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# Effect Of Drying Method On Husk Tomatoes (*Physalis Peruviana* Linn) Quality

**Sara M.S. Awad**

*Food Science and Technolog ,Agricultural Industrialization Unit, Desert Research Center, Cairo, Egypt.*
*E-mail: Sara.diet@yahoo.com*

**ABSTRACT**

The aim of this study was to evaluate the influence of both oven and solar drying on chemical composition (moisture, ash, protein, fat, fiber and carbohydrates) , pH, total acidity, antioxidant contents ( vitamin C and total carotenoids) , antioxidant effect by using DPPH (1,1-diphenyl-2- picrylhydrazyl) radical scavenging activity, colour and organoleptic evaluation of husk tomatoes (HT) fruits . The obtained results indicated that both fresh and dried husk tomatoes fruits is considered as a good source of ash and crude fibers. The results showed that husk tomatoes fruits in either fresh or drying had a rich source of vitamin C and carotenoids and also it has an antioxidant activity by using DPPH. Color of fresh husk tomatoes fruits was recorded the highest value, followed by solar dried and oven dried. It could be concluded that both fresh and drying husk tomatoes fruits recorded highly acceptable score of color, taste, odor, texture and overall acceptability score by the panelists and solar drying showed the best results than oven drying.

**Keywords**: Husk tomatoes; solar drying; oven drying; drying methods and sensory properties.

## INTRODUCTION

Husk tomatoes (*P. peruviana* Linn., family *Solanaceae*) has been mature in Bharat ‹Egypt, Republic of South Africa, New- Zealand, Australia and nice Great Britain (**Ramadan and Möersel,2003).** Berries are shown to supply vital health advantages attributable to their high antioxidants, vitamins, minerals and fiber (**Zhao, 2007).**

Husk tomatoes, is thought as “Güvey Feneri” in Turkey, “Uvilla” and “Topotopo” in South American country and “Golden Berry” in English speaking countries **(Puente *et al.*, 2011).** Additionally named as gooseberry, husk tomato, and winter cherry fruits (**Mericli,2011).**

Generally, the fruit of husk tomatoes is consumed recent that provides Associate in Nursing acid-sweet balance of fruit and vegetable salads. Also, the full fruit will be utilized in sweetening and dried because it becomes a very nice raisin. The fruit of husk tomatoes is also used in sauces and glazes for meats and food. Also it can be used as preservative for jams and jellies **(National Research Council (NRC), 1989 and Puente *et al.*, 2011)**.

Currently, there are different products processed for the fruit of husk tomatoes, such as, jams, raisins and chocolate-covered candies. It can also be processed for juice **Ramadan and Moersel (2007)**, pomace **Ramadan and Moersel (2009)** and other products sweetened with sugar as a snack. In European markets, it is used as ornaments in meals, salads, desserts and cakes **Cedeño and Montenegro (2004)**.

The benefits associated to cape gooseberry are mainly due to its nutritional composition as well as to the presence of its bioactive components **(Hassanien, 2011)**.

Consumption of Physalis in recent kind is restricted thanks to restricted post-harvest life as a result of it is high catalyst activity, that promotes its fast darkening, particularly when mechanical injury throughout transport and storage **Bravo and Dsorio (2016)**.

Therefore, thanks to its high content of phytochemicals, husk tomato lends itself to the assembly of variety of processed products, in particular, dehydrated products.Dehydration is one in all the foremost necessary unit operations utilized in formulation of a practical nutrient **(Oliveira *et al*., 2008)**.

Dominant the moisture content beneath important level that inhibits and/or slows down the organic chemistry and microbiological activities is one in all the simplest ways that for food preservation. One in all them is drying, being a thermal treatment applied by makers to an oversized extent of food materials to enhance their shelf-lives, since food material is receptive microbic spoilage and undesirable organic chemistry changes (**Esturk, 2012).**Drying processes gain high importance **(Doymaz *et al*.,2015)** . and recently, the assembly of fruit within the dehydrated kind to consume as a snack.

The fruit contains β-carotene (provitamin A), phosphorus, iron, potassium, zinc, calcium, fatty acids (linoleic, oleic, palmitic and lipide acids), vitamin C (ascorbic acid) and polyphenols, the latter confer inhibitor activity. Additionally, husk tomato is a remarkable supply of dietary fibre that acts as a bulking agent, normalizing intestinal motility and preventing diverticular disease among different diseases **.** The husk tomatoes has received augmented interest worldwide thanks to its biological process composition and therefore the presence of biologically active compounds that give health benefits and scale back the risks of sure diseases such as cancer, malaria, asthma, hepatitis, eczema and rheumatism **(Salazar *et al.,* 2008, Borchani *et al.,* 2011 and Ocampo *et al*., 2017 )**.

