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Nutritional Characterizations Of White Pine*(Pinus Eldarica*)Nuts

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Abstract:

The pine, (*Pinus eldarica*)belongs to the botanical family *pinaceae* and has been widely used as a protective for many diseases. It is contains numerous phenolic compounds and high nutritional value. Therefore, the aim of this work is to provide a detailed chemical quantification of nutrients. The results showed that the moisture, protein, fat, ash, fiber, carbohydrates and energy value were 1.1%,31.29%, 43.00%, 3.28%, 9.00%, 12.33% and 566.84 kcal/100g, respectively. The highest minerals content of white pine were recorded for potassium, phosphorus andmagnesium which were730.90, 683.0 and 364.0 mg/100g, respectively. The highest phenolic compounds of white pine recorded for epicatechin and catechin. The values were 10.43 and 10.28 mg/100g, respectively. White pine contains high amount of lysine and glutamic acid, While HPLC analysis of fatty acids showed high amounts of polyunsaturated fatty acid than that of saturated fatty acid. As conclusion, white pine has able to protect the human from many diseases due to high nutritional value and it's containsmany active compounds.

Key words:white pine,Chemical composition, Phytochemicals.

Introduction

Pinus eldarica is an evergreen tree which belongs to the *pinacea* family. It has been observed in the MiddleEast and the land around the Caspian Sea since 2500 years ago. It typically grows very fast and tolerates heat, wind and dry weather hence it is also named as desert pine. Data on the content of phenolic compounds in *P. eldarica* which is native to Iranian region are lacking **(Pasqualini*et al.*, 2003)**.

Pine nuts has anti-bacterial, anti-fungal, anti-viral, anti-septic, anti-neuralgic, choleretic, diuretic, expectorant, hypertensive propertiesSimilarly, hydro-alcoholic extract showed anti-inflammatory anti-bacterial and antioxidant properties **Sharma*et al.*,(2016).**

Pine nuts are eaten raw or roasted; they are included as ingredients in a variety of traditional dishes. They contain vitamins, particularly B1 and B2 and also minerals, especially potassium and phosphorus. Apart from the positive implications for cardiovascular health, pine nuts have a high nutritional value, being particularly rich in proteins (~31 g per 100 g dry matter (DM)), vitamins B1 (thiamine) and B2 (riboflavin) and minerals, especially potassium and phosphorus(**Nergiz and Donmez,2004**).

Leo and Geoffrey, (2013) reported that pine nuts are a good source of Cu, Mg, Mn, P and Zn, meeting or exceeding the recommended RDI for these minerals (based on an intake of 50 g nuts/day) while they supplied between 39%– 89% of the New Zealand RDI for Fe. Compared to other commonly eaten tree-nuts New Zealand grown pine nuts are an excellent source of essential minerals.

White pines contain pinolenic acid (PNLA), which represents 14-19% of fatty acids present. PNLA has anti-inflammatory action and may improve lymphocyte function**(Kayin*et al.*,2016)**.

In Russia and the Central Asian countries the P. *eldarica* needles, buds, resin and nuts have been widely used intraditional medicine for the treatment of bronchial asthma,and various skin diseases. Several components suchas β-caryophyllene, α-pinene, longifolene, α-humulene,δ-3-carene and β-pinene with antioxidant properties havebeen reported in the *P. eldarica* nut oil **(Mamedov*et al.*,2005)**.

Afsharypour and Sanaty, (2005)medicinal plants with antioxidant properties or dietary antioxidant intake have beneficial

effects on diabetes and hyperlipidemia. *P. eldarica* nut is one of the dietary antioxidants which are used as food and medicine in several countriesand contains several phenols and essential fatty acids with antioxidant properties.

A study inTurkey reported the catechin content in the bark of *P. brutia* and other Turkish pines,while, the former study measured*p*-comaric acid, vanilic acid, gallic acid,and ferullic acid **(Cannac *et al.*, 2007)**.

High concentrations of pine of totalpolyphenols and fatty acids have been detected in *P. eldarica* nut as indication of its antioxidant properties. Experimental studies strongly support the efficacy ofpolyphenols and unsaturated fatty acids in the treatmentof chronic diseases including cardiovascular disorders**(Sadeghi *et al.*,2014)**.

