Effect of Different Cooking Methods on Natural Antioxidants in Pumpkin (*Cucurbita moschata*) Products

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ABSTRACT

The present study aimed to investigate the effects of various cooking methods on antioxidant content and radical scavenging activity of pumpkin. Three heat treatments were applied, namely, blanching, and stir frying for cubes (1.5×1.5×1.5 cm) and roasting for slices (0.5 mm) to produce soup, juice and roasted pumpkin. The results indicated that carotenoids content ranged between 11.07 IU/100 g (soup) and 892 IU/100 g (juice). Roasted product exhibited significantly (*P*≤0.05) the least flavonoid content (12.09 g/kg), while soup possessed significantly (*P*≤0.05) the highest content (17.96 g/Kg). Lycopene content (0.15 mg/100 g) was found to be significantly (*P*≤0.05) the least (in soup produced from cubes blanched for 4 mins). In contrast, the counterpart raw juice had significantly (*P*≤0.05) the highest lycopene content (0.70 mg/100 g). Total polyphenols content of stir fried product was significantly (*P*≤0.05) the least (406.25 g/kg), while roasted product exhibited significantly (*P*≤0.05) the highest polyphenols content (670.18 g/kg). It was obvious that raw juice possessed significantly (*P*≤0.05) the highest DPPH (63.79%), on contrary to roasted product being significantly (*P*≤0.05) the least antioxidant activity as assessed by DPPH method (30.31%). The *H*₂*O*₂ scavenging (2.85%) was found to be significantly (*P*≤0.05) the highest (in soup produced from cubes blanched for 4 min). While, the raw juice has significantly (*P*≤0.05) the least *H*₂*O*₂ scavenging (0.32%). So, it is necessary to apply the most proper cooking conditions (temperature and cooking time) to avoid any degradation of the bioactive compounds present in pumpkin. The results revealed the superiority of blanching process since it maintained the bioactive compounds in pumpkin without any deteriorative effects.

Keywords: Natural antioxidants, antioxidant activity, cooked pumpkins, blanching, stir-frying, juice, soup, roasting.

INTRODUCTION

The tent "let food be the medicine and medicine be the food," espoused by Hippocrates nearly 2,500 years ago, is receiving renewed interest. It is worth to mention that there is a consumer interest in functional foods from the health point of view (Hasler, 1998, Anonymous, 2009). Antioxidants are compounds that protect cells against the damage effects of reactive oxygen species. It is worth to mention that some antioxidants are found in vegetables. In this respect, products high in vitamin C, vitamin E and carotene content (provitamin A) are believed to be the most beneficial antioxidants (Palace et al. 1999).

Pumpkin (*Cucurbita moschata*) is defined as a fruit botanically. Flesh and seeds of pumpkin are commonly used for culinary and medicinal purposes. Carotenoids are responsible for the orange colour of pumpkin. Murkovic et al. (2002) reported that three species of pumpkin (*Cucurbitapepo, C. maxima* and *C. moschata*) contained β-carotene (0.06-7.4 mg/100 g), α-carotene (0-7.5 mg/100 g) and lutein (0-17 mg/100 g). Similarly, it was reported that pumpkin contains both β-carotene and lycopene. Pumpkin is cooked or pureed, and has numerous culinary uses either as a vegetable or as an ingredient in many food products. Fresh pumpkins are very sensitive to microbial spoilage, even at refrigerated conditions, and thereby they must be frozen or dried (Doymaz, 2007).

Food preparation at home, in particular, cooking is often the final step in food processing. Various cooking methods were found to affect content of phytochemicals, in particular, antioxidants present in the vegetables (Ismail et al. 2004, Zhang & Hamauzu, 2004, Turkmen et al. 2005). Notwithstanding, Podşedek (2007) suggested that both antioxidant levels and activities of processed vegetables were lower than those of the corresponding fresh samples. This is probably attributed to degradation
of the bioactive compounds and adsorption of water during boiling, resulting in dilution of the active compounds. Moreover, a significant increase was reported in release of β-carotene and tocopherol in broccoli upon cooking. Antioxidants inhibit oxidation of lipids by transforming free radicals/ peroxo radicals into non-radicals by donating electron and hydrogen or by chelating transition metals (Frankel, 1998). Several synthetic antioxidants are available in the market. Due to their reported carcinogenic effects, use of such antioxidants is restricted. Moreover, synthetic antioxidants may cause kidney damage (Branen, 1975, Ito et al. 1983, Lindenschmidt et al., 1986). Consequently, it is necessary to search for new natural antioxidants as an alternative to synthetic antioxidants to prevent lipid oxidation in foods (Farvin et al. 2014). Many epidemiological studies have indicated that the oxidative stress imposed by reactive oxygen stress species (ROS) plays an important role in many chronic and degenerative diseases, (Young & Wood, 2001, Azizova, 2002, Fu et al., 2011., Zhang & Tsao, 2016)

