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# Nutritional composition of new peanut (*Arachis hypogaea* L.) cultivars

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**RESUMEN**

**Composición nutricional de nuevas variedades de cacahuate (*Arachis Hypogaea* L.)**

Se estudio el rendimiento agrícola y composición química (proteína, grasa, carbohidratos, fibra y cenizas), perfil de amino ácidos, digestibilidad, perfil de ácidos grasos, contenido de tocoferol y de esteroles de seis variedades de cacahuate (*Arachis hypogaea* L.) Col-24-Gro, Col-61-Gto, VA-81-B, Ranferi Díaz, NC-2 y Florunner. Los resultados mostraron que el mayor rendimiento se logró en las variedades Ranferi Díaz y Col-61-Gto (6.3 Ton/ha). El contenido de proteína fue de 23.5 a 26.6% y el contenido de grasa en un intervalo de 49.8 a 53.4%. La digestibilidad promedio de las seis variedades fue de 86%. El contenido de lisina y treonina en la proteína de todas las variedades fue suficiente para satisfacer los requerimientos del humano. La composición del aceite de las diferentes variedades de cacahuate se caracterizó por contener de 15-18% de ácidos grasos saturados. La relación oleico/linoleico fue de 1.3-1.4. El contenido de tocoferoles totales fue entre 390 a 706 ppm. El mayor contenido de tocoferol correspondió a las variedades con los rendimientos más bajos. Con respecto al contenido de alfa tocoferol se encontró entre 90-150 ppm y el gamma tocoferol fue entre 270-570 ppm. El contenido de β-sitosterol fue similar en las seis variedades (aprox. 65%). La variedad Ranferi Diaz presentó el más alto rendimiento agronómico y el más alto contenido de proteína. Sin embargo, esta variedad presento el más bajo contenido de ácido oleico, bajo contenido de esteroles y bajo contenido de tocoferoles totales. Estas diferencias entre las variedades de cacahuate sugieren que cada una de ellas deberá tener diferente uso como alimento.

*PALABRAS-CLAVE: Arachis hypogaea L. – Cacahuate – Composición química – Digestibilidad – Esteroles – Tocoferoles.*

**SUMMARY**

**Nutritional composition of new Peanut (*Arachis hypogaea* L.) cultivars**

Six peanut (*Arachis hypogaea* L.) cultivars (Col-24-Gro, Col-61-Gto, VA-81-B, Ranferi Díaz, NC-2 and Florunner) were studied for agricultural yield, chemical composition (protein, fat, carbohydrates, fiber and ash), amino acid profile, digestibility, fatty acid profile, tocopherol and sterol contents. Results indicated that Ranferi Díaz and Col-61-Gto presented the highest yield (6.3 Ton/ha). Protein content was from 23.5 to 26.6% and fat content ranged from 49.8-53.4%. Mean digestibility was 86%. Lysine and threonine levels in all cultivars were sufficient to meet human requirements. Total saturated fatty acids ranged from 15-18%. The oleic/linoleic ratio was estimated 1.3-1.4. Tocopherol levels varied from 390 to 706 ppm. The highest tocopherol levels corresponded to the cultivars with the lowest yield. The alpha tocopherol content was estimated at 90-150 ppm, while gamma tocopherol was 270-570 ppm. The main sterol present was β-sitosterol (approx. 65%). Ranferi Diaz variety presented the highest agronomic yield and the highest protein content but low oleic acid, low sterols and low total tocopherols. The differences among cultivars suggest differences in their applications.

*KEY-WORDS*: *Arachis hypogaea L. – Chemical composition – Digestibility – Peanuts – Sterols – Tocopherols.*

## 1. INTRODUCTION

Peanuts (*Arachis hypogaea* L.*)* are among the major oilseeds in the world. The peanut cultivar plays an important role in the economy of several countries (China, India, U.S.A., Netherlands, UK, Germany, Russia and Spain). The first three countries constitute the main suppliers of peanuts to the rest of the world. The remaining countries in the list depend totally on the importation of peanuts to meet their internal consumption needs. This is due mainly to a lack of tropical agricultural conditions to grow this product (USDA-NASS*,* 2004). The peanut consumption pattern varies among developed and developing countries. In the United States, the major proportion of this crop is processed for direct consumption as peanut butter, salted peanuts, and confectionary. In India, peanuts

are used mainly for oil production. In 2003, the US Food and Drug Administration reported that scientific evidence suggests that eating 1.5 ounces (43 g) per day of most nuts (including peanuts), as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease (Alper and Mattes, 2003).