The total antioxidant capacity of *Pinus gerardania*, or Chilgoza and the presence of antioxidant compounds which typically exist in pine nuts were quantified. The water and dichloromethane extracts displayed the highest antioxidant activity across all assays. Antioxidant compounds such as gallocatechin, catechin, lutein, lycopene, carotenoids and tocopherols were present in all extracts **(Lee *et al*.,2015)**.

Mechanisms white pine may also play a role for such effect. Increases in serum cholesterol and LDL-C and consequent oxidation of LDL-C are essential steps fordevelopment of atherosclerotic plaques **(Kumar *et al.*,2005)**.

For instance, catechins might be useful in body fat and malondialdehyde- modified low density lipoprotein (LDL) reduction, and in the prevention and improvement of other lifestyle-related diseases **(Nagao *et al.*, 2005).**

Pine nuts are beneficial for checking blood lipids and controlling coronary heart disease (CHD) as reported by **Ryan *et al*., (2006).** This is due to their containing only unsaturated fatty acids, whereas most other nuts also have monounsaturated fatty acids, primarily oleic acid.

However, pine kernels contain mostly linoleic acid in the form of polyunsaturated fatty acids. Linoleic acid can be transformed into cellular mediators that play an important role at the vessel level and improve blood coagulation **(Ros and Mataix, 2006)**.

Flavonoids at white pine improve dyslipidemia, inhibit lowdensity lipoprotein cholesterol oxidation and protectvascular endothelium against oxidative damage **(Loke *et al.*,2010)**.

Pine extract (Pycnogenol) was given in addition to diabetic and hypertensive medications may improve blood sugar and cardiovascular risk factors, and allow patients to lower antihypertensive medication**(Zibadia *etal.*,2008)**.

This work was conducted to study the chemical composition, minerals and quality to their contents of phytochemicals of white pine nuts.

Materials And Methods

Materials:

The fresh pods of white pine nuts*(pinus eldarica*.) was obtained from local market at, Cairo Governorate, Egypt, transferred frozen and stored at –18^{o}C until analysis.

Chemicals:

Folin-Ciocalteu reagent and standard substances including gallic acid, sinapic acid, caffeic acid, chlorogenic acid, *p*-coumaric acid and dihydroxy benzoic acid were purchased from Sigma Chemical Company (St. Louis, USA), vanillic acid, ferrulic acid, rutin and quercetin from Fluka St. Gallen, Switzerland. All reagents and standards were prepared using Milli-Q deionized water (Millipore, Bedford, USA). All other chemicals and reagents were of analytical reagent grade and purchased from Al-Ghomhoria Company for Drug, Chemicals and Medical Instruments, Egypt.

Methods:

Preparation of white pine

A part of the fresh white pine appropriated has been dried at 45^{o}C for approximately6 hours in an hot air, then minced to powder by milling using a locally Milling machine and then kept in plastic sachets at room temperature (25^{o}C±2^{o}C).

Analytical Methods

Moisture, Protein (N x 6.25 Keldahl method), fat (hexane solvent, Soxhielt apparatus), fiber and ash were determined according to the method recommended by **A. O. A. C. (2010)**.

Carbohydrates and energy value

Carbohydrate calculated by differences as follows:

% Carbohydrates = 100 - (% moisture + % protein + % fat + % ash + % fiber).

Determination of minerals content

Calcium, Cupper, Ferric, Zinc, potassium, and sodium were determined according to AOAC multi-element method 986.15 **(AOAC, 2012)** by inductively coupled plasma atomic emission spectrometry (ICP)(Shimadzu, model ICPE-9000). For this purpose, the sampleswere ash dried at 450°C (Boeco® furnace).

Determination of total phenolics content of white pine:

Total phenolic content analysis was performed using the FolinCiocalteau spectrophotometricmethod described by **Singleton *et al*.,(1999)**. The vegetable extracts were diluted in ethanol 80% and0.5 ml of the solution obtained was transferred to a tube with 2.5 ml of FolinCiocalteau reagent diluted in water at 1:10. The mixture was allowed to sit for 3-8 min, then 2 ml of sodium carbonate4% was added, and the tubes were kept in the dark for 2 h. afterwards, the absorbance was measuredat 740 nm using a UV-mini 1240 spectrophotometer (Shimadzu, Japan). A blank test was alsoperformed under the same conditions and the results of total phenolic compounds were expressed asgallic acid equivalent (mg GA/100g sample DW), based on a calibration curve of gallic acid in theconcentration range of 5 to 80 µg/ml.

