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EFFECT OF VARIOUS THERMAL TECHNIQUES AND FROZEN STORAGE ON SOME CHEMICAL COMPONENT AND PHYTOCHEMICAL COMPOUNDS OF GREEN BEANS AND BROCCOLI.

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ABSTRACT

The goal of this study was investigate effect of various thermal techniques, i.e. boiling, steaming , microwave and on moisture ,ash ,TSS, ascorbic acid , total phenols, total flavonoid and antioxidant activity of two vegetables type (green beans and broccoli). The recorded data pointed that various methods had significant effect on all analyzed vegetables components. as well as blanching have increased moisture contents of two variety vegetables (85.82%) and (91.43%) compared with the fresh form (84.44%)and (88.82%)respectively . while the Ash , TSS ,and antioxidant contents in two varieties were decreased. When steaming samples were reduce the all chemical and phytochemical parameters expect moisture ,total phenol and total flavonoid have increased in broccoli. the results suggested that the cooking method to save the concentration of (total phenol ,total flavonoid and antioxidant activity) nearest to the fresh form was microwaving method. at the same time this results suggested that the freezing storage due to decreasing in all levels of chemical and phytochemical components.

Key words: phytochemical, TSS, DPPH, vegetables

INTRODUCTION

The main source of antioxidants in the human diet is phytochemicals, which are also crucial in fighting against the negative effects of stress and a number of chronic diseases like type II diabetes, dementia, and muscle degeneration. Phenolic also promotes health by defending against many malignancies and disorders related to the heart, metabolism, and nervous system **(Carter et al ., 2010)**. Additionally, it serves as a significant source of anti-inflammatory compounds, such as phenolic acids, flavonoids, anthocyanins, glucosinolates, ascorbate, and carotenoids **(Slavin and Lloyd., 2012)**.

In terms of vitamins, minerals, dietary fibres, organic acids, phytochemicals, and micronutrients, vegetables and fruits have a higher nutritional content. These include flavonoids, vitamin C, folates (vitamin B9), tocopherols, carotenoids, and xanthophylls. **(Awad et al., 2012;Kiani and Sun., 2011, and Fratianni et al .,2021)**.

Broccoli(Brassica oleracea) and Green beans (Phaseolus vulgaris, L.) Vegetables are typically consumed after being heated in a microwave, steamed, or otherwise processed. **(Van et al., 2009;Martins and silva., 2004 and Mirsaeedghazi et al .,2015).** While conventional hot water blanching significantly reduces undesirable enzymatic reactions, kills microorganisms, softens the texture, and speeds up drying, it also causes undesirable product qualities, such as loss of texture, soluble nutrients, pigment, and aroma. Microwaves can minimise nutrition loss and are more effective. Non-thermal technologies can be a better alternative to thermal blanching to overcome these drawbacks, and more fundamental researche are needed for better design and scale – up **(Deng et al ., 2017).**

Food deterioration can be efficiently delayed by freezing since it lowers the activity of bacteria and enzymes. Furthermore, water crystallisation limits the amount of water in food products and prevents microbial growth. Nowadays, practically all food processes require freezing**(Sun.,2005).**

When compared to the same fresh form of an unfrozen product, frozen fruits and vegetables typically have a softer texture after thawing because slow freezing rates produced considerable softening due to extracellular ice formation during the freezing process (**Hui., 2006).**

Green beans' favourable texture impact increased the freezing rate even after cooking, according to objective texture testing. The freezing rate of cooked and frozen beans has an inverse relationship with cell damage, meaning that a higher freezing rate lessens tissue and tissue structure damage, **(Ferreira et al.,2006**;**Roy et al.,2001)** suggested high-temperature short time blanching before of rapid freezing for superior textural quality in frozen products.

Commonly eaten veggies that are cooked include green beans, broccoli, cabbage, and cauliflower. However, there is relatively little information in the literature about the overall phenolic content and antioxidant activity of these plants. The purpose of the current study is to ascertain the impact of various cooking techniques and frozen storage on the antioxidant activity, flavonoids, vitamin C content, and total phenolics of the vegetables.

MATERIAL AND METHODS:

Vegetables: fresh green been (*Phaseolus vulgaris*) and broccoli (*Brassica oleracea*) vegetables were purchased 5KG from local markets in El.Mina Governorate, to represent the studied Fresh **two** vegetables. research material.