In addition, regular peanut consumption has been associated with a reduced risk in developing Type II diabetes (Jiang *et al*., 2002), cardiovascular disease (Kris-Etherton *et al*., 1999), colon, prostate and breast cancer (Awad *et al*., 2000). It also seems to reduce osteoporosis and deficiencies in protein intake (Messina, 1999). Recently, it has been associated with metabolic benefits in the context of counteracting metabolic dysfunction associated with the increasing prevalence of obesity and metabolic syndrome (Coates and Howe, 2007).

Peanuts contain important components for human nutrition. Peanuts high nutritional content is attributed to the presence of biologically active compounds such as, tocopherols, flavonoids, phytosterols, resveratrol, as well as to their relatively high level of protein and their easy oil digestibility (Venkatachalam and Sathe, 2006; Tuberoso *et al*., 2007). The fat content in peanuts has been largely studied. In general, peanuts contain 50-55% fat of which approximately 30% is linoleic acid and 45% is oleic acid. The latter is susceptible to the development of rancid and off-flavors through lipid oxidation. Of particular interest is the oleic/linoleic ratio, which is currently used as a stability index and shelf life index for industrial applications. It is predicted that the use of high-oleic peanuts rather than normal peanuts would increase shelf life and thus improve the oxidative stability of peanut products (Isleib *et al*., 2006). Peanuts (*Arachis hypogaea* L.*)* contain various oleic/linoleic ratios (Venkatachalam and Sathe, 2006; Isleib *et al*., 2006). This quality is affected by cultivar location (Grosso *et al*., 1994), soil temperature (Golombek *et al*., 1995), atmospheric temperature, and amount of rain (Casini *et al*., 2003). Recently, several attempts have been made to produce new cultivars with improved nutritional qualities such as chemical composition, phytochemicals and high oleic/linoleic ratios (Jonnala *et al*., 2005a).

Due to the important nutrient components of peanuts and the high demand of this oily seed, it would be interesting to develop high yielding cultivars without modifying its nutrient qualities. This is an important issue because a negative correlation between protein content and high yield has been reported in chickpeas (Al-Karaki and Hammouri, 1999) and wheat (Oury *et al*., 2003).

The main purpose of this study was to evaluate the correlation between agricultural yield and nutrient properties as wells the nutrient components in six cultivars of peanuts (*Arachis hypogaea* L.*)*.

## 2. MATERIALS AND METHODS

### 2.1. Materials

The six peanut cultivars used in this study were: Col-24-Gro, Col-61-Gto, VA-81-B, Ranferi Díaz (INIFAP, 1995), NC-2 (North Carolina, 1953) and Florunner (Florida, 1969). These cultivars were grown by the Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias (INIFAP) in the city of Úrsulo Galván, Veracruz, Mexico (19º 23´ NL and 96º 19´ WL) 10 meters over sea level. Average monthly temperature was 26.1-27.6 °C and total rain precipitation was 791.6 mm.

### 2.2. Yield and Chemical Composition

Each cultivar production was estimated in Ton/ha of peanut. Three groups were classified according to yield: low, medium and high yield.

The chemical composition was estimated according to the following methodology: Moisture (AOAC, 950.46); Ashes (AOAC, 923.03); Fiber (AOAC, 978.10); Protein by Kjeldahl (AOAC, 928.08) and Fat by Soxhlet (AOAC, 1995). Carbohydrate level was estimated by difference.

### 2.3. Nutritional Quality

Each dried sample was treated with hexane (1:3 w/v) to obtain the oil fraction which was used to measure the lipid composition (fatty acids profile, tocopherols and sterols). The defatted flour was used to measure protein quality (amino acid profile and digestibility).

*Amino Acid Profile*

The amino acid profile was measured by HPLC (Varian, Model 9012) equipped with UV detector (Varian Fluorichrom Detector) according to Vazquez-Ortiz *et al*., (1995). The amino acid separation was performed at 330 nm in a Micrhosorb column with C-18 particles of octadecil dimethylsilane, 3 µm particle size (10 cm $\times$ 4.6 mm; Rainin Instrument Co., Emeryville, CA). The mobile phase was methanol and the buffer solution was sodium acetate (0.1M) at 1.4 mL/min flow rate. Identification of the peaks was performed using an excited $\lambda$ of 330 nm and emission filter of 428 nm, according to the retention times of standards.