Determination of total flavonoids:

Total flavonoids of white pine measured with 10 % $AlCl_3$. $3H_2O$ solution using (+) -catechin as a standard and explained as mg catechin equivalent (CE)/100 ml extract according to the methods described by **(Liu *et al.*, 2009)**.

Determination of antioxidant capacity (DPPH)of white pine:

Antioxidant activity was determined according to the method described by **Zhang and Hamauzu (2004)** as follows: Five grams of leek leavesin different parts were extracted by 100 ml. 80 % methanol. Different concentrations (10 to 50 µmol) were used to determine the antioxidant activity using 2,2 – diphenyl – 1 – picryl hydroxyl (DPPH).The percentage of antioxidant activity of the pine extracts and standard was calculated by determining the decrease in absorbance based on the following equation:

Percent (%) antioxidant activity = {A (ABTS+) - A (Sample or Standard) }× 100

A (ABTS+)

Determination of amino acids composition:

Amino acids determination was carried out by adding 3 ml of 6 N Hcl to accurately weighed flour samples in a glass ampoule for hydrolysis at 110°Cfor 24 h. After cooling, the hydrolysed samples were diluted and filtered then 1 ml of each filtrate was evaporated. Then, 5 ml of 0.02 N Hcl were used to dissolve the amino acids. To detect and quantify the amino acids, 2 ml of the resulting solution were injected into the Hitachi 835-50 Amino Acid Analyzer equipped with a 2.6 x 150 mm ion exchange column.Amino acids were determined by HPLC (Knauer) according to **Marino *et al.*, (2005)** with some modification. Sample preparation: 5 g sample was weighed and put into a tube and then covered.

Determination of fatty acids:

Lipids were extracted using the methods of **Bligh and Dyer (1959)**. In this fraction, the relative fatty acid profile was determined by the Official Method ISO 12966:2011 for fatty acids in oils, animal, and vegetable fats **(International Organization for Standardization [ISO], 2011)**. Analysis of fatty acid methyl esters was carried out using an HP 5890 gas chromatograph (Hewlett Packard HP series II 5890, Palo Alto, CA, USA) with flame ionization detector (FID) and integrated softwareYoung Lin Autochro-3000, version 2.0 (YL Instruments, Korea), using a HP-FFAP column (25 m × 0.2 µm diameter). The temperatures used were injector 210°C; detector 240°C; oven: initial 150°C × 2 min, ramp 10°C/min until 230°C, ramp 6°C/min until 215°C, ramp 30°C/min, total time: 45 min. Helium (carrier): 1 mL/min, hydrogen (FID): 30 mL/min (15 psi), air (FID): 300 mL/min (35 psi). Injection volume: 1 µL. The relative composition of fatty acids was expressed as percentage of each identified fatty acid in the total of fatty acids measured in the pine nut oil.

Statistical analysis:

Data were recorded as means and analyzed by (SPSS) (Ver.10.1). One–way analysis of variance (ANOVA) and Duncan comparisons were tested to signify a difference between different treatments of white pine**SAS (1988)**.

Results And Discussion

Chemical composition of white pine:

Data presented in Table (1) show the percentage of moisture, protein, fat, ash, fiber, carbohydrates and energy value of white pine as wet weight were 4.34%, 30.15%, 41.40%, 8.61%, 3.24% and 12.26%, respectively. On the other hand, the percentage of moisture, protein, fat, ash, fiber, carbohydrates and energy value of white pine as dry weight were 1.1%, 31.29%, 43.00%, 3.28%, 9.00% and 12.33%, respectively. These results are in agreement with **Nergiz and Donmez,(2004)**,they found that the pine nuts are a good source of nutrients. The proximate analysis of stone pine showed the following composition: moisture 5%, ash 4.5%, fat 44.9%, crude protein 31.6%, total soluble sugars 5.15% and energy value 583 kcal/100 g.