So, This study aimed to evaluate the effect of both oven and solar drying on chemical composition, pH, total acidity, antioxidant contents ( vitamin C and total carotenoids) , antioxidant effect by using DPPH radical scavenging activity, colour and organoleptic evaluation of husk tomatoes fruit.

## MATERIALS AND METHODS

### MATERIALS

The husk tomatoes (*Physalis peruviana* Linn) were obtained from local farm at Valley Al Natron, Alexandria way Desert, Desert Research Center - Egypt, sodium hydroxide, sodium metabisulphite purchased from El- Gamhoria Pharmaceutical Chemical, E- Ameriea , Cairo , Egypt.

## METHODS

### Drying procedure:

The husk tomatoes was brought to the laboratory within 24 hour of harvesting . The samples were selected and washed in clean water and divided in six group samples and refrigerated until the drying process. The moisture content of the fresh husk tomatoes fruits was immediately determined. Using two drying systems, first fixed the three treatment of solar drying and carried out to the National Research Centre, using Solar Power Plant, Solar Energy Department, Engineering Research Division, and husk tomatoes was dried at $50^0$C for four days. Another three treatment for oven drying was done at 50 To $55^0$C for 24 hours . After drying samples were stored packed in polyethylene plastic bags at the room temperature until analyses.

**Samples of Solar drying were divided into 3 different treatments as the following:**

**T 1(HT):** 1KG of husk tomatoes without treatment as control.

**T 2(HT. NaOH):** 1KG of husk tomatoes soaked in solution (distilled water + 0.2 % NaOH) / 1 min then washing by water.

**T 3 (HT. MET):** 1KG of husk tomatoes soaked in solution(distilled water + 0.2 % NaOH)/ 1 min then washing by water, then put in solution(distilled water + 0.1 % sodium metbisulphite)/ 5 min then washing by water.

**Samples of oven drying were divided into 3 different treatments as the following:**

**T 1(HT):** 1KG of husk tomatoes without treatment, drying at 50 To $55^0$C as control.

**T 2(HT .NaOH):** 1KG of husk tomatoes soaked in solution(distilled water + 0.2 % NaOH)/ 1 min then washing by water,drying at 50 To $55^0$C.

**T 3(HT. MET):** 1KG of husk tomatoes soaked in solution(distilled water + 0.2 % NaOH)/ 1 min then washing by water, then put in solution(distilled water + 0.1 % sodium metbisulphite)/ 5 min then washing by water and drying at 50 To $55^0$C.

**Chemical Analysis:**

Moisture, fat, total protein, fiber and ash were determined according to the **A.O.A.C, (2005)**. The carbohydrates content was calculated by difference.

The pH was determined using digital pH meter, total acidity was determined according to **A.O.A.C, (2010)**. Reducing sugars content was determined according to **Holme and Peck, (1983)**. Vitamin C was determined according to **Brubacher *et al*., (1985)**. Consistency was measured using viscometer, V60002, FFUNGILAB, Spain (Spindle R7) 100 rpm, torque was maintained at 100%. Total carotenoids were determined according to **Lichtenthaler and Wellburn, (1985)**. Husk tomatoes (HT) samples were analyzed for **DPPH** according to the methods described by **Aromatic *et al*., (2013)**. Estimation of antioxidant activities of fixed and volatile oils extracted from aromatic clove, using Spectrophtometer Laboratory Instrument “Thermo Scientific Heryios “.

Color was measured by Chroma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer at Cairo University Research Park (CURP), Faculty of Agriculture, Cairo University. Color was expressed using the CIE L, a, and b color system **(CIE, 1976)**. A total of three spectral readings were taken for each sample. Lightness (L*) (dark to light), the redness (a*) values (reddish to greenish). The Yellowness (b*) value (yellowish to bluish) was estimated.

**Sensory evaluation:**

The sensory properties (Color, taste, texture and overall acceptability), of husk tomatoes were judged by ten experienced panelists from stuff members of Dessert Research Centre according to **A.A.C.C. (2000)**.

**Statistical analysis:**

All analyses were performed in triplicate and data reported as mean ± standard deviation (SD). Data were subjected to analysis of variance (ANOVA). All tests were conducted at the 5% significant level. Statistics,**”SPSS” (1998)**, version 20.