Dried and ground peanut sample solutions were prepared at 6.25 mg protein/mL, which were hydrolyzed during 10 min at 37 °C by using an enzymatic mixture, containing 1.6 mg Trypsin, 3.1 mg chymotrypsin, 1.3 mg protease/mL (Sigma, St. Louis MO). pH changes were registered to determine the digestibility percentage according to Hsu *et al.,* (1977). The Protein Digestibility Corrected Amino acid Score (PDCAAS) was determined considering the amino acid profile, the % of digestibility and RDA of amino acids for children aged 2-5 years old (Henley and Kuster, 1994). The formula used was PDCAAS = [Essential

Amino acids content in 1 g of testing protein/ Essential amino acid content in 1 g of reference protein (mg)] × % of digestibility.

*Fatty Acid Profile*

Samples were saponified and methylated using the AOCS Ce 2-66 method (AOCS, 1998). The methyl esters were analyzed according to Medina-Juarez *et al*., (2000), using a Varian chromatograph (Mod. 3400, Varian, Mexico City, Mexico) equipped with an FID detector and the appropriate software (Varian Associates, Inc.). The capillary column was SP-2560, 100% packed with Plysiloxane Bicianopropil as stationary phase (100m × 0.25 mm, Supelco, Bellefonte, PA). The initial oven temperature was 140 °C, using a temperature rate of 4 °C/min up to 200 °C and 1.5 °C/min up to 235 °C. FAME peaks were identified by comparison with the retention time of the respective standards (Sigma Chemical Co., St. Louis, MO). Quantification was done using C17:0 as the internal standard (Sigma Chemical Co., St. Louis, MO). All of the solvents used were of analytical reagent grade from Merck (Merck, SA, México). Results are expressed as weight percentages of oil and they are the mean of two replicates.

*Tocopherols*

Tocopherols content was determined by high performance liquid chromatography (HPLC) according to the procedure described by Medina-Juarez, *et al*., (2000). Two grams of oil were dissolved in 25 mL of hexane. The samples (100 µl) were directly injected into a Varian 9050 chromatograph (Varian, Mexico City, Mexico) equipped with an ultraviolet detector (Varian 3400). A normal-phase LiChrosorb Si60 Supelco column (25 cm × 4 mm, 5 µm; Supelco-Sigma, Aldrich Quimica, México) was used, operating at room temperature. The mobile phase was hexane:isopropanol (99.5:0.5 v/v) at 1.7 mL/min flow rate. Tocopherols were measured at 292 nm. The peaks of the chromatogram were identified by comparison with the retention times of the respective standards (Supelco-Sigma, Aldrich Química, México). Purity and stability standards were defined by extinction coefficient ($E^{1\%}$) values measured in a spectrometer (PE UV-Vis Lambda 2S, Perkin Elmer of Mexico). The technique was verified using a certified coconut standard (NBS 1563-2, NIST, Gaithersburg, MD).

*Sterols*

The sterols content was determined according to the procedure described by Gutiérrez et al., (2000). Oil samples (5 g) and internal standard (cholesterol) were saponified with 10 M KOH (5 mL) in ethanol (45 mL). The solution was heated for 30 min at 70 °C. After saponification, 100 mL water was added and the unsaponified materials were extracted twice with 100 mL diethyl ether. The combined diethyl ether fractions were dried over anhydrous sodium sulfate. Samples (50 µL) were analyzed using a Varian 9050 HPLC chromatograph (Varian, Mexico City, Mexico) equipped with an ultraviolet light detector Varian 3400 and a Supelcosil LC-18 column (25 mm × 4 mm, 5 µm; Supelco-Sigma, Mexico). Wavelengths were programmed to detect each sterol at 205 nm (Holen, 1985). The mobile phase was methanol with 1.6 mL/min flow rate. The peaks of the chromatogram were identified by comparison with the retention times of standards of β-sitosterol, stigmasterol and campesterol (Supelco-Sigma, Aldrich Química, México).

### 2.4. Statistical Analysis

Descriptive statistics (mean and standard deviation), one-way ANOVA and Tukey´s multiple comparison test analysis were applied with Minitab for Windows, version 10.2, using 5% significance level.