Minerals content of white pine:

Data given in Table (2) show the minerals content of white pine. It is clear to mention that the highest minerals content of white pine were recorded for potassium, phosphorus andMagnesium The values were730.90, 683.0 and 364.0 mg/100g, respectively.On the other hand, the lowest minerals content ofwhite pine were recorded for copper andSodium. The values were 1.51 and 5.10 mg/100g, respectively. These results are in agreement with**Nergiz and Donmez,(2004)**they found that the potassium, phosphorus and magnesium were the predominant elements present in the seeds. Zinc, iron and manganese were also detected in appreciable amounts.

Total phenols, total flavonoids and antioxidant activity of white pine:

Data presented in Table (3)show thetotal phenols, total flavonoids and antioxidant activity (DPPH) of white pine.It is clear to notice that the percentage of total phenols, total flavonoids and antioxidant activity of white pine were 67.60 mg/g GAE, 49.80 mg/g as catchin and 37.60 %, respectively. These results are in agreement with **Afjeh *et al.*, (2014)**, they reported that phenolic compounds of pine (*P. eldarica*)show significant antioxidant activity through various mechanisms, and the high amount of total phenolic compounds in its bark; This might be attractive for studying their health benefits through designing clinical trials.

Identification of phenolic compounds of white pine:

Data given in Table (4) show the identification of phenolic compounds of white pine.The obtained results indicated that the highest

phenolic compounds of white pine recorded for epicatechin and catechin. The values were 10.43 and 10.28 mg/100g, respectively. On the other hand, the lowest phenolic compounds of white pine recorded for gallic acid and *O*. coumaric acid. The values were 1.59 and 0.13 mg/100g, respectively. These results are in agreement with **Kilic *et al*., (2011),** they found that the catechin content of three varieties of pine bark extracts in their study was reported higher than that of ours (0.13-0.16% vs. 0.03%).However they did not mention other polyphenols in the bark of their studied pines.

Identification of amino acidscompositionof white pine:

Data given in Table (5)showed theidentification ofamino acids composition ofwhite pine. The obtained results indicated that the highest amino acid recorded for lysine and glutamic acid. The values were 2.30 and 2.20% D.M, respectively.On the other hand, the lowest amino acids composition of white pine recorded for methionineandcystine. The mean values were 0.2 and 0.1% D.M, respectively. These results are in agreement with **(Lanner, 1981)**, who reported that the among all the Pinus varieties, the highest protein content (34%) was reported for *P. pinea*. Also, concluded that the white pine have high protein, fat, vitamin (B1 and B2).

Identification of fatty acidscompositionof white pine:

Data given in Table (6)show theidentification of fatty acids compositionofwhite pine.The obtained results indicated that the highest Fatty acids composition ofwhite pinerecorded forΣPUFA and C18:2.The mean values were 54.48 and 50.72 mg/100g, respectively.On the other hand, the lowest Fatty acids compositionof white pine recorded for C14:0 and C18:3. The mean values were 0.08 and 0.3 mg/100g, respectively. These results are in agreement with **Ramadan and Morsel, (2002)**, they found that the pine lipids of the investigated samples were rich in linoleic acid, which has a beneficial effect on blood lipids,lowering blood pressure and serum cholesterol. The nutritional value of linoleic acid is due toits metabolism at tissue levels which produces the hormone-like prostaglandins. Pine nut also had a high energy value (583 kcal/100 g), since lipids are the main component.

Table (1): Chemical composition of white pine

Components	**(W/W) %**	**(D/W) %**

Moisture	4.34	1.1
Protein	30.15	31.29
Fat	41.40	43.00
Fiber	8.61	9.00
Ash	3.24	3.28
Carbohydrates	12.26	12.33

W/W= Wet weight D/W= Dry weight

Table (2): Minerals content of white pine

Minerals	Concentrations (mg/100g)
Potassium	730.90
Sodium	5 . 1 0
Calcium	40.30
Magnesium	364.0
Phosphorus	683.0
Ferric	12.34
Zinc	8.10
Cupper	1.51

Table (3): Total phenols, total flavonoids and DPPH of white pine

Active compounds	Total phenolics (mg GAE/100g)	Total flavonoids (mg Cat. /100g)	antioxidant activity (DPPH %)
White pine	67.60	49.80	37.60

