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PHYSICOCHEMICAL CHARACTERISTICS OF SOME NEW PEANUT VARIETIES CULTIVATED IN EGYPT

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ABSTRACT

Peanuts are one of the major oilseed crops in the world and are an important source of protein in many countries. This study was carried out to evaluate new peanuts varieties (Giza5, Gregory and NC). The chemical composition, bioactive compounds and mineral of peanut cultivars were determined. The oil was extracted and physico-chemical properties and the fatty acid composition were determined. Finally, some types of butter were manufactured, and the sensory evaluation of processed butter was studied. Peanut seeds are a rich source of oil content (35.98 to 41.76%). Giza 5 variety has the highest contents of minerals as compared with other varieties. In addition, peanuts are considered an excellent source of certain vitamins, especially vit.E and the B complex. Also, results showed that saturated fatty acids ranged from 20.29 to 21.09%, monounsaturated fatty acids ranged from 41.64 to 42.93% and polyunsaturated fatty acids ranged from 34.67 to 36.07%. Peanuts butter made from Giza5 peanut variety had the best overall acceptability after control sample.

Key Words: Peanuts, Giza5, Gregory, NC and Peanut butter

INTRODUCTION

Peanut (*arachis hypogaea* L.) are known as groundnuts and are one of the most important crops in the world. The cultivation of peanut ranks highly in Egypt as one of the most important edible oil seeds, cash and export crops and a suitable plant to grow in the newly reclaimed area of Egypt. Several phytochemicals including resveratrol, flavan-3-ols and pro anthocyanin's have been identified in peanuts and evaluated for their potential health benefits such as a reduction in cardiovascular disease, colon, prostate & breast cancer, osteoporosis and diabetes. It is a dietary source of Ca, Mg, Fe, Zn, P ,vit.E, riboflavin, and thiamine. For that, peanuts are used as snacks, raw material in food and in the feed industry (**Elsorady & Ali, 2018 and Abbas *et al.*, 2020**). The US armed forces used peanuts as peanut butter (**Savage and Keenan, 1994).**

Peanuts are considered a source of vegetable oil. They are the 4th most important source of edible oil after soybeans, rapeseed & cotton seeds oil and the 3rd most important source of protein (**Savage and Keenan, 1994**). It contain about 43-59% oil. Fatty acid composition and content vary among different varieties. The oil quality depends on fatty acids composition, especially oleic and linoleic acids which have antioxidant properties, help by lowering cholesterol and, as a result, reduce the heart disease risk. The major fatty acids are C18:1, C18:2, C16:0, and C18:0 **(Abbas *et al.*, 2020)**. Also, the ratio between saturated and unsaturated fatty acids in crude oils and fats is more important to healthy nutrition. In our diet, more intakes of linoleic and linolenic acids increase HDL-cholesterol and reduce LDL-cholesterol. While more intake of oleic acid reduces LDL-cholesterol, but does not affect HDL cholesterol levels (**Lawton, *et al*., 2000**).

Peanuts protein is most important as food and feed sources, especially in developing countries. The seeds have different uses as processed or whole seed for making peanut butter, oil extraction and other products. Peanuts provide us with considerable amounts of minerals to supplement the dietary requirements of humans **(Asibuo *et al.*, 2008**).

Peanuts butter is a food paste made from ground roasted peanuts and blended with other ingredients such as sugar, molasses, hydrogenated vegetable oil, mono- and diglycerides and salt. It is a common feed product all over the world and is almost used as a sandwich spread, and sometimes in mixture (peanut butter and jelly sandwich) (**Odu and Okonwo, 2012**). The unique taste and flavour of food containing peanuts is important in the acceptance of these food preparations **(Asibuo *et al.*, 2008)**. The aims of his study were to evaluate physicochemical characteristics of some new peanut varieties in Egypt and to produce peanuts butter.

MATERIALS AND METHODS

Materials

Three varieties of peanuts were obtained from Agricultural Research Center, Giza, Egypt during season 2021. Peanuts varieties namely were Giza5, Gregory and NC. All solvents and chemicals were in HPLC grade and purchased from Merck, Sigma-Aldrich GmbH, Germany.

