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Nutrient and Phytochemical Compounds of Persimmon and Husk Tomato

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Abstract

The aim of this study was to determine the proximate chemical composition, minerals content, some vitamins, sugars composition, flavonoids content as well as phenols content of whole persimmon and husk tomato fruits. The results indicated that, husk tomato has higher amounts of crude protein, crude fat, crude fiber and ash compared with persimmon fruits. Iron (Fe) was the most predominant of micro-elements found in persimmon and husk tomato. Persimmon fruits contained much more Vit. K content compared with husk tomato fruits. Glucose, arabinose, xylose, glactose and fructose were the predominant sugars of both of persimmon and husk tomato fruits. The major flavonoids of persimmon fruits were narengin, luteolin, hesperidin, quercetrin and rosmarinic acid, while it were rosmarinic acid, luteolin, rutin, querectin and narengin in husk tomato fruits.

Regarding to phenolic compounds, pyrogallol was the major phenolics in both of persimmon and husk tomato followed by catechen in persimmon and benzoic acid in husk tomato.

Keywords: *Persimmon, husk tomato, phenols, flavonoids, vitamins.*

1- Introduction

The health promoting potentials associated with their consumption are mainly due to presence of bioactive components and these phytochemicals are distinct bioactive molecules widely acknowledged for their beneficial roles in human physiology (Manach *et al*., 2004).

Phytochemicals are biologically active, naturally occurring chemical composition found in fruits, vegetables, grains, nuts, tea and seeds that promote human health and prevent diseases. The abundance of scientific evidence indicates that such bioactive compounds have biological properties such as antioxidant activity, antimicrobial effect, modulation of detoxification enzymes, stimulation of the immune system, decrease of platelet aggregation and modulation of hormone metabolism and anticancer property (Wavinya *et al*., 2016).

Phytochemicals are not essential nutrient and are not required by the human body for sustaining life, but have important properties to prevent or to fight some common diseases (Holst and Williamson, 2008).

Persimmon (*Diospyros Kaki* L.) is fleshy fibrous tropical, deciduous fruit belonging to *Ebenceal* family. It is commonly cultivated in warm regions of the world including China, Korea, Japan, Brazil, Turkey and Italy (Itamura *et al*., 2005 ;Yokozawa *et al*., 2007). Mediterranean region is also suitable for persimmon production (Luo, 2007; Bubba *et al*., 2009). Persimmon is prominent for its nutrition comprising about 80.3% water, 0.58% protein, 0.19% total lipids, 18.6% total carbohydrates and up to 1.48 g and 7.5 mg total dietary fiber

and ascorbic acid, respectively (Achiwa *et al*., 1997; Ozen *et al*., 2004 and Ercisli *et al*., 2007). Persimmon is naturally bestowed with bioactive molecules including proanthocyanidins, flavonoids, tannins, phenolis, carotenoids and dietary fiber (Butt *et al*., 2015).

Husk tomato fruit *(Physalis pubescens* L*.)* belongs to the *Solanaceae* family. It is native to tropical and subtropical American regions. Physalis and juice are nutrition, containing particularly high levels of niacin, carotenoids and minerals (El Sheikha., 2004). It is exported from several countries including Colombia, Egypt, Zimbabwe and South Africa, but Colombia stands out as one of the largest producers, consumers and exporters (USDA, GRIN and NRCS Database, 2006).

In Egypt, physalis has been known for a long time. Recently, economical importance of physalis is rising, due to its high acceptance in the local consumption, achieving a great success in Arabic and European markets (El Shiekha., 2004).

Husk tomato (*Physalis pubescens* L.) has significant anti-inflammatory such as cancer, malaria, asthma and antioxidant properties. Husk tomato is an excellent high source of fiber, protein, vitamin C and good source of minerals (Wu *et al*., 2007).

In this rank, Brako, (1993) reported that, the moisture, crude protein, ether extract, ash, cured fiber, acidity, total sugars and non-reducing sugars contents of husk tomato fruit were 90.4-91.7%, 0.17-0.70%, 0.60-0.76%, 0.60-0.69%, 0.60-1.70%, 0.84-1.89%, 5.97-6.21%, 3.16-3.28% and 2.81-2.96%, respectively. Currently, nutrition and health linkages focused on emerging of diet based regimen to combat various physiological threats including cardiovascular disorders, oxidative stress, diabetes mellitus, etc. In this context, consumption of fruits and vegetables is gaining considerable important as safeguard to main tan human health (Butt *et al.*, 2015).