## 3. RESULTS AND DISCUSSION

### 3.1. Yield and Chemical Composition

Table 1 shows the yield and the chemical composition of the six peanut cultivars used in this study. Peanut cultivars were divided according to yield into three categories: low (average 2.5 ton/ha), medium (average 4.2 ton/ha) and high (average 5.9 ton/ha) yield. Nevertheless, all of them were superior in relation to conventional peanuts, in Mexico it reaches yields of 2-3 ton/ha (Figueroa *et al*., 2005). Protein content varied from 23.5 ± 1.2

Table 1
**Yield and chemical composition of six peanut (*Arachis hypogaea* L.) Cultivars**

| Cultivars | Yield (Ton/ha) | Ashes (%) | Fiber (%) | Carbohydrates (%) | Protein (%) | Fat (%) |
|---|---|---|---|---|---|---|
| Ranferi Díaz | 6.3 ± 0.2$^{b}$ | 2.2 ± 0.0$^{d}$ | 3.9 ± 0.3$^{a}$ | 19.4 ± 1.0$^{a}$ | 26.6 ± 0.2$^{b}$ | 52.8 ± 1.9$^{ab}$ |
| VA-81-B | 4.4 ± 0.1$^{c}$ | 2.4 ± 0.1$^{bc}$ | 4.0 ± 0.6$^{a}$ | 20.5 ± 0.5$^{a}$ | 24.8 ± 0.1$^{ab}$ | 51.9 ± 0.7$^{ab}$ |
| NC-2 | 3.9 ± 0.8$^{ac}$ | 2.5 ± 0.0$^{b}$ | 3.3 ± 0.1$^{a}$ | 18.9 ± 2.6$^{a}$ | 25.1 ± 0.3$^{ab}$ | 53.1 ± 2.1$^{b}$ |
| Col-61-Gto | 5.4 ± 0.4$^{bc}$ | 2.3 ± 0.0$^{c}$ | 3.5 ± 0.7$^{a}$ | 23.0 ± 0.2$^{a}$ | 24.6 ± 0.3$^{ab}$ | 50.1 ± 0.4$^{a}$ |
| Col-24-Gro | 2.5 ± 0.2$^{a}$ | 2.2 ± 0.0$^{d}$ | 4.4 ± 0.3$^{a}$ | 20.8 ± 1.8$^{a}$ | 23.5 ± 1.2$^{a}$ | 53.4 ± 0.4$^{b}$ |
| Florunner | 2.5 ± 0.3$^{a}$ | 2.0 ± 0.1$^{a}$ | 3.8 ± 0.3$^{a}$ | 23.4 ± 0.5$^{a}$ | 24.9 ± 0.4$^{ab}$ | 49.8 ± 0.1$^{a}$ |

Values represent means of duplicated ± standard deviation.
Values in the columns with different letters (a-d) are significantly different ($p < 0.05$).

(Col 24 Gro) to 26.6 ± 0.0 (Ranferi Díaz). Fat content, on the other hand, was from 49.8 % ± 0.1 in the Florunner cultivar to 53.4 % ± 0.4 in Col-24 Gro. These two chemical components constitute the main components in peanut cultivars. These values correspond to the expected percentages normally found in peanuts (Jonnala *et al*., 2005a; Jonnala *et al*., 2005b).

### 3.2. Nutrition Quality

*Amino Acid Profile*

As expected, glutamic acid (177 mg/g protein), aspartic acid (114 mg/mg protein) and arginine (125 mg/g protein) were the predominant amino acids in peanut cultivars. Glutamic and aspartic acids are considered essential amino acids by Reeds, (2000). Arginine is associated with the cardiovascular system as a precursor to nitric oxide synthesis, which is an important blood pressure regulator (Lira and Arredondo, 2004; Chavez *et al*., 1992).

Lysine and threonine are considered the only real essential amino acids from the metabolic point of view (Jonnala *et al*., 2005b). The results in this study showed that VA-81-B cultivar contains the highest level of lysine (43.5 mg/ g protein) and threonine (21 mg/ g protein). The PDCAAS on average was 86.3% for all peanut cultivars studied. It was shown that lysine and threonine are limiting amino acids for this age group (Table 2). However, considering adults' amino acid daily requirements, the content of these two essential amino acids are enough to cover the RDA.