The present study aimed at investigation the effect of various cooking methods (blanching, stir-frying and roasting) on the antioxidants content and potency of pumpkins

**MATERIALS AND METHODS**

**Materials**

Fresh pumpkin (Cucurbita moschata) of commercial maturity was obtained in July 2014. Representative sample was withdrawn from the Central Market of Vegetables and Fruits, Alexandria Governorate, Egypt. Other ingredients were purchased from Alexandria market, Egypt.

All chemicals and reagents used in the present study were purchased from El-Gomhoria Company for Chemicals, Alexandria, Egypt, except for DPPH reagent (1,1-diphenyl-2-picrylhydrazyl) which was obtained from Sigma Company, Germany.

**Preparation of samples:**

Pumpkin fruits were carefully washed with tap water, dried with a soft cloth and the skin was peeled. The seeds were removed from the pulp using knife, then the pulp was washed thoroughly with distilled water and cut into small pieces “cubes” (1.5×1.5×1.5 cm), and slices (0.5mm). One portion was retained raw while others were used to prepare different products (Juice, soup, fried and roasted).

**Preparation of pumpkin products:**

Raw juice (RJ), boiled juice (BJ), boiled soups (BS), roasted (RO-P) and stir fried pumpkin (SF-P) were prepared according to the methods shown in Fig. (1).

**Cooking methods**

Three thermal treatments were used including boiling, stir-frying, roasting along with fresh samples as a control. For preparing soup, 2.800 Kg of pulp cubes were blanched in boiling water (100°C) for 2, 4, 6 min. Meanwhile, traditional soup was prepared by boiling in water (100°C) for 20 mins. The chopped raw onion, garlic, carrots and celery were fried in corn oil until these ingredients have golden colour, and then the other ingredients were cooked for 8 min and added to blanched cubes to make soup. Ingredients used in preparation of pumpkin soup are shown in Table (1). Boiling was conducted for 4 and 2 min.

**Analytical methods**

**Determination of lycopene**

For extracting lycopene, one g of homogenized fresh or semi-dried pumpkin sample was weighed
into a screw-top tube, which was covered with aluminum foil to exclude light. The lycopene from the samples was extracted according to the method of Sadler et al. (1990) using 25 ml mixture of hexane–acetone–ethanol (2:1:1, v:v:v).

Lycopene was determined by Shimadzu spectrophotometer. The absorbance was measured at 503 nm and hexane was used as blank. Lycopene content was calculated using lycopene extinction coefficient (E% 3150) according to the method described by Chang & Liu (2007).

**Determination of total carotenoids**

Total carotenoids (mg 100g) were determined by a modified method of Ranganna (1997). Acetone and petroleum ether were used as extracting solvents and the absorbance was measured at 450nm.

**Determination of total polyphenols**

The method of Skerget et al. (2005) was applied to extract polyphenols with some modifications. Approximately 5g sample was extracted using 50 ml ethanol in 250 ml conical flask. The flask was placed in a water bath at 25°C for 1 hr. The crude extract was then filtered through a 0.4 um filter (Whatman, Maidstone, England) and the solvent was then evaporated under vacuum. The extraction yield was then determined as% weight. The extracts were kept at –20°C until analysis.

Total polyphenolics content was determined by Folin-Ciocalteu method (AOAC. 1990).