Methods

Chemical composition

The moisture, protein, oil, fiber and ash for peanuts varieties were determined according to **AOAC (2007)** methods. Total carbohydrates were calculated by difference, based on dry weight.

Minerals

Mineral contents were determined by digesting the ash with 3M hydrochloric acid and using the atomic absorption spectrophotometer for magnesium, zinc & iron and the flame photometer for potassium, sodium, calcium, phosphorus and Selenium **(Pearson, 1981)**.

Micronutrient

The vit. E, and vit. B complex of samples were determined according to the method of **Wong *et al.*, (1988) and Farag *et al.*, (2019),** respectively. Polyphenols and flavonoids were determined according to the method of **Gutfinger, (1981).**

Phyico-chemical properties of peanut oil

The refractive index, free fatty acids, peroxide value, iodine number and saponification values were determined according to **AOAC** methods, (**2007**).

Fatty acids composition of peanut oil

Fatty acids of oil samples were separated by using Agilent 6890 Gas chromatography. All GC measurements for each oil sample were made in triplicate and the mean values were reported according to the methods of **Cossignani *et al.*,(2005).**

Peanut butter preparation

Peanut butter was produced from ground, dehulled, dry roasted peanut seeds (Giza5, Gregory and NC) and by grinding in an electric mill until peanut butter formed **(Ma *et al.*, 2013)**.

Sensory analysis

Sensory evaluation of peanut butter samples and commercial peanut butter as control sample was evaluated in terms of colour, odour, taste, feeling factors, texture and overall acceptability by 12 panelists, according to **Moskowitz, (1985),** using a ten point measuring scale (from 1 to 10), where 1 is the least positive and 10 is the most positive response. Samples were served under white lightning and at room temperature in porcelain plates labeled with random 3-digit codes. Water was served to the panelists to cleanse the palate between evaluations.

RESULTS AND DISCUSSIONS

Results presented in Table 1 indicated that cultivated area with peanut crop gradually decreased from 2005 to 2019 year. This decrease was 10.79% at 2008 year but it was increased to 19.79 % in 2019 compared to 2005 year. Also, the same Table showed that the productivity per feddan increased from 2005 up to 2019 year. The highest values of feddan productivity (1.56 ton/feddan) recorded at 2017

year. On the other hand, the lowest value was recorded at 2010 year. Also, the obtained results illustrated that the highest total productivity 243000 ton was recorded at 2017 year while decreased to 199000 ton at 2019 year. The increase in total productivity at 2017 years. may be attributed to the increase of feddan yield as compared with other years .

Table 1: The cultivated area and acre productivity of the peanut crop in Egypt during the period (2005-2019).

Year	Cultivated area (1000 feddan)	Productivity (Ton/feddan)	Total Production (1000 Ton)
2005	184.02	1.35	199.30
2006	132.08	1.39	183.90
2007	155.31	1.40	217.40
2008	164.17	1.34	208.80
2009	151.85	1.35	205.10
2010	158.95	1.30	206.60
2011	154.81	1.36	210.50
2012	148.70	1.40	208.20
2013	147.78	1.40	207.00
2014	143.44	1.42	190.80
2015	134.02	1.40	200.20
2016	152.86	1.35	206.40
2017	156.04	1.56	243.00
2018	141,61	1.48	210.00
2019	142.67	1.39	199.00
Average	147.62	1.40	206.41

Source: Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agric. Statistics Bulle.

Moisture, oil,protein, fiber, carbohydrate and ash contents are listed in (Table 2). Moisture content ranged from 9.66% to 10.45. The NC variety had the highest oil content (41.76%). On the other hand, Giza5 had the lowest oil content (35.98%). Gregory variety had higher protein content (27.12%) than that of the Giza5. NC variety had the lowest protein content (25%). The fiber content of NC sample was the lowest level (7.01%) while Giza5 sample had the highest level (10.23%). Finally, the carbohydrate content calculated using the difference .The results clarified that Gregory variety recorded the lowest level (10.34%). While Giza5 variety recorded the highest level (13.67%). These results are approached with those obtained by **Taha *et al.* (2019).**

Table 2: Chemical composition of peanut varieties (%).

