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POSTHARVEST TREATMENTS FOR THE EXPANSION OF CARROT SHELF-LIFE DURING COLD STORAGE

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ABSTRACT

The aim of this investigation was current to expansion of carrot shelf life during cold storage. Gross chemical composition and bioactive compounds in raw carrots (Daucus Carota L.) were determined. Results revealed that carrot was rich in total carbohydrates and fibres content. In addition, carrot samples were rich in carotenoids and the antioxidant activity of raw carrots was 4.76 %. Carrots were sorted, washed, dried, separated into portions and treated by hot shock (55°C, 2 min.), citric acid solution (2%, 10min.) and steaming (70°C, 2 atm, 5 sec.) alone or in combination of hot shock + citric acid and citric acid + steaming compared to control. All samples were packed into polyethylene bags and stored at 5°C ±1 and RH 70% for 70 days. During storage, pH increased in all samples with a relevant decrease in acidity. On the other hand, total count, psychrophilic bacteria, yeast and mold didn't exceed the recommended limits, whereas, the steamed treatments had the most exceeded shelf life with the best quality attributes.

Keywords: Carrot; storage; drying; carotene; antioxidant activity

INTRODUCTION

Carrot (Daucus carota L.) is a root vegetable which is cultivated and consumed throughout the world. Carrot is rich in functional food components such as vitamins (A, D, B, E, C, and K) and minerals (calcium, potassium, phosphorus, sodium, and

iron). The high biological value of this vegetable relates mainly to carotenoid compounds and dietary fiber, which are components of carrot roots tissue (Alasalvar *et al.* 2005). It has been noted that100g of carrot contains between 6mg and15mg of carotenoids, mainly β-carotene (2–10 mg) (Herrmann, 2001). Thus, an increased intake of carrot may favor the massive synthesis of vitamin A. Moreover, the carotenoids and other antioxidants present in carrot play an important role in the inhibition and/or interruption of oxidation processes, as well as in counterbalancing free radical activities (Krinsky&Johnson, 2005). Therefore, carrot may protect humans against certain types of cancer and cardiovascular diseases. The presence of high concentration of antioxidants, carotenoids especially β-carotene, may account for the biological and medicinal properties of carrots (Alasalvar *et al,* 2001).

Epidemiological and clinical investigations have associated diets rich in fruits and vegetables with reduced risk of heart, cardiovascular, neurological and chronic diseases, and various forms of cancer (Steinmetz and Potter, 1991; Block et al., 1992; Ames et al., 1993; Joseph et al., 1999; and Surh, 2003). A major benefit from such diets may be increased consumption of antioxidants (Ames et al., 1993), including carotenoids, ascorbate, tocopherols and phenolics (Cao et al., 1996).

Several biochemical changes occur in carrots during postharvest storage. Kader (1986) mentioned that discoloration, sprouting, rooting, tissue cavitation, altered taste as increased bitterness, and postharvest disease are quality attributes that may cause deterioration of the product.

It has been determined that the freezing point of carrot roots is -1.68° C, so it is assumed that storage temperatures can be set higher than this value (Yanmaz *et al.* 1999). In addition, mature carrots can have a shelf life of 3 to 5 months if kept stored at 3-5 °C (Suslow *et al,* 2002).

Because of these changes during storage, there is a need to treat carrot roots with chemicals and blanching, to inhibit those microbial activities. Hot water immersion is a heat treatment technology that can be used for post harvest pests and disease control for perishable commodities such as fresh fruits (Tsang et al., 1995).

This study is aimed to investigate the effects of different treatments on the shelf life of carrot. Data are reported for several criteria such as pH, acidity, TSS, color parameters, carotenoids and microbiological status of whole carrot roots.

MATERIALS AND METHODS:-

Carrot roots (*Daucus carota* L.) were purchased from local market in Minia governorate. The mean root weight was found to be 105.89 gm. As for the root length and diameter, they were 15.8 and 5.7 cm, respectively.

All chemicals and reagents were of analytical grade and were purchased from Sigema chemicals (St. Louis,

MQ. USA). Aldrich chemicals co. and Alfa Aesar (Karlsruhe, Germany).

Preparation of Samples:-

The root diameter and length were measured using calipers and the average root weight was also recorded.

Roots were washed using pure distilled water in order to prevent any contamination, then several treatments have been implemented as shown below:-

Control (C): without any treatment.

Citric acid (CA): dipped in 2% citric acid solution for 10min.

Hot shock (H): hot shock in water bath at 55°C for 2 min.

Hot shock + Citric acid (HC): hot shock in water bath at 55°C for 2 min then dipped in 2% citric acid solution for 10min.

Steaming (S): steamed at 70 ±2°C and 2 atm for 5 sec.

Steaming + citric acid (SC): dipped in 2% citric acid solution for 10min then steamed at 70 ±2°Cand 2 atm for 5 sec.

Samples were then packed in polyethylene bags and stored at 5°C ±1 and RH 70%.