**Table 1 : Ingredients used in the preparation of pumpkin soup**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanched cubes of pumpkins</td>
<td>700</td>
</tr>
<tr>
<td>Chopped raw carrots</td>
<td>27.30</td>
</tr>
<tr>
<td>Chopped raw onion</td>
<td>70.6</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>0.1</td>
</tr>
<tr>
<td>Cloves</td>
<td>0.17</td>
</tr>
<tr>
<td>Chopped raw garlic</td>
<td>2.8</td>
</tr>
<tr>
<td>Black pepper</td>
<td>0.23</td>
</tr>
<tr>
<td>Ginger</td>
<td>0.3</td>
</tr>
<tr>
<td>Corn oil</td>
<td>7</td>
</tr>
<tr>
<td>Cumin</td>
<td>0.1</td>
</tr>
<tr>
<td>Food salt</td>
<td>6.5</td>
</tr>
<tr>
<td>Cardamom</td>
<td>0.5</td>
</tr>
<tr>
<td>Celery</td>
<td>92.5</td>
</tr>
<tr>
<td>Water</td>
<td>500 (ml)</td>
</tr>
</tbody>
</table>

**Determination of total flavonoids compounds (TFC)**

The method of Ordon et al. (2006) was used to determine the total flavonoid content (TFC). A volume of 0.5ml of 2% AlCl$_3$ ethanol solution was added to 0.5 ml of the supernatant. After 1hr of incubation at the room temperature, the absorbance was measured at 420 nm using Shimadzu spectrophotometer.

**Determination of antioxidant activities**

**The DPPH radical scavenging activity**

The method of Brand-Williams et al. (1995) with some modifications was used to measure free radical scavenging activity. The extracts were dissolved in 1.0 ml MeOH and the solutions were added to a 1.0 ml DPPH. The absorbance at 515 nm was measured using Shimadzu Spectrophotometer. The following equation was applied to calculate DPPH scavenging activity:

\[
\text{DPPH scavenging activity (\%)} = \left(\frac{A_0 - A_t}{A_0}\right) \times 100
\]

Where $A_0$ is the absorbance of the control at $t=0$ min, and $A_t$ is the absorbance of the antioxidant at $t=15$ min.

**Hydrogen peroxide scavenging activity**

The modified method of Ngonda (2013) was used to measure the scavenging activity of extract towards hydrogen peroxide radicals. The percentage of hydrogen peroxide scavenging by the extract and standard compound was calculated using the given formula:

\[
\text{Percentage scavenged \[H_2O_2\]} = 1 - \frac{\text{Abs (standard)}}{\text{Abs (control)}} \times 100
\]

Where $A_0$ is the absorbance of the control at $t=0$ min, and $A_t$ is the absorbance of the antioxidant at $t=15$ min.

**Statistical analysis**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Kotz, et al. 2006 & Kirkpatrick and Feeney, 2013), with one way ANOVA.

**RESULTS AND DISCUSSION**

The present study was conducted on four pumpkin products namely, juice, soup, stir-fried and roasted. Such products were subjectively evaluated along with the control. The highest ranked treatments were investigated in the present study, including (1-Juice: boiling for 2 mins, 2-Soup: boil-
ing for 4 min, 3-Stir fried:stir fried for 2 min and 4- Roasted:roasting for 4 min.) as figured out in our previous study (Lotfy et al, 2016).

Antioxidant activity and phytochemicals of pumpkin and its products:

Antioxidant activity

Pumpkin seems to be promising as antioxidants containing food. However, it was obvious that pumpkin and its products could serve as a good source of antioxidants. According to Moharram & Youssef (2014), antioxidant capacity should be evaluated by more than one method to trace the different mechanisms of free radicals scavenging. In the present study, DPPH- scavenging values of pumpkin products ranged from 30.31% (roasted pumpkin chips) to 63.79% (raw juice) (Table 2). The H\textsubscript{2}O\textsubscript{2} scavenging values varied from 0.32% to 2.85% for the raw juice and soup boiled for 4 min, respectively, (Table 2). It was obvious that blanching process was superior in terms of maintaining the antioxidant potency of pumpkin as compared to both stir frying and roasting. Consequently, blanching is favourable method of cooking for pumpkin.

Phytochemicals:

Carotenoids

The carotenoids content of pumpkin and its products are presented in Table (3). The raw pumpkin juice (RJ-P) exhibited significantly (P\leq0.05) the highest carotenoids content (1476 IU/ 100g). On the other hand, the least significantly (P\leq0.05) carotenoids content was found in roasted pumpkin for 4 min (584.00 IU/ 100g). The other products could be ascendingly ordered in terms of their carotenoid content as follows: (IU/100 g): Raw-P (raw pumpkin) (1200), BS-P (soup boiling for 4 min) (1107), BJ-P (juice boiling for 2 min) (892), P-ST(boling soup for 20 mins) (830) and SF-P (stirring fried for 2 min) (676).