## RESULTS AND DISCUSSION

### The effects of the drying method on chemical composition of husk tomatoes (HT)fruits:

Data **in Table (1)** showed that chemical composition of dried husk tomatoes HT fruits. Fresh HT contained of 79.75% as moisture, 1.09% as ash, 1.15% as protein, 0.23% as fat, 2.02% as fiber, 72.37% as t.carbohydrates and 1.89% as t.acidity. While, Chemical composition of solar drying of husk tomatoes moisture was ranged from 11.02 to 12.65, protein from 17.21 to 18.21, fat from 5.23 to 6.24, fiber from 13.54 to 16.66, t.carbohydrates from 71.12 to 71.96 and total acidity from 0.09 to 0.21. Meanwhile, oven drying of husk tomatoes moisture ranged from 12.043 to 12.69, protein from17.18 to 18.81, fat from 6.16 to 6.93, fiber from 17.69 to 22.23, t.carbohydrates from 68.43 to 71.41 and total acidity from 0.14 to 0.23(g/100g), respectively. On the other hand, pH value of dried solar energy of husk tomatoes fruits ranged from 3.84 to 3.87 and oven dried husk tomatoes ranged from 3.76 to 3.98.

**Table (1):**The effects of the drying method on chemical composition of husk tomatoes (HT)fruits.

| Physical properties | Fresh Husk tomatoes | Drying method | | | | | |
|---|---|---|---|---|---|---|---|
| | | Solar drying | | | Oven drying | | |
| | | T1 | T2 | T3 | T1 | T2 | T3 |
| **Moisture%** | $79.8^{a}\pm1.6$ | $12.7^{b}\pm0.0$ | $11.0^{b}\pm0.01$ | $11.2^{c}\pm0.01$ | $12.7^{b}\pm0.01$ | $12.6^{b}\pm0.01$ | $12.0^{b}\pm0.01$ |
| **Ash(%)** | $1.1^{d}\pm0.1$ | $4.6^{c}\pm0.02$ | $5.7^{b}\pm0.01$ | $5.1^{c}\pm0.02$ | $6.6^{a}\pm0.01$ | $5.9^{b}\pm0.02$ | $5.3^{b}\pm0.02$ |
| **protein(%)** | $1.2^{c}\pm0.1$ | $18.2^{a}\pm0.9$ | $17.2^{b}\pm0.97$ | $17.1^{b}\pm1.65$ | $18.8^{a}\pm1.18$ | $18.0^{a}\pm1.5$ | $17.2^{b}\pm0.91$ |
| **fat(%)** | $0.2^{c}\pm0.1$ | $5.2^{b}\pm1.8$ | $5.9^{b}\pm0.19$ | $6.2^{a}\pm1.61$ | $6.2^{a}\pm1.59$ | $6.9^{a}\pm1.3$ | $6.2^{a}\pm0.71$ |
| **fiber(%)** | $2.0^{d}\pm0.2$ | $13.5^{c}\pm1.6$ | $14.6^{b}\pm1.45$ | $16.7^{bc}\pm1.59$ | $20.2^{a}\pm2.8$ | $17.7^{b}\pm1.8$ | $22.2^{a}\pm1.33$ |
| **T.CHO(%)** | $72.4^{a}\pm5.6$ | $71.9^{a}\pm0.4$ | $71.1^{a}\pm0.31$ | $71.4^{a}\pm0.67$ | $68.4^{a}\pm0.76$ | $69.0^{a}\pm0.2$ | $71.4^{a}\pm1.19$ |
| **T. acidity** | $1.9^{a}\pm0.2$ | $0.2^{b}\pm0.1$ | $0.1^{b}\pm0.07$ | $0.2^{b}\pm0.07$ | $0.1^{b}\pm0.13$ | $0.2^{b}\pm0.1$ | $0.2^{b}\pm0.08$ |
| **PH** | $3.7^{a}\pm0.2$ | $3.8^{a}\pm0.0$ | $3.9^{a}\pm0.02$ | $3.9^{a}\pm0.01$ | $3.9^{a}\pm0.01$ | $3.8^{a}\pm0.02$ | $3.8^{a}\pm0.01$ |

*Solar drying.control= (T1), Solar drying. NaoH= (T2), Solar drying. sodium metbisulphite = (T3), oven drying.control= (T1), oven drying. NaoH= (T2), oven drying. sodium metbisulphite = (T3). Mean values in the same row followed by different letters are significantly different at $p\leq0.05$.*

For protein, there is no significant difference among T2,T3 in solar drying. The same result was observed in oven drying between T1, T2. In case of fat there were significant between all treatments. For fiber the best treatment was observed in T1, T3 in oven drying and showed significant difference compared with all treatments. In case T.CHO(%) there is no significant among all treatments.

These results are inagreement with those obtained by **Moustufa (2002**) and **USDA (2006**) Who concluded that both fresh and dried husk tomatoes is considered as a good source of ash and crude fibers.

**The effects of the drying method on antioxidant and DPPH content of husk tomatoes (HT) fruits:**

The influence of drying methods on antioxidant content and DPPH radical scavenging activity % was shown **in Table (2).** The results showed that vitamin C of fresh HT the mean was 45.432 mg/100g. Solar drying of HT the mean value was ranged from 12.11 to 18.13, while it was from 10.54 to 16.45 in oven drying of HT. Solar energy of HT showed higher values of vitamin C than oven drying. In case of T. carotenoids, there is no significant difference among T2,T3 in solar drying, The same result was observed in oven drying between T1, T3. for DPPH, there is no significant difference among T1,T2 and T3 in solar drying, The same result was observed in oven drying between T2, T3.