Chemicals:.

Chemicals and reagents used in the study were of A grade. Ascorbic acid ,2,6-dichlorophenol- indophenol, oxalic acid, ethanol, Sodium Nitrate (NaNO2) , Sodium carbonate (Na2CO3), Folin - Ciocalteu , gallic acid, DPPH,2,2-diphenyl- 1-picrylhydrazyl ,aluminum chloride(AlCL3),Sodium hydroxide

(NaOH) were purchased from El-Nasr company.

Preparation of vegetable samples:

After cutting off the inedible sections of the vegetables manually using a sharp knife, they were then rinsed with tap water. They were following drying on a paper towel and cut into roughly equal-sized pieces or slices. Then it is divided into four groups (control, blanching, steaming, and microwave) for (zero time in all treatments and 3 months of frozen storage), weighing 200 grams of all treatments, except for the microwave, 100 grams, taking into account storage treatment. It is packaged with low-density polyethylene and stored at the freezing temperature of -18 °C.

Blanching: Blanching: Vegetables was added to 300 ml of water that had just reached the blanching in a stainless pan for 5 minutes the sample were drained off and cooled rapidly on plenty of ice.

Steaming: Steaming: Vegetables were placed on a tray in a steam cooker over boiling water under atmospheric pressure for 7.5 min. the samples rapidly cooled on ice.

Microwave: Microwave: Vegetables were placed in a special microwave plastic container with 6 ml of pure water added for 100 g (12 ml for green beans) covered and boiled in a commercial microwave 90s oven 1000 watts(Mod:KOR-131G,2450MHz) . cooled rapidly on plenty of ice.

Freezing : Freezing: all treatment samples were stored under frozen temptation (-18°C). Every month we determined the analytical parameters for 3 months.

Packaging materials:

Packaging samples used in this study it is low-density poly-ethylene bags LDPE purchased from the local market of Minia City, Egypt.

Analytical methods:

Determination of chemical composition:

Moisture and ash contents:

Ashes and moisture were measured using the procedures outlined in **(A.O.A.C, 2006)**

Total soluble solids TSS:

The total soluble solids contents of the homogenate samples were determined by using an Abbe Refractometer (model 1). The TSS of three samples for each experimental design was recorded at room temperature .results are expressed as Brix according to (**AOAC., 2000)** .

determination ascorbic acid:

vegetables are a significant source of ascorbic acid. The chemical estimation techniques that reduce 2,6-dichlorophenol indophenol by ascorbic acid and those that involve the reaction of dehydroascorbic acid with 2,4-dinitrophenylhydrazine are the most effective. Visual Titration of 2,6-Dichlorophenol and Indophenol **(A.O.A.C., 2006).**

Determination of Total Phenolic:.

By dissolving 35 g of anhydrous Na_2CO_3 in 100 ml of hot distilled water and stirring until the combination was completely dissociated, a 35% saturated sodium carbonate solution was created. To avoid oversaturation, more water was added. To avoid precipitation, the prepared solution was initially kept at a low temperature throughout the study. Analysis was performed by adding 3.5ml of distilled water, 50µL of sample extract and Folin Ciocalteu reagent and 300µL of sodium carbonate to tubes . After completely blending, the mixture was left for an additional 15 minutes. and then the absorbance was measured in triplicate at 730nm using a UV/VIS spectrophotometer (Shimadzu, Kyoto, Japan). The blank consisted of all reagents excluding the sample extract. A standard curve was fashioned using Gallic acid at concentrations of 0.2, 0.4, 0.6, 0.8, and 1.0mg/mL diluted in ethanol. Total phenolic concentration was expressed as mg of tannic acid equivalents via the standard curve **(Ting and Rouseff., 1986; modified by Abd El-aal and Halaweish., 2010).**

Determination of Total Flavonoids Content:

The total flavonoids content of vegetables extract was determined using a colorimetric method described by **(Zhishen et al., 1999) modified by Abd El-aal and Halaweish .,2010).** A 0.5 ml aliquot of appropriately diluted sample solution was mixed with 2 mL of distilled water and subsequently with 0.15 mL of a 5% $NaNO_2$ solution. After 6 min, 0.15 mL of a 10% $AlCL_3$ solution was added and allowed to stand for 6 min, then 2 mL of 4% NaOH solution was added to the mixture. Immediately, water was added to bring the final volume to 5 mL, After completely blending, the mixture was left to for an additional 15 minutes. A spectrophotometer (Shimadzu, Kyoto, Japan) was used to measure the mixture's absorbance at 510 nm in comparison to a produced water blank. In order to measure the total amount of flavonoids, quercetin was utilised as the reference compound. All values were expressed as milligrams of quercetin equiv per 100grams of vegetables . Data were reported as means (SD) for three replications. A 1.4mg/mL quercetin dehydrate standard was prepared for comparison.

Determination of Total Antioxidant Activity:

The method of measuring total antioxidant activity **(Su and Silva .,2006)** A 100µM 2.2- diphenyl-1-picrylhydrazyl was prepared by dilution of 32mg of DPPH with 800mL of ethanol. 500µL of sample extract was added to 3.0mL of DPPH solution in a cuvette. After 10 minutes, the reaction mixture's absorbance at 517 nm was measured in triplicate in a spectrophotometer (Shimadzu, Kyoto, Japan). The control solution was prepared by adding 500µL of ethanol to the DPPH solution and ethanol was used as blank. The antioxidant activity (%) was determined by the following formula:

$$\text{Activity } (\%) = \frac{(\text{Abs } control - \text{Abs } sample)}{(\text{Abs control})} \times 100$$

Where Abs. is the absorbance at 517nm.

Statistical analysis:

Data were analyzed by analysis of variance (ANOVA) by using the SPSS statistical differences between means by Duncan’s Multiple Range test **(SPSS., 2007),** The least significant difference ($p \leq 0.05$**).**

Data in Table (2) showed that the moisture content of the fresh control of green beans and broccoli were (84.44%and 88.82%) respectively. in the range of the data in the literature

(Martínez et al., 1995 ; Mohamed et al., 2014; Pellegrini et al., 2009 and Afify et al .,2017). The moisture increased in green beans and broccoli by blanching which agrees with **(Pellegrini et al., 2009 and Armesto et al.. 2017)**. The middle lamella of cellulose is little affected by heat during boiling, but it is broken down, causing vegetables to absorb water as the starch gelatinizes; this increase in moisture content may be caused by the leaching of water-soluble nutrients during the blanching or boiling processes **(Rickman et al., 2007).**and in the microwave cooking the moisture in green beans and broccoli was reduced, it may be due to the increase in solid content, Therefore, the microwave showed a significantly higher solid content than the corresponding raw vegetables**(Buratti et al .,2020).** While steam cooking, the moisture increased in the broccoli but decreased in the green bean. The same trend happened during storage for all treatments (fresh, blanching, steaming, and microwave). This result is in agreement with which reported by **(Kapusta-Duch et al., 2014).**

In the same Table, it's clear that the ash content of the fresh control green bean and broccoli were 9.29 and 8.96%. This result is convergent with (**Mohamed et al., 2014andWadmare et al .,2000).** While ash contents of green bean and broccoli slightly decreased in controls of all treatments. However, steam treatments and microwaving produced the lowest reductions in ash concentration, these reductions may be explained by their diffusion into the cooking water. Leaching into the cooking water is the sole way that minerals are lost during cooking; they are not destroyed **(Fennema., 1996).** it's observed that the ash contents of green beans and broccoli during storage for 3 months have slightly decreased in fresh, blanching, steaming, and microwave from 9.29 -8.71, from 7.48-6.69, from 7.56-6.85 and from 9.13-8.05% for green bean and from 8.96-6.89, from 6.65-5.09, from 7.97-6.84, from 8.59-6.16% for broccoli respectively. **(Waldemar et al., 2000** ;**Mohamed et al .,2014 and Kmiecik et al .,2000**) pointed that their results blanching and freezing caused a significant decrease in its level of ash contents. Our results in this work showed that the ash content in microwave samples of green beans and broccoli has a level of ash contents nearest to fresh control.