Pumpkins are a good source of provitamin A. The high content of provitamin A in pumpkins can be utilized by availing the pumpkins to the markets worldwide, device cultivation methods for large production and determined conditions for long storage shelf life (Karanja et.al. 2012).

Carotenoids possess nutritional properties and health promoting effects. Pumpkins flesh has an intense yellow/orange colour owing to the high level of carotenoids, mainly α-carotene, β-carotene, β-cryptoxanthin, lutein, lycopene and zeaxanthin (Durante et al. 2014). It is worth to mention that the total carotenoids content (on dry weight basis) of the pumpkins peel depends on variety being in a range of 12 to up to 175 mg/ kg (Kreck et al. 2006).

Lycopene content (mg/100g) ranged from 0.15 (soup boiled for 20 min) to 0.70 (raw pumpkin juice) as shown in Table (3). Significant differences (P\leq0.05) could be traced in lycopene content of the different pumpkin products. It was obvious that boiling for 4 min, stir-frying for 2 min and roasting for 4 min significantly (P\leq0.05) lowered the lycopene content of pumpkin (Table 3).

The β-carotene contents in pumpkin products investigated in the present study ranged from 98.59 to 6834.9 IU/ 100 gm. It is worth to mention that the high content of carotenoids in RJ-P may be attributed to increase the surface area as a result of disintegration that occurred in blending process. No β-carotene could be detected in both TS-P (soup boiled for 20 min) and SF-P (stirring fried for 2 min), it was clear that heat applied in the preparation of these pumpkin products affected negatively the β-carotene content. The most pronounced effect was that for boiling for 20 min to prepare soup and stir frying for 2 min to prepare stir-fried pumpkin (Table 3).

<table>
<thead>
<tr>
<th>Table 2: Antioxidant activity of pumpkin and its products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Raw-P</td>
</tr>
<tr>
<td>RJ</td>
</tr>
<tr>
<td>BJ</td>
</tr>
<tr>
<td>BS</td>
</tr>
<tr>
<td>TS</td>
</tr>
<tr>
<td>SF</td>
</tr>
<tr>
<td>RO</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>C.V</td>
</tr>
<tr>
<td>F</td>
</tr>
<tr>
<td>P</td>
</tr>
</tbody>
</table>

Values are expressed as means± SD. Mean in a column not sharing the same superscript are significantly different at P \leq 0.05

Raw-P: control  TS: boiling soup for 20 min  RJ: raw juice  SF: stirring fried for 2 min  BJ: boiling juice for 2 min  RO: roasting pumpkin for 4 min  BS: boiling soup for 4 min
The data presented here regarding the effect of boiling and stir-frying on carotenoids content of pumpkins are not in agreement with data of Azizah et al. (2009). They found that the aforementioned treatments elevated the contents of both β-Carotene (2 to 4 times) and lycopene (17 to 40 times) of pumpkin after cooking for 2, 4 and 6 min. It is well known that numerous factors affect the stability of carotenes in food. Temperature, oxygen and duration of heat treatment are the main factors in this respect. Consequently, cooking of pumpkins by different methods (blanching, stir-frying and roasting) vary in terms of their effects on the stability of carotenes.

Flavonoids and phenolic compounds

Table (4) shows that each of Raw -P, RJ-P and P-ST possessed significantly (P≤0.05) the highest content of flavonoids. The other pumpkin products had flavonoids contents ranged from 12.09 to 14.64 g/kg.

Data in Table (4) show that raw -P and RJ-P exhibited significantly (P≤0.05) the highest polyphenolics content being 670.18 g/kg, followed by Raw-P (530.32, RO-P (518.22) TS-P (440.86), BJ-P (430.26), BS-P (411.25) and SF-P (406.25) g/kg. It is well known that several phenols, i.e. non-flavonoids mainly derived from cinamic acid, are part of the plant antioxidant system. Most common hydroxycinnamates are p-coumaric, caffeic, ferulic as well as caffeoylquinic acid and chlorogenic acid.