**Table (2):**The effects of the drying method on antioxidant and DPPH.

| Physical properties | Fresh Husk tomatoes | Drying method | | | | | |
|---|---|---|---|---|---|---|---|
| | | Solar drying | | | Oven drying | | |
| | | T1 | T2 | T3 | T1 | T2 | T3 |
| V.C (mg/100g) | 45.43[a] ±1.23 | 18.1[b] ±0.02 | 14.76[b] ±0.02 | 12.11[c] ±0.01 | 16.39[b] ±0.02 | 12.75[c] ±0.59 | 10.54[c] ±0.02 |
| T.carotenoids | 5.7 [c] ± 1.2 | 21.0[a] ±0.17 | 14.29[b] ±0.08 | 16.35[b] ±0.14 | 18.82[a] ±0.11 | 13.52[b] ±0.09 | 17.17[a] ±0.13 |
| DPPH% (RSA) | 48.14[b] ±.906 | 44.9[b] ±0.01 | 48.52[b] ±0.01 | 50.09[b] ±0.01 | 56.39[a] ±0.02 | 48.89[b] ±0.01 | 46.41[b] ±0.01 |

*Solar drying.control=(T1), Solar drying. NaoH=(T2), Solar drying. sodium metbisulphite = (T3), oven drying.control=(T1), oven drying. NaoH= (T2), oven drying. sodium metbisulphite = (T3). Mean values in the same row followed by different letters are significantly different at p≤0.05.*

Ascorbic acid is widely distributed in fresh fruits and vegetables. It is classified as a soluble vitamin, which is the reason why it is abundant in fruits with water content that exceeds 50% **(Gutiérrez *et al* ., 2007)**. This would explain the high level of ascorbic acid (vitamin C) in the fruit of husk tomato. This vitamin plays an important role in human nutrition, including growth and maintenance of tissues, the production of neurotransmitters, hormones and immune system responses. Vitamin C is an important dietary antioxidant, since it reduces the adverse effects of reactive oxygen and reactive nitrogen that can cause **(Naidu, 2003)**.

It is evident from the results that total carotenoids of fresh HT was 5.7 µg/g. Solar energy of HT showed that total carotenoids of HT was ranged from 14.29 to 21.02 µg/g, meanwhile it was from 13.52 to 18.82 µg/g in oven drying HT.

Carotenoids prevent cancer is related to the antioxidant activity that deactivates free radicals generated in tissues **(Castro *et al*., 2008)**.

Phenolics in fruits are of great interest owing to their important pharmacological properties **(Meyer, 1999).** Good amounts of phenolics were estimated in cape gooseberry juice, wherein the level of total phenols was 6.30 mg/100 g juice as caffeic acid equivalents **(Ramadan and Möersel, 2007).**

Results showed that DPPH of fresh HT was 48.135 mg/100g. Solar energy of HT showed that DPPH of HT was ranged from 44.997 to 50.09mg/100g, meanwhile it was from 46.41 to 56.39 mg/100g in oven drying HT.

The antioxidant activity of husk tomatoes fruits was assessed by means of a 1,1-diphenyl-2- picrylhydrazyl (DPPH) test. Fresh fruits caused reduction about 48.14% for the absorbance of DPPH radicals' control solution. Phenolic are responsible for the antioxidant activity of juices and wines, while ascorbic acid plays a minor role in the antioxidant efficiency of juices **(Rapisarda *et al*., 1999). Miller and Rice- Evans (1997)** found the significant contributory role of phenols to the antioxidant activity of orange juice, even if vitamin C was the most abundant antioxidant. The presence of a good amount of phenolic compound in Husk tomatoes fruits, could contribute to the high level of antioxidant capacity.

**The effects of drying method on color of husk tomatoes fruits :**

Data **in Table (3)** showed that the effect of drying methods on color of husk tomatoes fruits. Mean color values of fresh and dried husk tomatoes chromatic parameters are shown **in Table(3)** . Values of fresh husk tomatoes L*,a*,and b* were 50.75, 9.06, and 39.63, respectively.

Except for a*, the L* and b* coordinates exhibited significant differences between fresh and dehydrated samples (P≤ 0.05).