From Table (2) it's clear that the TSS % of the fresh green bean and broccoli were 10.33 and 10.66%, respectively. This result is in harmony with those of Hawall et al (2018). TSS value of the studied vegetables for all treatments decreased. This is explained by **(Ahmed and Ali .,2013, and (Palermo et al., 2014). (Martínez et al .,2018,and Armesto et al., 2016)** They reported that significant losses of soluble solids during canning using various treatments (boiling, steaming, and microwave) might be due to thermal breakdown and leaching of the cooking medium, its extent of filtration depends on the amount of water used as well as the cooking time. Also the TSS contents of the studied vegetables for all treatments during the storage period decreased in green beans and broccoli as shown in the Table from 10.33-6.50 , from7.16-4.66, from 7.33-4.66, and from 8.16-5.83% for green bean, as well as from 10.66-6.50, from 9.16-4.84, from

9.66-4.66, and from 9.83-6.16% in broccoli samples respectively. In this point **(Vina et al., 2007)** suggested that frozen storage affected on physical and chemical parameters of freezing vegetables,t his is due to the action of enzymes which remain active at low temperatures below 0 °C.

Data in Table (3) showed that the ascorbic acid content of the fresh green bean and broccoli were 86.12 and 551.14 mg/100g respectively. The results are in agreement with those reported by (**Filiz et al ., 2017; Podsędek ., 2007 and Franke et al., 2004)**. They clarified that the ascorbic acid content decreased in green beans and broccoli treated by blanching, steaming, and microwaving, maybe the loss of vitamin C content during the various cooking procedures may be brought on by these factors since vitamin C is highly soluble in water and is particularly unstable at high temperatures **(Adefegha and Oboh., 2011)**. According to research, microwaving retains more vitamin C than boiling. This can be due to different sample preparation and hydro modules being used **(Igwemmar et al., 2013)**. Also after storage at -18°C for 3 months, ascorbic acid content decreased from control to the third month, in fresh, blanching, steaming, and microwave, green beans were from (86.12-16.37), (56.70-44.18), (58.30-28.21), (68.63-42.42) mg /100g DW, and broccoli was (551-113.41), (436.87-264.11), (391.42-119.75), (507.49-412.51) respectively. in this case Variations in the vegetable surface area, cellular rupture level, kind of matrix, and enzyme activity **(Li et al ., 2017)**. Loss of vitamin C during frozen storage may depend on many factors, including the initial content of the ingredient, and the variety of vegetables **(Grajek., 2007).** The results in this Table indicated that the microwave has the highest value of vitamin C followed by steaming, while the blanching has the lowest value of vitamin C.

In the same table the total phenol content also of the fresh green bean was (506.48mg/100g DW**)**, but in fresh broccoli was (1533.27)mg/100g **,**the results are agreement with (**Podsędek .,2007;Wu et al .,2004 and Kaur et al ., 2018**). Total phenol content increased in green beans and broccoli treated by steaming followed by microwave in control this is agreement with**(Turkman et al., 2005)**, but decreased in blanching may be lost due to the leaching ,water in cooking process. Similar results were reported by **(Danesi and bordoni ., 2008)** , This might result from the decomposition of phenols while cooking **(Crozier et al ., 1997)**.But in Steaming and microwaving produced an increase in the TP content, related as well to the cooking time. These effects are explained by the release of free phenolic from the hydrolysis of high molecular weight compounds, the dissolution of polyphenol-protein complexes, which is encouraged by heat treatment, and the concurrent softening of the vegetable tissues, which increases the extractability and solubility of the phenolic components, **(Mazzeo et al., 2011,and Buratti et al., 2020).**The results explained that the steaming have the highest value of total phenols content followed by microwave in green bean and broccoli in control .while after storage at -18°C for 3 months , total phenol content decreased from control to third month, in fresh, blanching, steaming ,and microwave were in green beans from (832.29-586.17), (1077.36-949.22), (1133.78-886.96), (1661.79-2075.27)mg /100g DW and broccoli was from (796.97-642.71), (985.75-804.64), (894.33-657.86),(987.76-807.68) mg /100g respectively .this may be due to Phenols are unstable compounds that change after harvesting and during storage and manufacturing processes (**(Barbara et al., 2005 and Rossi et al., 2003)**. Sometimes it is positive and in another is negative, and in some cases there is no effect **(Rickman et al., 2007)**. Freezing and boiling reduce the concentration of polyphenols, mainly due to their volatilization and leaching in the cooking water **(Mahn and Reyes .,2012)**. the microwave showed have the highest value of total phenols in the freezing storage samples.

