in temperature is similar to other oilseed crops (Qadir *et al*., 2006). Demurin *et al*., (2000) found an increase in oil content with increase in temperature during flowering to maturity in Sunflower and Maize. They also reported that 1$^{o}$C rise in temperature increased oil content by 1% in Sunflower. Similarly, Kaleem & Hassan (2010) observed variation in oil content in different circles of sunflower head which was mainly driven by temperature.

**Table 1. Oil and fatty acid composition of peanut cultivars.**

| Cultivars | Oil (%) | Palmatic acid (%) | Stearic acid (%) | Oleic acid (%) | Linoleic acid (%) |
|---|---|---|---|---|---|
| SP-96 | 53.06 | 10.42 | 1.76b | 49.34 | 34.23 |
| SP-2000 | 52.44 | 10.17 | 2.19 | 54.78 | 29.08 |
| BARI-2000 | 52.17 | 9.95 | 1.67 | 54.83 | 28.99 |
| BARD-479 | 51.80 | 10.42 | 1.63 | 51.28 | 32.75 |
| Chakori | 51.25 | 10.79 | 2.01 | 53.37 | 30.23 |
| Banki | 51.11 | 10.62 | 1.85 | 52.19 | 31.31 |
| No. 334 | 49.83 | 10.55 | 1.75 | 51.73 | 32.34 |
| SE | 0.174 | 0.118 | 0.021 | 0.339 | 0.396 |

Statistically significant differences were observed among cultivars for palmatic acid. The maximum (10.79%) palmatic acid was recorded in Chokari, significantly higher from rest of the cultivars except those of Banki and No. 334, those were statistically at par with each other. The minimum (9.95) palmatic acid was observed for BARI-2000 (Table 1). The significant differences for palmatic acid among cultivars was attributed to the genetic makeup and place of origin of a particular cultivar. All of the cultivars tested were bred at diverse centers having divergent temperature and moisture regimes. A range of 6.3–8.2% of palmatic acid in Australian cultivars has been reported by Weiss (2000). Thus, our results were consistent to those reported by Weiss (2000) and cultivars grown in Pakistan match the international standard of fatty acids.

Data revealed statistically significant differences among cultivars for stearic acid (Table 1). The cultivar SP-2000 accumulated the highest (2.19%) stearic acid which significantly differed from rest of the cultivars except Chakroi. Though BARD-479 accumulated the lowest (1.63%) stearic acid but it was statistically at par with rest of the cultivars except those at the top. Significant differences among the cultivars was due to genetic makeup of the cultivars, their place of origin and environmental changes taking place during the time of flowering to maturity (Anderson *et al*., 1998). Khan (1997) reported 2% of stearic acid in Peanut seeds which confirms the findings of present study. Similarly, Weiss (2000) reported stearic acid range of 4.9-6.2% in Australian Peanut which is higher than those observed in present study, thus cultivars grown in Pothwar are superior to those grown in other parts of the world.

Data presented in Table 1 revealed statistically significant differences among cultivars for oleic acid content. The highest (54.83%) value recorded in BARI-2000 which was statistically at par with SP-2000 but significantly different from rest of the cultivars. The lowest (49.34) oleic acid was recorded in SP-96. The oleic acid recorded in this study was higher than those reported by Khan (1997) but similar to those reported by Weiss (2000) who found a range of 52.3-60.1% of oleic acid in different cultivars commonly grown in Australia, thus, cultivars grown in Pakistan are of similar qualities of international standards.

The accumulation of linoleic acid in different cultivars showed statistically significant variations (Table 1). The highest (34.23%) linoleic acid was recorded in SP-96 which was significantly different from rest of the cultivars. The lowest linoleic acid (28.99%) was recorded in BARI-2000 which was statistically at par with SP-2000. The significant differences among cultivars may be attributed to their genetic make up and the place of their origin. Weiss, (2000) reported a range of 20-40% linoleic acid in different cultivars. The type of groundnut (bunch or erect) of the cultivar is also considered responsible for variation of linoleic acid. In other oilseed crops such as Sunflower and Brassica linoleic acid showed inverse relationship with oleic acid. Similarly, in present study linoleic acid showed inverse relationship (Fig. 2) with oleic acid, which is confirmatory to earlier reported by Dwivedi *et al*., (1993). It also depicted that peanut oil of cultivars grown in Pakistan de-saturates to linoleic acid as in other oilseed crops which is mainly governed by prevailing temperature at and near maturity.

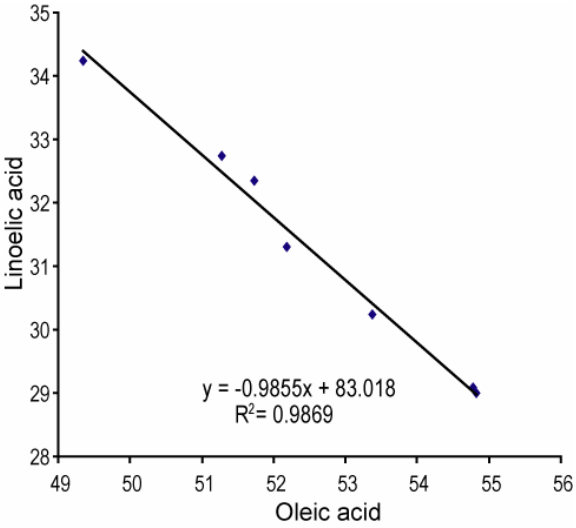


Fig. 2. Relationship between oleic and linoleic acid.

## Conclusion

It may be concluded from present investigation that peanut cultivars commonly grown in the country match the international quality standards in terms of oil and fatty acid composition. Thus, there is no technical barrier to country's peanut products to enter into international trade.

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