**Table (3):** The effects of drying method on color of husk tomatoes fruits

| Color properties | Fresh Husk Tomatoes | Drying method | | | | | |
|---|---|---|---|---|---|---|---|
| | | Solar drying | | | Oven drying | | |
| | | T1 | T2 | T3 | T1 | T2 | T3 |
| **L*** | 50.75[a] ±1.2 | 37.85[b] ±1.5 | 34.91[b] ±0.8 | 35.63[b] ±0.9 | 34.45[b] ±0.2 | 30.19[b] ±0.6 | 35.49[b] ±0.5 |
| **a*** | 9.06 [a] ± 0.9 | 8.66[a] ±0.8 | 9.49[a] ±0.5 | 9.93[a] ±0.3 | 5.96 [b] ±0.2 | 5.75[b] ±0.5 | 5.61[b] ±0.5 |
| **b*** | 39.63[a] ± 1.6 | 12.59[b] ±1.6 | 10.38[b] ±0.6 | 14.24[b] ±0.6 | 13.76[b] ±0.5 | 8.14[c] ±0.3 | 11.9[b] ±2.7 |

*Solar drying.control= (T1), Solar drying. NaoH= (T2), Solar drying. sodium metbisulphite = (T3), oven drying.control=(T1), oven drying. NaoH=(T2), oven drying. sodium metbisulphite = (T3). Mean values in the same row followed by different letters are significantly different at p≤0.05.* L*,brightness/darkness. a*, greeness/ redness. b*,yellowness/blueness.

All treatments decreased brightness (L*), which indicates that fresh fruits had a bright color as well as high luminosity as compared with processed samples. There were reports showing that the higher the degree of browning, the lower the sample L* value **(Prathapan *et al.*, 2009)**.

Moreover, dehydrated physalis fruits become darker probably because of an extensive Maillard reaction **( Vega-Gálvez *et al.*, 2009)**.These chemical reactions are a consequence of reducing sugars and amino acids in the material being dehydrated **(Perera, 2005)**. Some non-enzymatic causes of browning in foods include the Maillard reaction, auto-oxidation reactions involving phenolic compounds, and the formation of iron-phenol complexes **(López-Nicolás and García-Carmona, 2010)**. At oven NaOH drying, parameter b* showed a decrease to 8.14% in its value as compared with fresh samples; this generates brown products caused by non-enzymatic reactions **(Vega-Gálvez *et al.*, 2009)**. The effect of different drying methods on sensitive components, such as proteins and carbohydrates; this indicates appreciable differences in dehydrated husk tomatoes color according to **Chen, (2008)**. Golden berry color changes caused by the thermal treatment may be caused not only by the non-enzymatic browning reaction, but also by the destruction of pigments present in the fruits, such as β-carotene.

**Sensory evaluation of dried husk tomatoes fruits:**

Organoleptic properties (color, taste, odor, texture and overall acceptability) of drying husk tomatoes fruits are illustrated **in Table (4).** Results indicated was slightly that colour acceptability ratings of the oven drying decreased. Dried above 22°C leads to loss of yellow-orange carotenoid pigments responsible for color of the fresh fruits (**Krokida *et al*., 1998)**. The colour of solar dried was acceptable as compared to oven drying. This is probably because oven dried was dried for a longer time (24 hours) and thus lost more of its yellow-orange color and underwent more browning reactions. Colour acceptability for solar dried could be improved by preventing browning reactions, minimizing carotenoid degradation or addition of colour additives.

**Table (4):** Sensory evaluation of dried husk tomatoes fruits.

| Physical properties | Drying method | | | | | |
|---|---|---|---|---|---|---|
| | Solar drying | | | Oven drying | | |
| | T1 | T2 | T3 | T1 | T2 | T3 |
| **Color** | 9.6$^{a}$±0.52 | 9.1$^{a}$±0.21 | 9.2$^{a}$±0.54 | 7.6$^{b}$±1.58 | 7.3$^{b}$±0.91 | 7.1$^{b}$±1.65 |
| **Taste** | 9.1$^{a}$±0.21 | 8.9$^{a}$±0.52 | 8.5$^{b}$±0.88 | 8.8$^{a}$±0.79 | 8.6$^{a}$±0.61 | 8.0$^{b}$±0.67 |
| **Odor** | 9.2$^{a}$±0.42 | 9.1$^{a}$±0.52 | 8.8$^{a}$±0.79 | 9.0$^{a}$±0.67 | 8.7$^{a}$±0.79 | 8.0$^{b}$±0.94 |
| **Texture** | 9.2$^{a}$±.54 | 9.0$^{a}$±0.75 | 8.8$^{a}$±0.98 | 8.7$^{a}$±0.79 | 8.5$^{b}$±0.88 | 8.1$^{b}$±0.03 |
| **Overall** | 9.3$^{a}$±0.22 | 9.0$^{a}$±0.10 | 8.8$^{a}$±0.29 | 8.5$^{b}$±0.63 | 8.3$^{b}$±0.61 | 7.9$^{c}$±0.62 |