The aim of this study was focused on determination of some nutrients and phytochemicals of persimmon and husk tomato fruits.

2-Materials and Methods

2.1- Materials:

Full persimmon (*Diospyros Kaki* L.) and husk tomato (*Physalis-pubescens* L.) fruits were obtained from local market of Assiut, Egypt during (November and December, 2014.

The fruits were carefully selected according to the degree of ripeness depending mainly on their color. The fruits were washed, dried and the whole fruits were prepared for analysis. Persimmon and husk tomato fruits were cut manually by using a knife into small parts. The obtained parts were placed in hold salver, dried in an air oven provided with a fan, at 70 ºC for 2 hrs., and then dried at 55 ºC (for approximately 16-18 hrs.) till its moisture content reached to ≤ 10%. The dehydrated flakes of fruits were ground by using a laboratory mill according to Hashem *et al.* (2013).

2.2- Methods:

2.2.1- Gross chemical composition and minerals analysis:

Moisture, ash, crude fiber, crud protein (N x 6.25) and ether extract

content were determined according to the methods described in AOAC (2005).

Nitrogen free extract was calculated by difference as followed:

%NFE= 100 – (% crude protein + % fat + % ash +% crude fiber).

The minerals content (K, Ca, Mg, Fe, Cu, Mn and Zn) were measured in ash solution using Flam photometer and inductively coupled plasma Emission spectrophotometer (ICAP 6200), at The Central Laboratory for Chemical Analysis, Faculty of Agriculture, Assiut University.

2.2.2- Vitamins analysis:

2.2.2.1- HPLC analysis of vitamin B- complex:-

Vitamin B- complex (Thiamine, Riboflavine, Pyridoxin, Folic acid, Cobalamin and Nicotinic acid) of persimmon and husk tomato fruits were determined using HPLC in Food Chemistry Laboratory, Food Technology Research Institute, Agricultural Research Center, Giza, Egypt, according to the method of Batifoulier *et al*.(2005).

2.2.2.2- Vitamin A:-

Vitamin A was determined by HPLC according to the method of Gottfried.(1996).

2.2.2.3- Vitamin E:-

Vitamin E was determined by HPLC according to the method of Pyka and Sliwiok (2001).

2.2.2.4- Vitamin K:-

Vitamin k was determined by HPLC according to method Perez-Ruiz *et al*., (2007).

2.2.2.5- Vitamin D:-

Vitamin D was determined by HPLC according to the method of Gfimiz-Gracia *et al*., (2000).

2.2.2.6- Vitamin C:-

Vitamin C was determined using HPLC according to the method of Romeu-Nadal *et al*.(2006).

2.2.3- Sugars content:

HPLC analysis of sugars content of persimmon and husk tomato were done according to the method of Zielinski *et al*.(2014).

2.2.4- Flavonoids and phenolic compounds:-

Flavonoid of persimmon and husk tomato fruits were identified by HPLC according to the method of Mattila *et al*. (2000).

Total phenolic compounds were determined by HPLC according to the method of Goupy *et al*., (1999).

2.2.5- Statistical analysis:

The statistical analysis of data analysis was performed by analysis of variance (ANOVA) and the results were submitted to Duncan's test**.**

3- Results and Discussion:

3.1- Gross chemical composition and minerals:

The gross chemical composition of persimmon and husk tomato fruits are present in Table (1). The moisture content recorded 77.00 and 83.78% for persimmon and husk tomato, respectively, with significant differences. The moisture content of persimmon was lower than that (80.32%) reported by Butt *et al*. (2015) for Japanese persimmon and that may be due to including the peel and seeds in this study. On other hand, the moisture content of persimmon fruits was in the range of 76.34 ± 0.52 to 81.10±0.05% which reported by Chen *et al*.(2016) for five selected persimmon cultivars.