Total flavonoids in the same table of the fresh green bean was (15.72mg/100g DW**)**, but in fresh broccoli was (26.26)mg/100g This result is convergent with **(Ribarova et al .,2005;Miean and Muhamed ., 2001 and Vallejo et al., 2003)**. but in blanching green bean and broccoli controls have decreased (11.84) and (26.19)mg/100g respectively. the microwave and steaming control of broccoli content was increased while it was decreased in green beans control. The variation may have resulted from variations in the extraction and cooking techniques and such as the food matrix, the cooking method or state, and the chemical makeup of flavonoids **(Palermo et al., 2014).** It out that depending on the type of vegetables used, cooking can have both favorable and bad impacts on TFC**(Saikia and Mahanta., 2013)** .The results showed that the microwave have the highest value of total flavonoids content followed by steaming in broccoli . as well as during storage the total flavonoids content of green bean and broccoli were decreased as shown in fresh, blanching, steaming ,and microwave in green beans were (15.72-10.27), (11.84-11.46), (12.08-11.03), (14.15-11.33)mg /100g DW but broccoli were (26.26-19.36), (26.19-21.94), (26.67-24.18), (28.93-24.84) mg /100g respectively. it's clear that the microwave have the highest value of total flavonoids in freezing storage from all treatment .

Data in the same Table (3) showed that the antioxidant activity content of fresh green beans was(31.00%). While in fresh broccoli was (48.25%), This is the nearest result to which reported by **(Turkman et al., 2005 and Kaur et al., 2018)**. The antioxidant activity of all treatments in green beans has slightly increased, but it was decreased in all treatments of broccoli. While during storage for 3 months, the antioxidant activity decreased in fresh, blanching, steaming, and microwave, in green beans were (31.00-24.80%). (31.03-26.33%),(31.46-26.90%),(31.98-26.85%) but in broccoli were(48.25-23.23%), (32.99-28.07%), (39.79-34.07), (44.34-41.13) respectively. This suggests that the pro-oxidant activity was due to peroxidases which were inactivated at high temperatures **(Gazzani, et al., 1998)**. There are many hundreds of different phytochemicals contained in food, and each has a unique way of reacting to changes in their biological matrix brought on by heat treatments or cooking. This could be the likely source of an increase or decrease in antioxidant activity. This can result in a rise or fall in the vegetables' antioxidant activity (**Saikia and Mahanta .,2013**)

CONCLUSIONS:

In this study, blanching, steaming, and microwaving, affected the chemical composition, phytochemical contents, antioxidant activity, and phenolic profiles of green beans and broccoli. Dry matter, mineral, and phytochemical contents were significantly lost during the blanching process, and the moisture was increased.

However, the steaming treatment causes slight losses in some parameters of chemical and phytochemical contents such as ash, TSS, V.C, and total flavonoid of green bean vegetables, while the steam cooking increased the moisture of broccoli compared to the control.

Total phenols, total flavonoid, and DPPH of green bean and broccoli, except DPPH, was reduced. From the results of the work, we suggested that microwave cooking is the greatest retention and saves nutrients and phytochemicals. vegetables tested, broccoli had the highest amount of total phenolic and antioxidant activity .Moreover, moderate heat treatment (microwave) might have been considered a useful tool in improving the health properties of some vegetables.

Table(1) The time of every treatment.

Treatments / Material raw	*Blanching*	*Steaming*	*Microwave*	*Freezing*
	Time			
Green been	**5**	**7.5**	**1.5**	**3 months**
Broccoli	**5**	**7.5**	**1.5**	

Table (2) : Effect of cooking methods and Frozen Storage on some chemical components of green bean and broccoli.