Variety	Moisture	oil	Protein	Fiber	Ash	Carbohydrates
Giza5	**10.45**	**35.98**	**26.11**	**10.23**	**3.56**	**13.67**
Gregory	**10.01**	**39.65**	**27.12**	**8.78**	**4.10**	**10.34**
NC	**9.66**	**41.76**	**25.00**	**7.01**	**3.77**	**12.80**

Data in Table 3 show that peanut is a good source of potassium, sodium, phosphorus, iron, magnesium, zinc, and calcium. Giza5 variety had the highest contents of minerals as compared with other varieties. The good availability of calcium, magnesium, phosphorus is a good indication that the groundnut is so rich in the minerals for bone formation. Calcium is very essential in blood clotting, muscles contraction and in certain enzymes in metabolic processes **(Ayoola and Adeyeye, 2010)**. In general, peanuts provide a wide range of minerals elements to supplement human dietary requirements **(Savage and Keenan, 1994).**

Table 3: Minerals content of peanut varieties.

Minerals content	Peanut variety		
	Giza5	Gregory	NC
Na (mg/100g)	**40.00**	**38.30**	**39.00**
K (mg/100g)	**691.00**	**657.00**	**678.00**
Mg (mg/100g)	**3.78**	**3.52**	**3.45**
Ca (mg/100g)	**2.31**	**2.33**	**2.25**
Fe (mg/100g)	**7.10**	**6.87**	**6.66**
Zn (mg/100g)	**3.32**	**3.11**	**3.00**
P (mg/100g)	**11.01**	**10.45**	**10.70**
Se (µg/100g)	**6.30**	**5.70**	**6.11**

Results in (Table 4). show that vitamin E content ranged from 7.20 to 7.45 mg/100g, vitamin B1 ranged from 0.85 to 0.88 mg/100g, and vitamin B2 ranged from 0.071 to 0.078 mg/100g. Peanuts are known to be an excellent source of certain vitamins, especially E, and the B complex. The peanut is one of the richest sources of thiamine (B1) in plants. Test was contained about 90% of total thiamine **(Savage and Keenan, 1994).** Also, **Savage and Keenan, (1994)** mentioned that the tocopherol content of Indian groundnut oil was 0.93 mg/g and was similar to soybean oil. Smooth peanut butter alone provides 2.3% of the vitamin E present in the U.S. diet. The levels of vitamin E in peanuts are influenced by cultivar, genotype, growing conditions, origins, year, regions, and maturity stages **(Chun *et al.*, 2006).**

Also, results in (Table 4). revealed that Giza5 peanut variety had the highest content of polyphenols and flavonoids 491.00 (µg GAE/g) and 52.40 (µg QE/g), respectively. **Elsorady and Ali (2018)** indicated that peanut skin extracts may be a potential source of natural antioxidants because of high content of phenols and flavonoids.

Table 4: Micronutrient content of peanut seeds varieties.

Micronutrient	Peanut seeds variety		
	Giza5	Gregory	NC
Vitamin E (mg/100g)	7.20	7.45	7.33
Vitamin (B1) (mg/100g)	0.86	0.88	0.85
Vitamin (B2) (mg/100g)	0.071	0.078	0.076
Vitamin (B3) (mg/100g)	11.45	11.00	10.93
Vitamin B6 (mg/100g)	0.21	0.19	0.23
Vitamin B9 (µg/100g)	135.00	133.00	136.00
Polyphenols (µg GAE/g)	491.00	485.00	478.00
Flavonoids (µg QE/g)	52.40	49.90	50.80