Table 1. Gross chemical composition of persimmon and husk tomato fruits

Characteristic	Persimmon	Husk tomato
Moisture (%)	77.00 ± 0.36 b	83.78 ± 0.36 a
Crude protein (%)*	8.68 ± 0.03 b	19.43 ± 0.03 a
Crude fat (%)*	3.37 ± 0.06 b	11.10 ± 0.06 a
Crude fiber (%)*	10.72 ± 0.08 b	15.33 ± 0.08 a
Ash (%)*	2.43 ± 0.03 b	6.13 ± 0.03 a
NFE*	74.8 a	48.01 b

*On dry weight basis.
NFE= Nitrogen free extract.
Different superscript letters indication significance within the same row ($P < 0.05$).

Regarding to husk tomato fruits the moisture content was in the same line with the results of ElSheikha *et al*., (2008). Crude protein of the studied persimmon and husk tomato fruits sample was 8.68±0.03 and 19.43±0.03% on dry weight basis, respectively.

The crude fat content was 3.37±0.06 and 11.10±0.06% on dry basis for persimmon and husk tomato, respectively. Ash content of persimmon and husk tomato fruits recorded 2.43 and 6.13%, respectively. With significant higher content in husk tomato. The ash content of husk tomato was in the same line with that by El Shikha *et al*.(2008). One other hand, the ash content of dried Japanese persimmon was 1.59% as reported by Butt *et al*. (2015). Crude fiber content recorded 10.72 and 15.33% for persimmon and husk tomato; respectively.

The nitrogen free extract of persimmon recorded 74.8% which is in agreement with the results of Butt *et al*. (2015). Moreover, NFE value was lower (48.01%) as a results of higher values of moisture, crude protein, crude fat, ash and crude fiber of husk tomato compared with persimmon fruits.

3.2- Minerals content of persimmon and husk tomato fruits.

Data in Table (2) revealed some minerals of persimmon and husk tomato. The obtained data indicated that, husk tomato has higher content of iron and zinc compared with persimmon which had higher contents of calcium and magnesium.

Table 2. Minerals content of persimmon and husk tomato fruits (mg/100g fresh weight)

Mineral	Persimmon	Husk tomato
Potassium (K)	172.49±0.25 b	239.09±0.30a
Calcium (Ca)	34.18±0.15 a	12.31±0.15 b
Magnesium (Mg)	36.65±0.23 a	34.52±0.23b
Iron (Fe)	2.95±0.14 a	2.53±0.14 a
Copper (Cu)	0.31±0.00 a	0.035±0.00 a
Manganese (Mn)	0.35±0.01 a	0.27±0.01 a
Zinc (Zn)	0.88±0.04 b	1.18±0.04 a

Different superscript letters indication significance within the same row ($P < 0.05$).

However, there were non-significant differences between the two studied fruits in their contents of copper and manganese. Gorinstein *et al*.(2001) reported that, whole persimmon fruit contained 254, 8.22 and 9.35 mg/100g fresh weight of K, Mg and Ca, respectively. While Fe, Mn, Zn and Cu recorded 101.4, 107.1, 13.9 and 9.76 mg/100g of fresh fruit, respectively. One other hand, the minerals contents minerals of husk tomato were 6.3-10.9, 23, 243, 0.57-1.4 and 0.09 mg/100g of edible portion for Ca, Mg, K, Fe and Cu, respectively. From the data in Table (2) it could be noticed that, the iron was the most predominated of micro-elements found in persimmon and husk tomato, which is one of the most important minerals for the healthy promoting that are found in foods which contributing to the formation of red blood cells.

3.3- Vitamins content of persimmon and husk tomato fruits.

Water soluble vitamins (B-complex and vitamin C) contents of persimmon and husk tomato fruits are presented in Table (3). Persimmon fruits recorded significantly higher content of nicotinic acid, thiamine, pyridoxine and folic acid compared to husk tomato fruits. While, husk tomato content high amounts of riboflavin, cobalamin and ascorbic acid.

Table 3. Vitamin B-complex and vit. C contents of persimmon and husk tomato (mg/100g dry wight):

Vitamins	Persimmon	Husk tomato
Nicotinic acid	48.83± 0.15 a	20.21±0.15 b
Thiamine B1	105.48± 0.28 a	23.41± 0.28 b
Pyridoxine B6	64.54± 0.25 a	19.73±0.25 b
Folic acid B9	13.81± 0.14 a	5.23± 0.14 b
Riboflavine B2	4.63± 0.11 b	6.24±0.11 a
Cobalamin B12	11.33± 0.18 b	16.32± 0.18 a
Ascorbic acid	8.87±0.10 b	9.64± 0.10 a

Different superscript letters indication significance within the same row ($P< 0.05$).