*Solar drying.control =(T1), Solar drying. NaoH=(T2), Solar drying. sodium metbisulphite = (T3), oven drying.control=(T1), oven drying. NaoH=(T2), oven drying. sodium metbisulphite = (T3). Mean values in the same row followed by different letters are significantly different at p≤0.05.*

Solar dried had comparable scores which were significantly (P ≤ 0.05) greater than oven dried. The taste of solar is contributed by the amount of sugars contained in the fresh pulp, increase in the amount of sugar beyond optimum amounts may, however, reduce the taste ratings thus requiring optimization **(United Nations Industrial Development Organisation (UNIDO),2008)** . It is important to note that taste may also be influenced by and may correlate with aroma (**Fennema, 2000)** . Therefore, enhancing aroma may also improve taste acceptability.

The aroma for both solar and oven dried leather was acceptable (scores ≤ 5). **Jain and Nema (2007)** found That produced jackfruit leather using a cabinet dryer at 50˚C for 24 hours with acceptable aroma**.** The aroma of products results from volatile substances in the fresh food such as esters, ketones, terpenes, aldehydes and others **(Cremer and Eichner, 2000 and Fennema, 2000).**The loss of these volatiles leads to a decrease in aroma detection. High aroma acceptability scores for solar dried could be attributed to the short drying times (3-4 days) used as opposed to 72 hours in solar drying. Longer drying times may allow for greater loss of volatiles. **Jain and Nema (2007)** used direct sun drying to produce guava leathers of 15% moisture content with acceptable aroma **(UNIDO, 2008)**.

The highest acceptability rating for texture was observed for solar dried from 8.8 to 9.2, followed by oven dried from 8.1 to 8.7. The acceptability for texture of oven . This illustrates the importance of sensory methods in quality assessment of leather texture. The texture of fruit leather can be improved by adding malto-dextrin, coconut oil or chopped nuts (**Jain and Nema, 2007).**

Results showed that overall acceptability of the **Table (4)** was the highest for both solar 9.28 and oven 8.53. The results obtained are similar to those obtained for all the other sensory attributes rated. It is reported that the acceptability of fruits and vegetables is influenced by their aroma **(Karmas and Harris,1988).**

## CONCLUSION:

The obtained results indicated that both fresh and dried husk tomatoes fruits is considered as a good source of ash and crude fibers. The results showed that husk tomatoes fruits in either fresh or drying had a rich source of vitamin C and carotenoids and also it has an antioxidant activity by using DPPH. Color of fresh husk tomatoes fruits was recorded the highest value, followed by dried HT by solar energy and oven dried. It could be concluded that both fresh and drying husk tomatoes fruits recorded highly acceptable score of color, taste, odor, texture and overall acceptability score by the panelists. Solar drying of HT showed the best results than oven drying.

## REFERENCES:

**A.A.C.C. (2000):** Approved methods of the American Association of Cereal Chemists. St Paul, MN (USA). American Association of Cereal Chemists.

**A.O.A.C. (2005):** Official Method of Analysis. Association of Analytical Chemistry. Washington D.C,91(1): 112-122.

**A.O.A.C. (2010):** Association of Official Analytical Chemist Official Methods of Analysis. 17$^{th}$ ed., Washington , USA.

**Aromatic, F.A.; Elmhdwi, M. F.; Aromatic, F. and Aromatic, O. O. (2013):** Estimation of antioxidant activities of fixed and volatile oils extracted from Aromatic aromatic (Clove) . Der. Chemica. Sinica. , 4(3) : 120-125.

**Borchani, C.; Besbes, S.; Masmoudi, M.; Blecker, C.; Paquot, M. and Attia, M. (2011):** Effect of drying methods on physico-chemical and antioxidant prop- erties of date fibre concentrates. Food Chem., 125:1194–1201.

**Bravo, K.; and Dsorio, E. (2016):** Characterization of polyphenol oxidase from Cape gooseberry (Physalis peruviana L.) fruit. J. Food Chemistry, 197 (1):185-190.

**Brubacher, G.; Muller-Muolt, W. and Southgate, D.A. (1985):** Methods for the determination of vitamin in food. Elsevier Applied Science Publishers, London.

**Castro, A.; Rodriguez, L. and Vargas, E. (2008):** Dry gooseberry (*Physalis peruviana* L) with pretreatment of osmotic dehydration. Vitae - Revista de la Facultad de Química Farmacéutica, 15(2): 226−231.

**Cedeño, M., and Montenegro, D. (2004):** Plan exportador, logístico y comercialización de uchuva al mercado de Estados Unidos para frutexpo sci ltda. Facultad de Ingeniería, vol. Ingeniero Industrial. : Bogotá Pontificia Universidad Javeriana.