Materials / *treatments*	***Green been***			**Broccoli**		
	Moisture%	**Ash%**	**TSS%**	**Moisture %**	**Ash%**	**TSS%**
Fresh						
Control	84.44b^{c}	9.91^{a}	10.33^{a}	88.82^{cd}	8.96^{a}	10.66^{a}
1month	82.47d^{e}	9.29^{ab}	9.66^{a}	88.15^{ef}	8.69^{a}	9.00^{bcd}
2months	82.19e^{fg}	9.12^{b}	7.33^{cd}	88.11^{f}	8.02^{cd}	7.33^{ef}
3months	81.92^{fg}	8.71^{b}	6.50^{ef}	88.08^{f}	6.89^{fg}	6.50^{fg}
Blanching						
Control	85.82^{a}	7.48^{cd}	7.16^{de}	91.43a	6.65^{g}	9.17^{bc}
1month	84.79^{b}	7.06^{de}	6.16^{efg}	90.84b	6.61^{g}	8.16^{de}
2months	84.58^{b}	6.71^{e}	5.50^{g}	90.80b	6.49^{g}	6.33^{g}
3months	84.36^{bc}	6.69	4.66^{h}	90.61b	5.09^{h}	4.84^{h}
Steaming						
Control	83.14^{d}	7.56^{cd}	7.33^{cd}	89.04^{c}	7.97^{cd}	9.66^{b}
1month	82.98^{de}	7.27^{de}	6.16^{efg}	88.97^{c}	7.38^{def}	8.50^{cd}
2months	81.41^{gh}	7.02^{de}	5.66^{fg}	88.91^{cd}	6.91^{fg}	6.66^{fg}
3months	80.82^{h}	6.85^{e}	4.66^{h}	88.89^{cd}	6.84^{fg}	4.66^{h}
Microwave						
Control	84.38b^{c}	9.13^{b}	8.16^{b}	88.78^{cd}	8.59^{ab}	9.66^{b}
1month	83.68^{cd}	8.96^{b}	7.83^{bc}	88.61^{cde}	8.28^{bc}	8.50^{cd}
2months	83.54^{cd}	8.79^{b}	6.33e^{fg}	88.44^{def}	7.65^{cde}	6.66^{fg}
3months	82.47^{de}	8.05^{c}	5.83^{fg}	88.17^{ef}	7.02^{efg}	4.66^{h}

TSS: total soluble solid

Table (3) : Effect Of Cooking methods And Frozen Storage On some Phytochemical Components In Green bean and broccoli.

Materials / treatments	Green been				Broccoli			
	AA	**TP**	**TF**	**DPPH**	**AA**	**TP**	**TF**	**DPPH**
Fresh								
Control	86.12^{a}	506.48^{c}	15.72a	31.00^{b}	551.14^{a}	1533.27^{f}	$26.26b^{c}$	48.25^{a}
1month	21.96^{j}	325.97^{l}	10.41^{L}	25.04^{f}	124.8^{m}	776.88^{n}	19.62^{h}	28.65^{j}
2months	18.19^{m}	240.63^{n}	10.61^{K}	24.92^{f}	118.42^{n}	760.98^{o}	19.15^{h}	23.48^{k}
3months	16.37^{n}	197.51^{o}	10.27^{L}	24.80^{f}	113.41^{o}	598.73^{p}	19.36^{h}	23.23^{k}
Blanching								
Control	56.70^{d}	436.57^{f}	11.84^{e}	31.03^{b}	436.87^{d}	1333.56^{j}	$26.19b^{c}$	32.99^{h}
1month	50.63^{e}	375.69^{h}	11.68^{fg}	28.1^{5}	360.26^{g}	1221.67^{k}	22.21^{g}	30.84^{i}
2months	47.28^{f}	343.02^{j}	11.57^{gh}	26.53^{e}	332.70^{h}	1189.19^{L}	$25.43d^{e}$	32.41^{h}
3months	44.18^{g}	310.34^{m}	11.46^{hi}	26.33^{e}	264.11^{i}	1090.3^{m}	21.94^{g}	28.07^{j}
Steaming								
Control	58.30^{c}	536.63^{a}	12.08^{e}	31.46^{ab}	391.42^{f}	1795.89^{a}	26.67^{b}	39.79^{e}
1month	40.72^{i}	475.63^{d}	11.29^{i}	29.78^{c}	204.35^{i}	1770.06^{b}	25.35^{de}	39.18^{e}
2months	30.50^{j}	345.81^{i}	11.03^{j}	28.10^{d}	144.82^{k}	1545.72^{g}	24.22^{f}	37.68^{f}
3months	28.21^{k}	331.02^{k}	11.03^{j}	26.90^{e}	119.75^{l}	1444.99^{i}	24.18^{f}	34.74^{g}
Microwave								
Control	68.63^{b}	518.26^{b}	14.15^{b}	31.98^{a}	507.49^{b}	1655.21^{c}	28.93^{a}	44.34^{b}
1month	56.62^{d}	408.50^{g}	13.16^{c}	27.91^{d}	473.22^{c}	1630.50^{d}	25.95^{cd}	42.07^{c}
2months	49.21^{f}	462.88^{e}	12.66^{d}	26.97^{e}	438.67^{d}	1565.31^{e}	25.39^{de}	41.52^{cd}
3months	42.21^{h}	407.46^{g}	11.33^{i}	26.85^{e}	412.51^{e}	1502.79^{h}	24.84^{e}	41.13^{d}