Ascorbic acid content was ranged from 9.43 to 43.17 mg /100g for five selected persimmon cultivars as reported by Chen *et al.* (2016). However, similar results for ascorbic acid of persimmon fruit (7.5 mg /100g fruit) was reported by Yaqub *et al*. (2016). Beside, El Sheikha *et al*. (2008) reported that, physalis fruits contained 39.68 mg/100g of ascorbic acid. As shown in Table (3) both of husk tomato and persimmon recorded a high value of cobalamin (vit. B12)which recorded 16.32 and 11.33 mg /100g (dry weight), respectively. Vitamin B12 improves mental health and greatly reduces risk of pernicious anemia.

Fat soluble vitamin of persimmon and husk tomato are presented in Table (4). Persimmon fruits significantly contained higher levels of vitamins A, K and D compared with husk tomato fruits.

Table 4. Fat soluble vitamins content of persimmon and husk tomato (mg/100g dry wight):

Fruits	Vit A	Vit E	Vit K	Vit D
Persimmon	0.19± 0.00 a	0.03 ± 0.00 a	29.33 ±0.06a	0.19 ± 0.00 a
Husk tomato	0.01 ± 0.00 b	0.04± 0.00 a	2.33 ±0.06b	0.04 ±0.00b

Different superscript letters indication significance within the same row($P < 0.05$).

However, there was no significant between the two studied fruits in their contents of vitamins E. From the data in Table (4) it could be noticed that, persimmon fruits contained a high amount of vitamin K (29.33mg /100g dry weight).

However, vitamin K is essential for the process of blood clotting. Regarding to vitamin A, it recorded 0.19 and 0.01 mg /100g dry weight) of persimmon and husk tomato, respectively.

3.4- HPLC sugar analysis of persimmon and husk tomato:-

Data in Table (5) showed the HPLC analysis of sugars content of persimmon and husk tomato. The obtained data indicated that, glucose, arabinose, xylose, glactose and fructose were the predominate sugars in persimmon and husk tomato fruits.

Senter *et al*., (1991), reported also that, arabinose, glactose, glucose, fructose and sucrose were the major sugar of Japanese persimmon.

On the other hand, the main sugars found in flesh of all persimmon cultivars were sucrose, glucose and fructose as reported by Novillo *et al*. (2015).

Table 5. HPLC analysis of sugars content (% of total sugar) of persimmon and husk tomato:

Sugars	Persimmon	Husk tomato
Inulin	0.619	1.624
Glucuronic	0.093	0.482
Stachyose	0.074	2.376
Galacturonic	0.079	0.471
Raffinose	0.155	0.244
Sucrose	0.079	0.123
Maltose	0.104	0.530
Lactose	0.363	0.480
Glucose	20.200	12.936
Xylose	1.276	1.449
Galactose	1.199	1.225
L-Rhaminose	1.000	0.804
Mannose	0.739	0.730
Fructose	1.122	0.830
Arabinose	14.383	9.016
Manitol	0.378	0.056
Sorbitol	0.126	0.054
Ribose	0.043	0.117

Glucose in persimmon recorded 20.2% of total sugars while it recorded 12.93% only in husk tomato fruits. However, persimmon fruits contained higher amounts of arabinose and fructose than its amounts of husk tomato as presented in Table (5).

3.5- Flavonoids content of persimmon and husk tomato fruits:-

Fractionation and determination of flavonoid contents of persimmon and husk tomato using HPLC are presented in Table (6).

Table 6. HPLC analysis of flavonoids content (mg/100g on dry weight) of persimmon and husk tomato:-

Compound of Flavonoids	Persimmon	Husk tomato
Narengin	13.836	3.253
Luteolin	11.213	6.896
Rutin	3.121	6.042
Hisperidin	8.466	0.648
Rosmarinic	3.636	8.294
Quercetrin	3.900	2.808
Quercetin	2.372	4.495
Kampferol	0.738	0.721
Apegnin	1.013	1.747
7-OH-Flavone	0.204	0.171

The data revealed that, the predominate flavonoids of persimmon fruits were narengin (13.84 mg/100g), luteolin (11.21 mg/100g), hisperidin (8.45 mg/100g) followed by quercetrin (3.9 mg/100g) and rosmarinic (3.64 mg/100g). While, the predominate flavonoids of husk tomato were rosmarinic (8.29 mg/100g), luteolin (6.90 mg/100g), rutin (6.04 mg/100g) followed by quercetin (4.50 mg/100g) and narengin (3.25 mg/100gm).