*Fatty Acid Profile*

Peanut oil is characterized by 45.2% oleic acid (18:1) and 32.4% linoleic acid (18:2). In the six new cultivars the oleic acid (18:1) ranged from 43.4 to 46.2%, and linoleic acid (18:2) went from 32 to 32.6%. The total saturated and unsaturated fatty acid content averaged 17% and 79% respectively (Table 3). There is a general tendency to avoid peanut consumption due to high fat content. However, the oil is easily digestible and peanut consumption has been associated with the prevention of cardiovascular disease (Alper and Mattes, 2003; Kris-Etherton *et al*., 1999) and a reduced risk of developing type II diabetes (Jiang *et al*., 2002). This protective role of peanut consumption is attributed to the presence of biologically active compounds such as, tocopherols, flavonoids, phytosterols, resveratrol (one of the components responsible for the health benefits of red wine consumption) and to high oleic/linoleic ratios (Venkatachalam and Sathe, 2006; Tuberoso *et al*., 2007; Sanders *et al*., 2000). The oleic/linoleic ratio is an important parameter in terms of oil stability, the higher the ratio the more stable the oil (Branch *et al*., 1990). In this study, the ratio was 1.4 on average. Grosso and Guzmán, (1995) studied local peanut cultivars in Peru and reported an oleic/linoleic ratio of 1.2. The oleic/linoleic ratio in oil depends on several factors: type of soil; high precipitation and sandy soils promote a high ratio (Grosso *et al*., 1994; Holaday and Pearson, 1974), soil and air temperature; the higher, the better (Golombek *et al*., 1995; Casini *et al*., 2003). The environmental and soil conditions (sandy, high

Table 2
**Digestibility, lysine, threonine, and PDCAAS of six peanut (*Arachis hypogaea* L.) cultivars**

| Cultivars | Digestibility %[e] | Lysine mg/g protein | Threonine mg/g protein | PDCAAS Lysine[f] | PDCAAS Threonine[f] |
|---|---|---|---|---|---|
| Ranferi Díaz | 87.1 ± 2.1[a] | 38.3 ± 7.3[a] | 12.8 ± 0.3[ac] | 0.6 ± 0.1[a] | 0.3 ± 0.0[ac] |
| VA-81-B | 84.0 ± 0.9[a] | 43.5 ± 8.0[a] | 21.1 ± 1.7[b] | 0.6 ± 0.1[a] | 0.5 ± 0.0[b] |
| NC-2 | 87.1 ± 0.6[a] | 39.1 ± 5.1[a] | 17.0 ± 1.8[d] | 0.6 ± 0.1[a] | 0.4 ± 0.1[d] |
| Col-61-Gto | 87.1 ± 3.3[a] | 43.4 ± 4.1[a] | 14.1 ± 0.8[cd] | 0.7 ± 0.1[a] | 0.4 ± 0.0[cd] |
| Col-24-Gro | 85.1 ± 2.0[a] | 35.5 ± 4.4[a] | 13.9 ± 2.2[cd] | 0.5 ± 0.1[a] | 0.3 ± 0.1[c] |
| Florunner | 87.2 ± 1.4[a] | 42.9 ± 7.4[a] | 9.8 ± 1.4[a] | 0.7 ± 0.1[a] | 0.3 ± 0.0[a] |

Values in the columns with different letters (a-d) are significantly different ($p < 0.05$)
e) Hydrolyzed amino acid percentage by proteolytic enzymes.
f) Protein Digestibility-Corrected Amino Acid Scoring.

Table 3
**Fatty acid profile and oleic/linoleic (O/L) ratio in peanut oil**

| Fatty acids[e] / Cultivars | Total Saturated | 18:1 | 18:2 | O/L | Total Unsaturated |
|---|---|---|---|---|---|
| Ranferi Díaz | 17.8 ± 0.6[bc] | 43.4 ± 0.4[a] | 32.4 ± 0.3[a] | 1.3 ± 0.0[a] | 77.0 ± 0.3[a] |
| VA-81-B | 15.5 ± 0.04[a] | 45.1 ± 0.6[c] | 32.0 ± 0.4[a] | 1.4 ± 0.0[b] | 77.8 ± 1.0[ac] |
| NC-2 | 16.4 ± 0.3[acd] | 46.2 ± 0.4[b] | 32.6 ± 0.3[a] | 1.4 ± 0.0[b] | 79.6 ± 0.5[b] |
| Col-61-Gto | 18.1 ± 0.4[b] | 45.9 ± 0.5[c] | 32.5 ± 0.2[a] | 1.4 ± 0.0[b] | 79.4 ± 0.6[b] |
| Col-24-Gro | 17.8 ± 1.0[bd] | 45.6 ± 0.3[bc] | 32.2 ± 0.3[a] | 1.4 ± 0.0[b] | 79.2 ± 0.4[b] |
| Florunner | 17.1 ± 1.2[ab] | 45.2 ± 0.1[c] | 32.5 ± 0.4[a] | 1.4 ± 0.0[b] | 78.8 ± 0.4[bc] |