AA: Ascorbic acid(mg/100g dry weight) TP: Total phenol (mg/100g dry weight)
TF : Total flavonoid (mg/100g dry weight) DPPH :Antioxidant activity % : $p \leq 0.05$

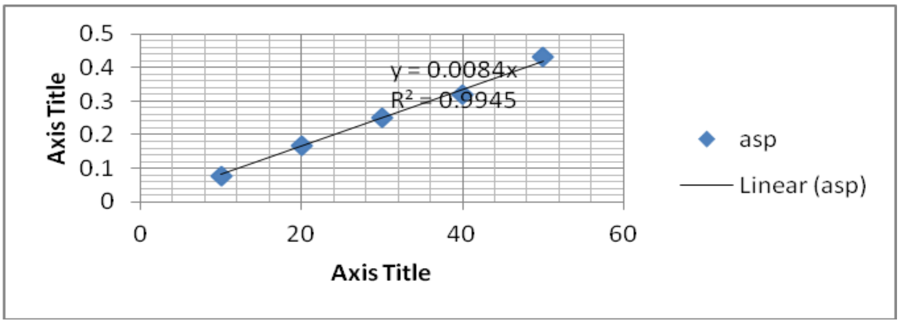

Fig.: (1):stander curve of total phenolic acids .

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الملخص العربي

تأثير المعاملات الحرارية المختلفة والتخزين المجمد على بعض المكونات الكيميائية والمركبات الكيميائية النباتية للفاصوليا الخضراء والبروكلي

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عند استهلاك اغلب الخضر لابد من تعريضها لإحدى المعاملات الحرارية وذلك لتلين الأنسجة وتحسين القابليتها وزيادة القدرة الحيوية للمغذيات الطبيعية ويهدف بدراسة طرق الطهى المختلفة لبعض الخضر (سلق بالماء – سلق بالبخار- بالميكرويف - بالاضاف الى التخزين بالتجميد فى نوعين من الخضار) وتأثيرها على بعض التقديرات الكيميائية والمركبات الفيتوكيميائية (الرطوبة ، والرماد ، والمواد الصلبة ، وجامض الأسكوربيك. ، الفينولات الكلية، الفلافونويدات الكلية ونشاط ونشاط مضاد الاكسدة) ومقارنتها بالطازجة ، وقد تبين أن لها تأثير معنوي على جميع مكونات الخضر التي تم تحليلها ،و كانت النتائج كالاتي:

1- أدى السلق بالماء إلى زيادة الرطوبة فى كل من نوعى الخضار الفاصوليا الخضراء والبروكلى (85.82%) و(91.43.%) مقارنة بالشكل الطازج (84.44%)و(88.82%). على التوالي ، بينما انخفضت قيم الرماد والمواد الصلبة الذائبة ومحتوى مضادات الاكسدة فى النوعين .

2- ادى السلق بالبخار إلى انخفاض فى كل من التقديرات الكيميائية و الفيتوكيميائية ماعدا الرطوبة – الفينولات الكلية والفلافونويد الكلية التى زادت فى البروكلى ، بينما زادت الفينولات الكلية فى الفاصوليا اثناء هذه المعاملة .

3- أظهرت النتائج ان طريقة الطبخ بالميكروويف تحافظ على تركيز كل من (الفينولات الكلية والفلافونويدات الكلية ونشاط مضادات الاكسدة) وهى اقرب للعينة الطازجة.

4- ادى التخزين بالتجميد الى انخفاض جميع قيم المكونات الكيميائية والفيتو كيميائية تدريجيا طوال فترة التخزين.