The recorded refractive indices (RI) of peanut oil extracted from different varieties are indicated in (Table5) which not highly vary. The obtained RI values from the peanut oil varieties are similar to those of vegetable oils. The high values of oil RI showed that the oil samples contain long chain fatty acids with a large number of carbon atoms **(Bello and Olawore, 2012; Agomuo *et al*., 2014)**. FFA indicates the enzymatic or chemical hydrolysis which forms off volatile components. FFA is an indication of lipase efficiency **(Gulluoglu *et al*., 2016)**. FFA content ranged from 0.67 % for Giza5 oil variety to 0.81% for Gregory oil variety. Peroxide value is an indicator of peroxidation and measure primary oxidation product. Data indicated that PV values ranged from 1.45 to 2.00 (meq O_2/kg oil). Giza5 oil had the lowest PV content. This is may be related to high contents of polyphenols, flavonoids and tocopherols. Results of PV are in agreement of **Codex (2003)** as edible oil which 10 mEq.O2/ kg oil for refined oils and up to 15 mEq.O2/ kg of oil for cold pressed and virgin oils.

The iodine number (I NO) of the studied peanut oils ranged from 106.12 to 107.00 g/100g as shown in (Table 5). The highest I NO was in NC oil and the lowest was in Giza5 oil. I NO is used to measure the unsaturation fatty acid degree and the stability of peanut oil. The saponification values of peanuts oils are illustrated in Table 5. NC oil variety had the highest content (179.04 mgKOH/g). On the other side, Giza5 oil had the lowest content (169.23 mgKOH/g). SVs from peanuts were in agreement codex range of most vegetable edible oils **(Codex, 2003)**. These results are in agreement with those obtained by **Cifuentes and Cruz (2017), Elrasheid *et al.* (2017), Gomaa and Nassaar, (2019) and Taha *et al*. (2019).**

Table 5: Some physico-chemical properties of peanut varieties.

Variety	Physico-chemical properties				
	Refractive index (IR)	Free fatty acids (FFA)	Peroxide value (PV)	Iodine number (I NO)	Saponification value (SV)
Giza5	1.4667	0.67	1.45	106.12	169.23
Gregory	1.4685	0.81	2.00	106.98	173.12
NC	1.4672	0.77	1.79	107.00	179.04

Table (6) showed fatty acid composition of peanut oils varieties. The major detected fatty acids in Giza5, NC, and Gregory peanut oils were palmitic acid C16:0, oleic acid C18:1 and linoleic acid C18:2. The ranges of fatty acids were from 11.20 to 12.60% of C16:0, 2.56 to 2.77 of C18:0, 2.30 to 3% of C20:0, 1.25 to 1.67% of C22:0 and 1.00 to 1.40% of C24:0 in studied varieties. The differentiations among peanut varieties were observed for saturated fatty acids in all peanut varieties under study. The saturated fatty acids per cent in peanut oil were strongly affected by the variety **(Isleib *et al.*, 2008 ; Castro and Leite, 2018)**. **Hassan *et al.*, (2005)** indicated that the difference for saturated fatty acids between peanut samples was related to the diversity of the genotypes. These results agree with **Taha *et al.*, (2019); Zahran and Tawfeuk, (2019).**

The predominant unsaturated fatty acids were oleic (C18:1) and linoleic acid (C18:2) in the studied varieties. According to different species, the oleic (C18:1) and linoleic acids (C18:2) percentage ranged from 41.40 to 42.67% and from 35.74 to 37.71%, respectively (Table. 6). **Andersen and Gorbet (2002)** mentioned that oleic acid in peanut ranged from 21 to 85% and from 2 to 43% in linoleic acid. **Escobedo *et al.*, (2015)** cited that peanut oil is rich in oleic and linoleic acids. In general, all peanuts varieties have a high content of total unsaturated fatty acids and a low content of saturated fatty acids which are a good indicator for human nutrition. The composition of peanut oil is affected by several sets of factors that consist of genetic factors, environmental conditions & interactions between environmental and genetic factors **(Andersen and Gorbet, (2002); Isleib *et al.*, (2008); Chaiyadee *et al.*, (2013).**

Table 6: Fatty acid composition of peanut varieties (%).