[e] g/100 g total fatty acids.
Values in the columns with different letters (a-d) are significantly different ($p < 0.05$).

Table 4
**Tocopherol composition (mg/100 g oil) of peanut oils and α-tocopherol equivalent**

| | Tocopherols (mg/100 g oil) | | | | |
|---|---|---|---|---|---|
| **Cultivars** | α | γ | δ | **Total** | **Eq. α-toc[A]** |
| Ranferi Díaz | 11.1 ± 0.7[d] | 27.3 ± 0.8[a] | 0.6 ± 0.2[ab] | 38.9 ± 0.2[a] | 1.9 |
| VA-81-B | 9.3 ± 0.5[a] | 34.3 ± 0.9[d] | 0.5 ± 0.2[a] | 44.2 ± 0.5[d] | 1.7 |
| NC-2 | 10.0 ± 0.9[ad] | 34.9 ± 1.3[d] | 0.6 ± 0.2[ab] | 45.5 ± 0.4[d] | 1.8 |
| Col-61-Gto | 15.5 ± 0.4[b] | 36.9 ± 1.7[cd] | 1.5 ± 0.1[ab] | 54.0 ± 2.1[c] | 2.6 |
| Col-24-Gro | 12.9 ± 0.8[c] | 39.0 ± 0.6[c] | 2.0 ± 0.1[b] | 53.9 ± 0.3[c] | 2.3 |
| Florunner | 13.1 ± 0.3[c] | 56.8 ± 0.5[b] | 0.8 ± 0.1[ab] | 70.6 ± 0.8[b] | 2.5 |

[A]: mg/portion, 1 portion = 13.5 g oil (USDA-NASS, 2004).
Values in the columns with different letters (a-d) are significantly different ($p < 0.05$).

precipitation and high temperatures) described as favorable factors to increase the oleic/linoleic ratio are typical conditions in Veracruz, Mexico, where the present study was carried out. Cultivars NC-2 and Fluorunner were developed in the 60's in the USA, the oleic/linoleic ratio reported for these cultivars was 1.9 (Hui, 1996), which is higher than the ratio found here (Table 3). Recently, new peanut cultivars have been developed to increase the oleic acid content to around 80%, at the expense of linoleic acid; increasing the oleic/linoleic ratio to around 2.0 (Jonnala *et al.*, 2005a) but also, to increase the phytochemical properties of peanuts (Jonnala *et al.*, 2006b).

*Tocopherols*

Total tochopherols in the peanut cultivars studied ranged from 38.9 ± 0.2 mg/100g (Ranferi Díaz) to 70.6 ± 0.8 mg/100g (Florunner), which were statistically significantly different (Table 4). The total tocopherol content in peanuts is reported between 268 and 510 ppm (Hui, 1996). Recently, new peanut breeding lines were examined for total tochopherols reporting levels of up to 322 ppm (Jonnala *et al.*, 2006a; Jonnala *et al.*, 2006b). The main tocopherols present in peanuts are α- and γ- tocopherols. Hashim, *et al.*, (1993) reported reduced levels of α-tocopherol and increased levels of γ-tocopherols as an effect of peanut maturity. Even though the total tocopherol levels in other oilseeds are higher than those reported here, it is the α- and γ- tocopherols proportion that determines the α- tocopherol equivalent, accounting for the biological activity of vitamin E.