CHEMICAL ANALYSIS:-

Moisture content, ash, total lipids, crude protein, crude fiber and acidity of fresh and stored carrots were determined according to the method described in the A.O.A.C. (2005). TSS was determined using Abbe' refractometer model 1T at 20°C and expressed as °Brix (A.O.A.C, 2005). pH value was determined by using pH meter with glass electrode (Model 41250, ICM, OR, USA) (Ranganna, 1979).

Total phenolic compounds determination:-

Total phenolic compounds were determined according to the method described by Ting and Rouseff (1986). A 35% saturated sodium carbonate solution was prepared by dissolving 35g of anhydrous Na_2CO_3in 100ml of pure water. Heat and stirring were added overnight in order to facilitate complete dissociation. Additional water was added to prevent super saturation. Once solution was prepared it was left in low heat during analysis to prevent precipitation as solution was used. Analysis was performed by adding 3.5 ml of deionized water, 50 µl of sample extract and Folin-Ciocalteu reagent and 300 µl of sodium carbonate to cuvette. The reaction was left for 15 minutes and then absorbance was measured in triplicate at 730 nm using a UV/VIS spectrophotometer (T80, S/N, PG instruments, ltd).

The blank consisted of all reagents excluding the sample extract. A standard curve was fashioned using tannic acid at concentrations of 0.2, 0.4, 0.6, 0.8 and 1.0 mg/mL diluted in ethanol. Total phenolic concentration was expressed as mg of tannic acid equivalents via the standard curve.

Total flavonoid determination:-

The total flavonoid content of carrot roots was determined using a colorimetric method described by Zhishen *et al.* (1999). A 0.5ml aliquot

of appropriately diluted sample solution was mixed with 2ml of distilled water and subsequently with 0.15 ml of a 10% $AlCl_3$ solution was added and allowed to stand for 6 min. and then 2 ml of 4%NaOH solution was added to the mixture. Immediately, water was added to bring the final volume to 5ml, and then the mixture was thoroughly mixed and allowed to stand for another 15 min. Absorbance of the mixture was determined at 510 nm versus prepared water blank. Rutin was added as standard compound for the quantification of total flavonoids. All values were expressed as milligrams of rutin equiv. per 100 gram of fresh roots. Data were reported as means (SD) for three replications.

Total carotenoid determination:-

Total carotenoid were determined according to the method described by Umeil and Gabelman (1971) as follow: appropriate weight of the grated samples (10-15 g) were extracted and blended by using 50ml acetone – hexane (6:4, V/V) solvent, with 10ml water was added to prevent the samples from drying on the cup ($MgCO_3$ added) in a waring blender, samples were blended for 5 minutes at height speed. The blended material was filtered and the residue washed with small volumes of acetone and hexane until colorless. It was sometimes necessary to repeat the process in order to complete the extraction, the acetone was removed from the extract by washing with water. The pigment solution in hexane was brought to constant volume, and measured at 450 mμ on a spectrophotometer. The percent transmission was used to calculate the total carotenoids as a β-carotene, using standard curve prepared with pure β-carotene.

Total antioxidant activity:-

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

Activity (%) = {(Abs control – Abs sample) / Abs control} ×100

Where Abs. is the absorbance at 517 nm. A 1.4 mg/ml querctin dehydrate standard was prepared for comparison.

Microbiological assay:-

Total count:-

Total bacterial counts were determined using plate count agar according to the methods described in APHA (1976) and Difco (1984).

Psychrophilic count:-

Psychrophilic counts were determined using plate count agar according to the methods described in the standard methods of (APHA. 1985; and Vaderzant and splitotoesser, 1992).

Yeast and mold count:-

For Yeast and mold count determination: triplicate plates were inoculated thoroughly mixed with 15 ml portions of potato dextrose agar. The plates were incubated for 48 hours at 37°C according to APHA (1976) AND Difco (1984).

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of carrot roots. The moisture content was 87.22%, which was higher somewhat than those reported by Arscott and Tanumihardjo (2010) and Moustafa *et al.* (2016), while it was a little bit lower than result reported by Pushkala *et al.* (2012) results also indicated that ash in carrot roots exist by 1.23% which is in approval to result conducted by Moustafa *et al.* (2016). On the other hand the crude protein content in carrots was 0.87 and this was in accordance to result reported by Ascrott and Tanumihardjo (2010) but much lower than reported result in the investigation of Azam *et al.* (2013).

In addition, fibers and carbohydrates were found to be 2.96 and 7.1, respectively, were correspond with the reported ones by Ascrott and Tanumihardjo (2010) (3% and 7%, respectively for carrot roots), Olalude *et al.* (2015) (10.6% for carrot roots). Lipid content in the carrot cultivar was (0.2%) which is typical to the result presented by Ascrott and Tanumihardjo (2010).

Moreover, bioactive components have been listed in Table 2. Results for total phenols, total flavonoids and the antioxidant activity are in recognition with those shown by Moustafa *et al.* (2016) with values of 0.24, 1.24 and 5.5, respectively. While total carotenoids (334.56 mg/100gm) was higher than those referred by Fikselova *et al.* (2008) and Nauman Ahamad *et al.* (2007). Velišek (1999) reported that the carotene content of carrots ranges from 60–120 mg/100g, but some varieties can contain up to 300 mg/100g.