Fatty acid	Peanut variety		
	Giza5	Gregory	NC
$C_{12:0}$	0.11	0.22	0.26
$C_{14:0}$	0.64	0.72	0.82
$C_{15:0}$	0.52	0.77	0.71
$C_{16:0}$	11.20	11.87	12.60
$C_{16:1}$	0.24	0.22	0.26
$C_{18.0}$	2.61	2.56	2.77
$C_{18:1}$	41.40	42.10	42.67
$C_{18:2}$	37.71	36.14	35.74
$C_{18:3}$	0.35	0.44	0.67
$C_{20:0}$	2.65	2.30	3.00
$C_{22:0}$	1.50	1.25	1.67
$C_{24:0}$	1.00	1.40	1.34
Σ SFA	20.29	21.09	20.66
Σ MUFA	41.64	42.33	42.93
Σ PUFA	36.07	36.58	34.67

***SFA, Saturated fatty acids; MUFA, monounsaturated fattyacids; PUFA, poly unsaturated fatty acids**

Table (7) shows sensory evaluation of peanut butter made from the studied varieties and compared with control sample. The aim of manufacturing peanut butter was to choose the most appropriate varieties in the field of study to manufacture butter from it. This selection was made through sensory evaluation of different samples.

Results showed that control sample had the highest score of overall acceptable (45 points) followed by Giza5 peanut butter sample (43 points). Gregory and NC peanut butter samples had the same score (41 points). The differences in the degrees of sensory evaluation of the samples, the field of study, may be due to the compounds of taste and aroma in the seeds, and other compounds produced from carbohydrates and protein, as well as the peanut oil with its distinctive smell and taste, and as a natural result of interactions that took place between them during the roasting process of the peanut before manufacturing.

Table 7: Sensory evaluation of peanut butter

Sensory attributes	Commercial control	Variety		
		Giza5	Gregory	NC
Colour	9	9	9	8
Odour	9	8	8	8
Taste	9	9	8	9
Feeling factors	8	8	8	8
Texture	10	9	8	8
Overall acceptability	45	43	41	41

CONCLUSION

Finally, it could be concluded that the chemical composition, physical & chemical properties, phytochemicals and the fatty acid composition of peanut were affected by the variety. The NC peanut variety had the highest values of oil and oleic acid contents as compared with Giza5 and Gregory peanut seed varieties. While, Giza5 peanut variety had the highest values in minerals, polyphenols and flavonoids contents. Also, peanuts butter made from Giza5 had the best overall acceptable after control sample. The presence of high amounts of unsaturated fatty acids as compared to saturated fatty acids and high scores of sensory attributes of peanut butter as nutritional application. The data may also be helpful for best food products by nutritionists.

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الخصائص الفيزيائية والكيميائية لبعض أصناف الفول السوداني الجديده المنزرعه في مصر

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قسم بحوث الزيوت و الدهون – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – الجيزة – مصر

الفول السوداني هو أحد المحاصيل الزيتية الرئيسية في العالم ومصدر مهم للبروتين في العديد من البلدان. أجريت هذه الدراسة لتقييم أصناف الفول السوداني الجديدة (Giza5, Gregory and NC). تم تقدير التركيب الكيميائي والمركبات النشطة حيويا و العناصر المعدنية لأصناف الفول السودانى واستخلاص الزيت وتم التعرف على الخواص الفيزيائية والكيميائية وتركيب الأحماض الدهنية. تم تصنيع بعض أنواع الزبدة ، ودراسة التقييم الحسي للزبدة المصنعة. تعتبر بذور الفول السوداني مصدرًا غنيًا بالزيت (35.98 إلى 41.76٪). يحتوي الصنف جيزه5 على أعلى نسبة من المعادن مقارنة بالأصناف الأخرى. بالإضافة إلى ذلك ، يعتبر الفول السوداني مصدرًا ممتازًا لبعض الفيتامينات ، وخاصة فيتامين E و B. كما أظهرت النتائج أن نسبة الأحماض الدهنية المشبعة تتراوح من 20.29 إلى 21.09٪ ، والأحماض الدهنية الأحادية غير المشبعة تتراوح من 41.64 إلى 42.93٪ والأحماض الدهنية المتعددة غير المشبعة (34.67 – 36.07 ٪). كما اوضحت النتائج ان زبدة الفول السوداني المصنوعة من صنف (جيزه5) حصلت على أفضل نتيجة مقبولة بشكل عام بعد عينة المقارنه.