Data presented here regarding the effect of boiling and stir-frying on total phenols of pumpkins are in accordance with data published by Azizah et.al. (2009), who found that the aforementioned treatments resulted in 18 to 54% lossess of total phenolics content of the pumpkins.

CONCLUSIONS

Pumpkin pulp can be prepared in many forms (juice, soup, stir-fried cubes and roasted chips). It was obvious that all these aforementioned forms were well accepted by panelists. Due to presence of bioactive compounds mainly dietary fibers and antioxidants, it is advisable to promote and encourage consumption of pumpkin dishes in Egypt.

Recommendations

Based on the results of the present work, the

**Table 3: Total carotenoids, lycopene and β carotene contents of the products prepared from pumpkins**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Total carotenoids (IU/100g)</th>
<th>Lycopene (mg/100g)</th>
<th>β-carotene* (IU/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw-P</td>
<td>1200 ± 0.27 b</td>
<td>0.65 ± 0.14 a</td>
<td>845.30</td>
</tr>
<tr>
<td>RJ</td>
<td>1476 ± 0.08 a</td>
<td>0.70 ± 0.07 a</td>
<td>6834.94</td>
</tr>
<tr>
<td>BJ</td>
<td>892 ± 0.56 d</td>
<td>0.18 ± 0.02 bc</td>
<td>98.59</td>
</tr>
<tr>
<td>BS</td>
<td>1107 ± 0.47 c</td>
<td>0.54 ± 0.08 a</td>
<td>602.04</td>
</tr>
<tr>
<td>TS</td>
<td>830 ± 0.27 e</td>
<td>0.15 ± 0.06</td>
<td>Not detected</td>
</tr>
<tr>
<td>SF</td>
<td>676 ± 0.05 f</td>
<td>0.35 ± 0.03 b</td>
<td>Not detected</td>
</tr>
<tr>
<td>RO</td>
<td>584 ± 0.74 e</td>
<td>0.17 ± 0.05 bc</td>
<td>566.86</td>
</tr>
<tr>
<td>Mean</td>
<td>967.025</td>
<td>0.3959</td>
<td></td>
</tr>
<tr>
<td>C.V</td>
<td>0.435</td>
<td>19.19</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1656948*</td>
<td>30.20*</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.0001*</td>
<td>&lt;0.0001*</td>
<td></td>
</tr>
</tbody>
</table>

Values are expressed as means± SD. Means in column not sharing the same superscript are significantly different at P≤0.05.

**Table 4: Flavonoids and phenolies contents of pumpkins and its products**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Flavonoids (g/kg)</th>
<th>Phenols (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw-P</td>
<td>17.24 ± 0.46 a</td>
<td>530.32 ± 0.10 b</td>
</tr>
<tr>
<td>RJ</td>
<td>17.96 ± 0.76 a</td>
<td>670.18 ± 0.61 a</td>
</tr>
<tr>
<td>BJ</td>
<td>13.53 ± 0.78 bc</td>
<td>430.26 ± 0.40 e</td>
</tr>
<tr>
<td>BS</td>
<td>17.18 ± 0.17 c a</td>
<td>411.25 ± 0.44 f</td>
</tr>
<tr>
<td>TS</td>
<td>14.64 ± 0.85 b</td>
<td>440.86 ± 0.10 d</td>
</tr>
<tr>
<td>SF</td>
<td>13.59 ± 0.86 bc</td>
<td>406.25 ± 0.85 e</td>
</tr>
<tr>
<td>RO</td>
<td>12.09 ± 0.61 c e</td>
<td>518.22 ± 0.69 c</td>
</tr>
<tr>
<td>Mean</td>
<td>15.177</td>
<td>486.76</td>
</tr>
<tr>
<td>C.V</td>
<td>4.502</td>
<td>0.108</td>
</tr>
<tr>
<td>F</td>
<td>33.15*</td>
<td>97051.59*</td>
</tr>
<tr>
<td>P</td>
<td>&lt;0.0001*</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

Values are expressed as means± SD. Mean in a column not sharing the same superscript are significantly different at P≤0.05.