(a) Expressed as gallic acid equivalents, (b) Expressed as catechin equivalents,
(c) DPPH =2,2–diphenyl-1-picryl hydroxyl

Table (4): Identification of phenolic compounds of white pine

Phenolic compounds	Concentrations (mg/g)
Epicatechin	10.43
Catechin	10.28
***P*. Coumaric acid**	1.38
Ferullic acid	1.67
***O*. Coumaric acid**	0.13
Vanillic acid	4.28

Gallic acid	1.59

Table (6): Amino acids composition of white pine

Amino acids	Concentrations (% D.M)
Aspartic acid	1.60
Thrionine	1.10
Serine	1.30
Glutamic acid	2.20
Glycine	1.70
Proline	1.90
Alanine	1.40
Cystine	0.25
Valine	1.30
Methionine	0.13
Isoleucine	0.90
Leucine	1.30
Tyrptophane	1.40
Phenylalanine	1.20
Histidine	0.60
Lysine	2.30
Arginine	0.90

Table (6): Fatty acids composition of white pine

Fatty acids	Concentrations %
Myristic acid (C14:0)	0.08
Palmitic acid (C16:0)	6.90
Stearic acid (C18:00)	4.81
Oleic acid (C18:1)	37.13
Linoleic acid (C18:2)	50.72
Linolenic acid (C18:3)	0.37
Arachidic acid (C20:0)	0.80
Eicosenoic acid (C20:1)	0.52
Eicosadienoic acid (C20:2)	0.59

Eicosatrienoic acid (C20:3)	1.85
ΣSFA	11.79
ΣMUFA	37.13
ΣPUFA	54.48

ΣSFA: sum of main saturated fatty acids; ΣMUFA: sum of main monounsaturatedfatty acids.
ΣPUFA: sum of main polyunsaturated fatty acids.

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الخصائص التغذوية للصنوبر الأبيض

ألفت رشاد خاطر ـ عماد محمد الخولي ـ آية عبد القوي شريف
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الملخص العربى:

ينتمي الصنوبر إلى العائلة الصنوبرية وقد استخدم على نطاق واسع كحماية للعديد من الأمراض. نظرا لإحتوائه على العديد من المركبات الفينولية والقيمة الغذائية العالية. لذلك فإن الهدف من هذه الدراسة هو تقدير التركيب الكيميائى للصنوبر عن طريق تقدير الأملاح المعدنية والفينولات الكلية والفلافونيدات الكلية ونشاط مضادات الأكسدة والتعرف على المركبات الفينولية وكذلك معرفة محتواه من الأحماض الأمينية والأحماض الدهنية. أظهرت النتائج أن الرطوبة ، البروتين ، الدهون ، الرماد ، الألياف ، الكربوهيدرات وقيم الطاقة كانت ١.٢٪ ، ٣١.٢٩٪ ، ٤٣,٠٠٪ ، ٣,٢٨٪ ، ٩,٠٠٪ ، ١٢,٣٣٪ ، على التوالي. وسجلت أعلى نسبة من المعادن فى الصنوبر الأبيض مع عنصر البوتاسيوم والفوسفور والمغنيسيوم التي كانت ٧٣٠,٩٠ ، ٦٨٣,٠ ، ٣٦٤,٠ ملجم / ١٠٠ جرام ، على التوالي. أعلى قيم من المركبات الفينولية من الصنوبر الأبيض سجلت معمركب الأيبيكاتشينوالكاتشين. وكانت القيم ١٠,٤٣ ، ١٠,٢٨ ملجم / ١٠٠ جرام ، على التوالي. يحتوي الصنوبر الأبيض على كمية عالية من حمض اللايسين والجلوتاميك ، بينما أظهر تحليلHPLCللأحماض الدهنية أحتوائه على كميات مرتفعة من الأحماض الدهنية العديدةعديمةالتشبع بنسبة أكثر من الأحماض الدهنية المشبعة. في الختام ، فإن الصنوبر الأبيض قادر على حماية الإنسان من العديد من الأمراض بسبب ارتفاعالقيمة الغذائية واحتوائه على العديد من المركبات النشطة.

الكلمات الدالة: الصنوبر الأبيض ـ التركيب الكيماوى ـ المركبات الكيميائية النباتية