**Chen, X.D. (2008):** Food drying fundamentals. p. 1-54. In X.D. Chen, and A.S. Mujumdar (eds.) Drying technologies in food processing. Wiley-Blackwell Publishing, West Sussex, UK.

**CIE (Commission International de Clairage), (1976):** Official recommendations on uniform color spaces. Color difference equations and metric color terms, Suppl. No. 2. CIE Publication No. 15 Colourimetry, Paris, France.

**Cremer, D.R. and Eichner, K. (2000):** Formation of volatile compounds during heating of spice paprika (Capsicucum annum) powder. J. Food Chem., 48 (6): 2454-2460.

**Doymaz, İ.; Demir, H. and Yildirim, A. (2015):** Drying of Quince Slices: Effect of Pretreatments on Drying and Rehydration Characteristics. Chem. Eng. Commun., 202: 1271-1279.

**Fennema, O.R. (2000):** Food chemistry. 3rd Ed. Taylor and Francis Group, London. (1996).

**Esturk, O. (2012):** Intermittent and Continuous Microwave- Convective Air-Drying Characteristics of Sage (*Salvia officinalis*) Leaves. Food Bioprocess Tech.,5: 1664-1673.

**Häkkinen, S. H.; Kärenlampi, S. O.; Heinonen, I. M.; Mykkänen, H. M. and Riitta, A. T. (1999):** Content of the flavonols quercetin, myricetin, and kaempferol in 25 edible berries. Journal of Agricultural and Food Chemistry, 47: 2274−2279.

**Hassanien, M. F. (2011):** "*Physalis peruviana*: A rich source of bioactive phytochemicals for functional foods and pharmaceuticals," Food Reviews International, 27(3): 259–273.

**Holme, D.J. and Peck, H. (1983):** Analytical biochemistry. 1st Ed., PP. 305, London group limited, England.

**Gutierrez, T.; Hoyos, O. and Paez, M . (2007):** Determination del conterido de ascórbico en uchuva (*Physalis peruviana* L.), por cromatografía líquida de alta resolución (HPLC). Revista de la Facultad de Ciencias Agropecuarias, 5(1):70−79.

**Jain, P.K. and Nema, P.K. (2007):** Processing of pulp of various cultivars of guava (*Psidium guajava*) for leather production. Agr. Engng. Intl., 9: 1-2.

**Karmas, E. and Harris, R.S. (1988):** Nutritional evaluation of food processing. Van Nostrand Reinhold Publishers, New York, USA.

**Krokida, M.K.; Tsami, E. and Maroulis, Z.B. (1998):** Kinetics on colour changes during drying of some fruits and vegetables. DRT, 16: 667– 685.

**Lichtenthaler , H. K. and Wellburn, A, R.(1985):** Determination of total carotenoids and chlorophylls a and b of leaf extracts in different solvents .Biol. Soc. Trans., 11.591- 592.

**López-Nicolás, M.J. and García-Carmona, F. (2010):** Enzymatic and nonenzymatic degradation of polyphenols. p. 101-103. In de la Rosa, L., E. Alvarez-Parrilla and G. Gónzalez-Aguilar (eds.) Fruit and vegetables phytochemicals. Wiley-Blackwell Publishing, Ames, Iowa, USA.

**Mericli, F. (2011):** "Bilimsel acidan altin cilek meyveleri (Physalis peruviana)," Fitomed, 20 : 18–22.

**Meyer, A. S. (1999):** Antioxidant activity of phenolic compounds in grape juice and prune juice on human low-density lipoproteins. Fruit-processing, 11:426−430.

**Miller, N. J. and Rice-Evans, C. A. (1997):** The relative contributions of ascorbic acid and phenolic antioxidants to the total antioxidant activity of orange and apple fruit juices and blackcurrant drink. Food Chem., 60: 331–337.

**Moustufa, B. (2002):** Chemical and Technological Studies on Some Vegetables and Fruits Juices. Ph.D. Thesis, Faculty of Agriculture, Moshto- hor, Zagazig University (Benha Branch), Egypt.

**Naidu, K. (2003):** Vitamin C in human health and disease is still a mystery? An overview. Nutrition Journal, 2(1): 1−10.

**National Research Council (NRC). (1989):** Golden berry (*Cape Gooseberry*). Lost crops of the incas: Little-known plants of the andes with promise for worldwide cultivation (pp. 240−251). Washington D.C.: National Academy Press.

**Ocampo, Y.; Caro, D.;Rivera, D. and Franco, L. (2017):** Safety of sucrose esters from *Physalis peruviana* L.in a 28-day repeated-dose study in mice. Biomed Pharmacother, 90: 850–862.

**Oliveira, E.G.; Rosa, G.S.; Moraes, M.A. and Pinto, L.A. (2008):** Phycocyanin content of spirulina platensis dried in spouted bed and thin layer. J. Food Proc. Eng., 31(1):34–50.