Narengin, the major flavonoids in persimmon has antioxidant, anticarcinogenic and cholesterol lowering activity. While rosmarinic acid which was the major flavonoid of husk tomato fruits has a number of interesting biological activites, e.g. antiviral, antibacterial, antiflammatory and antioxidant (Petersen and Simmonds, 2003).

HPLC analysis of phenols content of persimmon and husk tomato fruits are presented in Table (7). However, pyrogallol was the major phenol compound in both persimmon and husk tomato fruits which recorded 731.01 and 173.56 mg /100g dry weight, respectively.

Table 7. HPLC analysis of phenols content (mg/100g on dry weight) of persimmon and husk tomato fruits.

Compound Phenols	Persimmon	Husk tomato
Gallic	10.909	2.679
Pyrogallol	731.009	173.556
4-Amino-benzoic	2.735	4.011
Catechein	60.413	10.672
Protocatchuic	7.664	8.183
Chlorogenic	15.293	12.830
Catechol	20.605	12.017
Epicatechein	8.783	11.123
Caffeine	0.498	0.274
P-OH-benzoic	5.326	7.748
Caffeic	2.568	7.678
Vanillic	8.585	9.917
P-Coumaric	1.395	5.110
Ferulic	2.953	3.593
Iso-Ferulic	1.064	6.839
Resveratrol	0.520	2.405
Ellagic	17.549	15.919
Benzoic	9.251	21.003
3,4,5-methoxy-cinnamic	0.499	1.717
Coumarin	1.104	1.727
Salycilic	5.338	10.282
Cinnamic	0.429	1.629

Besides, catechein content of persimmon recorded about 6 times itscontent of husk tomato.

On the other hand, the other predominat phenols compounds in persimmon was catechol (20.61 mg/100g), ellagic acid (17.54 mg/100g) and chlorogenic acid (15.29 mg/100g).

While, in husk tomato, the other predominat phenolic compounds were benzoic acid (21.00 mg/100g), ellagic acid (15.91 mg/100g), and chlorogenic acid (12.83 mg/100g). However, El Sheikha *et al*. (2008), reported that, the major phenolic compounds in fresh juice of husk tomato were catechin, salicylic, para-cumaric and chlorogenic acids. On the other hand, Gorinstein *et al*. (2001). Reported that, the individual phenolics in persimmon were in the following order. P-coumaric>gallic> ferulic>protocatchuic>epicatechin> vanillic acid.

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المغذيات والمركبات الكيميائيه الطبيعيه في ثمار الكاكا والحرنكش

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الملخص

هدفت هذه الدراسه إلى تقدير التركيب الكيميائى العام والمحتوى المعدنى ومحتوى بعض الفيتامينات وتقدير السكريات والفلافونات والفينولات فى الثمار الكاملة لكل من الكاكا والحرنكش.

وتبين من الدراسة أن ثمار الحرنكش تحتوى على مستويات أعلى من كل من البروتين والدهن الخام والرماد والألياف الخام مقارنة بثمار الكاكا. وأن عنصر الحديد كان هو السائد ضمن عناصر الآثار الموجودة فى كل من ثمار الكاكا والحرنكش. وقد تميزت ثمار الكاكا بإحتوائها على مستويات أعلى كثيرا من فيتامين ك مقارنة بثمار الحرنكش.

كما أظهرت الدراسة أن سكريات الجلوكوز والأرابينوز هى السائدة فى ثمار كل من الكاكا والحرنكش. وأن الفلافونات السائدة فى ثمار الكاكا هى

Narengin, luteolin, hisberidin, quercetrin and rosmarinic acid

بينما كانت الفلافونات السائدة فى ثمار الحرنكش هى

Rosmarinic acid, luteolin, rutin, quorectin and narengin

وبالنسبة للمركبات الفينولية فإن مركب البيروجالول كان سائدا فى كل من ثمار الكاكا والحرنكش متبوعا بمركب catechein فى ثمار الكاكا وBenzoic acid فى ثمار الحرنكش.