The peanut cultivars studied show that a good correlation ($R2 = 0.7$) between the agronomic yield (Figure 1 and Table 4) and high tocopherol content ($p = 0.05$). Additionally, the low yield cultivars Col-24-Gro and Florunner, showed the highest unsaturated fatty acid content (Table 3). It is well known that the levels of tocopherols in plant systems vary depending on climate stress factors (Demming-Adams and Adams, 2003; Britz *et al.*, 2008) and polyunsaturated fatty acid contents (Kamal-Eldin and Andersson, 1997). In this study, the growing conditions were the same for all cultivars. However, according to these results, the high unsatured fatty acids content in cultivars Col-24-Gro and Florunner could be related with a high tocopherol content. These results should be supported by further investigation.

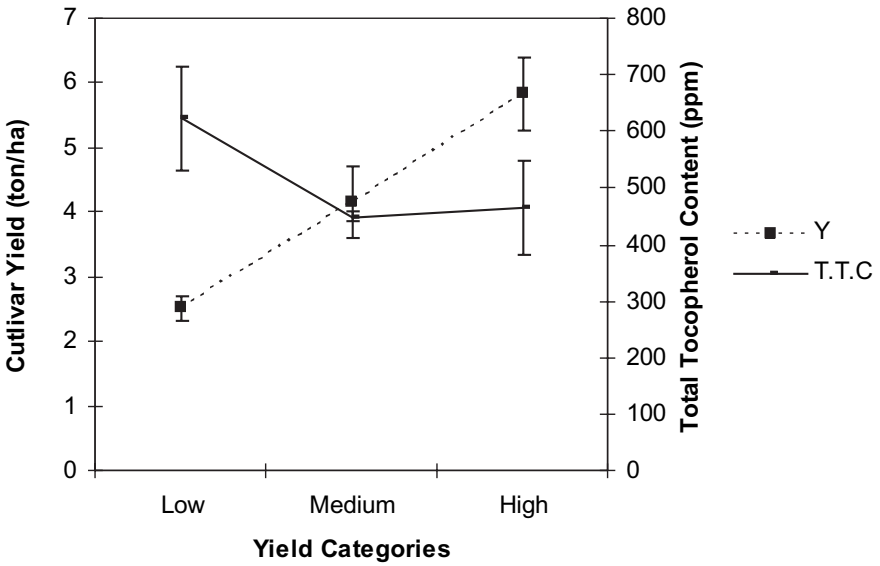


Figure 1
Peanut (*Arachis hypogaea* L.) cultivar yield (Y) and total tocopherol content (T.T.C).

Table 5
**Phytosterol composition (g/100 g total sterols) of peanut oils**

| Cultivars | Stigmasterol | Campesterol | β-Sitosterol |
|---|---|---|---|
| Ranferi Díaz | 9.6 ± 3.1[a] | 7.9 ± 5.4[b] | 62.5 ± 4.0[a] |
| VA-81-B | 9.9 ± 1.5[a] | 13.2 ± 2.9[ab] | 66.9 ± 4.0[a] |
| NC-2 | 11.4 ± 0.7[a] | 13.4 ± 2.2[ab] | 65.2 ± 2.9[a] |
| Col-61-Gto | 10.0 ± 0.6[a] | 9.4 ± 1.3[a] | 70.7 ± 1.8[a] |
| Col-24-Gro | 9.8 ± 0.9[a] | 15.2 ± 2.4[ab] | 65.0 ± 3.2[a] |
| Florunner | 9.1 ± 1.5[a] | 14.3 ± 1.7[ab] | 66.6 ± 3.0[a] |

Means in the column with different letters (a-b) are significantly different ($p < 0.05$).

*Sterols*

Table 5 shows the levels (g/100 g of total sterols) of stigmasterol, campesterol and sitosterol found in this study. Sitosterol was the most abundant and the three accounted for 90% of total phytosterols, which is in accordance with Grosso and Guzmán, (1995). Also, the percentage reported here for sitosterol in peanuts is similar to the recently reported levels of sitosterol in new breeding lines of peanuts (Jonnala *et al*., 2005b; Jonnala *et al*., 2006a; Jonnala *et al*., 2006b). The role of phytosterols in reducing total plasma cholesterol, mainly LDL-cholesterol has been reported by several authors (Alper and Matter, 2003; Coates and Howe, 2007; Valenzuela and Ronco, 2004).

## 4. CONCLUSIONS

It was shown that the production of these cultivars provides a good agronomic yield without detriment to their nutritional quality. The cultivars Ranferi-Díaz and Col-61-Gto had the highest yields, and both represent good choices for agronomical applications and genetic breeding programs.

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