**Perera, C.O. (2005):** Selected quality attributes of dried foods. Drying Technology, 23:717-730.

**Prathapan, A.; Lukhman, M.; Arumughan,C.; Sundaresan,P.; and Raghu,K.(2009):** Effect of heat treatment on curcuminoid, colour value and total polyphenols of fresh turmeric rhizome. International Journal of Food Science and Technology, 44:1438-1444.

**Puente, L. A.; Pinto-Muñoz, C. A.; Castro, E. S. and Cortés,M.**

**(2011):** *Physalis peruviana* Linnaeus, the multiple properties of a highly functional fruit: A review. Food Res .Int.,44(7): 1733-1740.

**Ramadan, M. and J. Möersel .(2003):** Oil golden berry (*Physalis peruviana* L.). Journal of Agricultural and Food Chemistry, 51(4):969−974.

**Ramadan, M.F. and Moersel, J.T. (2007):** Impact of enzymatic treatment on chemical composition, physicochemical properties and radical scavenging activity of golden berry (*Physalis peruviana* L.) juice . J. Sci .Food Agric., 87: 452-460.

**Ramadan, M.F. and Moersel, J.T. (2009):** Oil extractability from enzymatically treated goldenberry (*Physalis peruviana* L.) pomace: range of operational variables. Int. J. Food Sci .Tech.,44: 435-444.

**Rapisarda, P. A.; Tomaino, R.; Cascio, L.o.; Bonina De Pasquale, F. A. and Saija, A.( 1999):**Antioxidant effectiveness as influenced by phenolic content of fresh orange juices. J. Agric. Food Chem., 47: 4718–4723.

**Salazar, M.R.; Jones, J.W.;Chaves, B. and Cooman, A.(2008):** A model for the potential production and dry matter distribution of Cape gooseberry (*Physalis peruviana* L.). Sci. Hort.,115: 142-148.

**SPSS, (1998):** Statistical Package for Social Science, Computer Software, Ver. 20, SPSS Company. London, UK.

**United Nations Industrial Development Organisation (UNIDO) (2008):** Sun and solar drying techniques and equipments. 16.pdf.

**USDA. (2006):** National Nutrient Database for Standard Reference, NDB No.11954. The US Department of Agriculture, Washington DC.

**Vega-Gálvez, A.; Di Scala, K.; Rodríguez, K.; Lemus-Mondaca, R. ; Miranda, M.; López, J. and Pérez-Won, M. (2009):** Effect of air-drying temperature on physico-chemical properties, antioxidant capacity, colour and total phenolic content of red pepper (*Capsicum annuum,* L. *var. Hungarian*). Food Chemistry, 1174:647-653.

**Zhao, Y., In Y. Zhao (Ed.) (2007):** Berry fruit,value-added products for health promotion., NW (USA): CRC Press0-8493-5802-7.

# تاثير طريقة التجفيف على جودة ثمار الحرنكش

**سارة محمد صلاح عواد سالم**

**مركز بحوث الصحراء – قسم الانتاج النباتي– وحدة التصنيع الزراعي– القاهرة – مصر**

يهدف هذا البحث الي دراسة تاثير كل من التجفيف الشمسي و التجفيف بواسطة الفرن الكهربائي علي التركيب الكيميائي (الرطوبة، الرماد، البروتين، الدهون، الالياف و الكربوهيدرات)، مضادات الاكسدة (فيتامين سي و الكاروتينات الكلية) و كذلك دراسة التاثير المضاد للاكسدة باستخدام الشقوق الحرة. و اللون و التقييم الحسي (الطعم، القوام ، الرائحة، اللون و القبول العام) في ثمار فاكهة الحرنكش . و قد دلت النتائج علي أن ثمار الحرنكش الطازجة و المجففة سواء بالطاقة الشمسية او بالفرن الكهربائي مصدر جيد لكل من الالياف و المعادن, و أن الحرنكش الطازج و المجفف كمصدر غني بمضادات الاكسدة (فيتامين سي و الكاروتينات الكلية) و لها تاثير مضاد للاكسدة و ذلك باستخدام الشقوق الحرة. سجل اللون درجات عالية في الحرنكش الطازج يليه المجفف بواسطة الطاقة الشمسية ثم التجفيف بالفرن الكهربائي. سجل التقييم الحسي للحرنكش درجات قبول عالية لدي المحكمين من حيث اللون، الطعم، و الرائحة و المظهر العام ، ولذلك تبين ان التجفيف بالطاقة الشمسية اعطي افضل النتائج من التجفيف بالفرن.

**الكلمات المفتاحية :** ثمار الحرنكش – التجفيف الشمسي – التجفيف بالفرن الكهربائي – طرق التجفيف – التقييم الحسى .