Raw-P: control
TS: boiling soup for 20 min
RJ: raw juice
BJ: boiling juice for 2 min
BS: boiling soup for 4 min
TS: boiling soup for 20 min
SF: stirring fried for 2 min
RO: roasting pumpkin for 4 min

BJ-P (430.26), BS-P (411.25) and SF-P (406.25) g/kg. It is well known that several phenols, i.e. non-flavonoids mainly derived from cinamic acid, are part of the plant antioxidant system. Most common hydroxycinnamates are p-coumaric, caffeic, ferulic as well as caffeoylquinic acid and chlorogenic acid.

Data presented here regarding the effect of boiling and stir-frying on total phenols of pumpkins are in accordance with data published by Azizah et.al. (2009), who found that the aforementioned treatments resulted in 18 to 54% lossess of total phenolics content of the pumpkins.
following recommendations are suggested:

1– It is necessary to apply the most proper cooking conditions (temperature and cooking time) to avoid any degradation of the bioactive compounds present in pumpkins. Study reveal the superiority of blanching since it maintained the bioactive compounds in pumpkins without deteriorative effects.

2– Promotion and encourage the consumption of different pumpkin products in Egypt, since these products are considered as functional foods and thereby protect against many degenerative diseases.

REFERENCES


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تأثير طرق الطهو المختلفة على مضادات الأكسدة الطبيعية
في منتجات الفرع العسلي

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في هذه الدراسة تم تطبيق ثمانية طرق للطهو على شكل مكعبات ذات أبعاد (1,5 × 1,5 × 1 سم). وأجريت معاملات حارضان ومن ثم التحمير مع التقلب، وكذلك تم القطع على شكل شرائح (بسمك 0.5 سم من الفرع العسلي للعكسة الشعبية. تم تقييم بعض المنتجات (عصير – شوربة – المكعبات المحمية – شرائح مشويه) وتم استخدام مكعبات الفرع سلقة السلق في إعداد كل من عصير وحساء. حيث أن المحتوى الكارتوينودات (وحدة دولية / 100 جم) ترتفع بين 11.000 للحساء و 86.000 للعصير. أما بالنسبة للمحتوى المنتجات من البيتا كاروتين فكانت من مجموعة الأعلى معنوية 34.62 وحدة دولية / 100 جم في العصير الحام في حين تحتوي العصير الذي تم إعداده باستخدام مكعبات سابقة للسلقة على 98.69 وحدة دولية / 100 جم.

أوضح النتائج أن الشرائح المشويه قد احتوت على الفلافونيدات بنسبة 12.09 جم/كمجم بينما بلغ محتوى الليكوين في الحساء الذي تم إعداده من مكعبات سابقة السلق لمدة 4 دقائق على تركيز الأعلى معنوي (15.0 ملجم / 100 جم)، على عكس الحساء الذي تم إعداده بالطريقة التقليدية (الع cânية لمدة 20 دقيقة) حيث احتوت على التركيز الأعلى معنوي من الليكوين (7.40 ملجم / 100 جم). أيضاً، أوضح النتائج أن المكعبات المحمية تحتويت على تركيز ثابت من الفلافونيدات (25.00 ملجم / كجم). على عكس الشرائح المشويه التي تحتوي على التركيز الأعلى معنوي (18.70 جم / كجم).

تم قياس النشاط المضاد للأكسدة للمنتجات موضع الدراسة بطريقة كيح كل من الـ DPPH فوق أكسيد الهيدروجين. وتبين أن العصير الحام كان الأعلى معنوي بنسبة للكيح بالـ DPPH التعليمي والذي كان الأقل معنوي (31.00٪) في حين كانت قيمة كيح فوق أكسيد الهيدروجين هي الأعلى معنوي (28.05٪) للكيحة الحام الذي تم تبريده من مكعبات سلقت لمدة 4 دقائق على عكس العصير الحام الذي أعطي القيم الأقل معنوي لكيح فوق أكسيد الهيدروجين (32.00٪). ومن ثم، إذاً، فإن الضروري استخدام طريقة الطهو الأكثر مثالية من حيث درجة حرارة ومن الطهو وذلك للحصول على كيحة من المنتجات الشهية حيويًا الموجودة في الفرع العسلي. ولقد أوضحت النتائج هذه الدراسة تطورت معايير السلق على الممارسات الأخرى وذلك لأنها تحافظ على المركبات النشطة حيويًا في الفرع العسلي دون أضرار.