Table 1:- Chemical composition of raw carrots:-

Parameter	Value
Moisture (%)*	87.22
Lipids (%)*	0.02
Ash (%)*	1.23
Fibers (%)*	2.96
Protein (%)*	0.87
Total carbohydrates (%) **	7.71

*Based on fresh weight **Calculated by difference.

Table 2:- Bioactive compounds in raw carrots:-

Parameter	Value
Total phenols (g/100gm)*	0.21
Total flavonoids (g/100gm)*	1.20
Total carotenoids (mg/100gm)*	334.56
Antioxidant activity (%)*	4.76

*Based on fresh weight.

Results in Fig. 1 and 2 demonstrated the pH and total acidity of the different samples upon storage for 70 days. The samples were characterized by an initial pH ranged between 6.01-6.25 and total acidity of 0.20-0.25% depending on the pretreatment process. Other reports indicated that the pH ranged from 6.1 to 6.5 (Rocha et al., 2007; Vibhakara *et al.* 2006) and acidity ranged from 0.061 to 0.064 mg/100gm (Pilon et al., 2006). An increase in pH with corresponding reduction in acidity was observed in all samples upon storage, similar to the findings of Phan *et al.* (1973). On the other hand, Mastromatteo *et al.* (2012) noticed no change in these values during the entire storage period.

Fig. 3, 4 and 5 show the evolution of the microbial populations for all samples. The microbial counts of the control sample was higher than that of treated samples which indicate that the treatments showed detrimental effect upon the microbial load that resulted in an averaged reduction of the total bacterial population by 0.31 to 0.54 log10 cfu/g.

Regardless the different treatments, the microbial counts steadily increased during storage but on the other hand, none of the samples exceeded the recommended limit of 7.7 log10 cfu/g for total microbial count (DGHM, 2002).

Sample without treatments didn't show any microbial spoilage during the 70 days of the storage but, by the 70th day carrot roots showed some rooting and sprouting actions which may be considered some of the undesirable distinctiveness in fresh-cut produce (Snowdon, 1991) and a possible reason to reject the product. As for using citric acid as a postharvest chemical treatment for reducing microbial spoilage, in a study on shredded carrots implemented by Pushkala et al.(2012) citric acid was used in concentration of 0.1% that reduced microbial development during storage for 10 days in carrot shreds. This study indicates that dipping whole carrots in citric acid solution decreased microbial activity during the storage duration of 70 days.

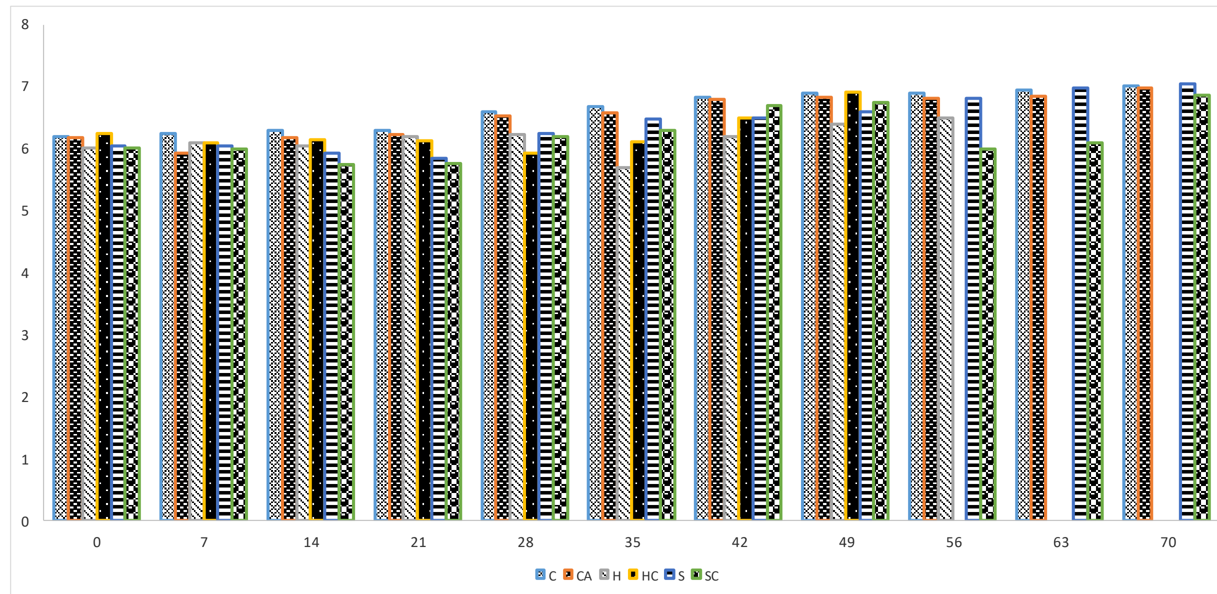

Fig. 1:- Effect of postharvest treatments on pH value of carrots:-

C= CONTROL, CA= CITRIC ACID, HS= HOT SHOCK, CH= HOTSHOCK+CITRIC ACID, SC= STEAMING+CITRIC ACID, S= STEAMING. ND= not detected.

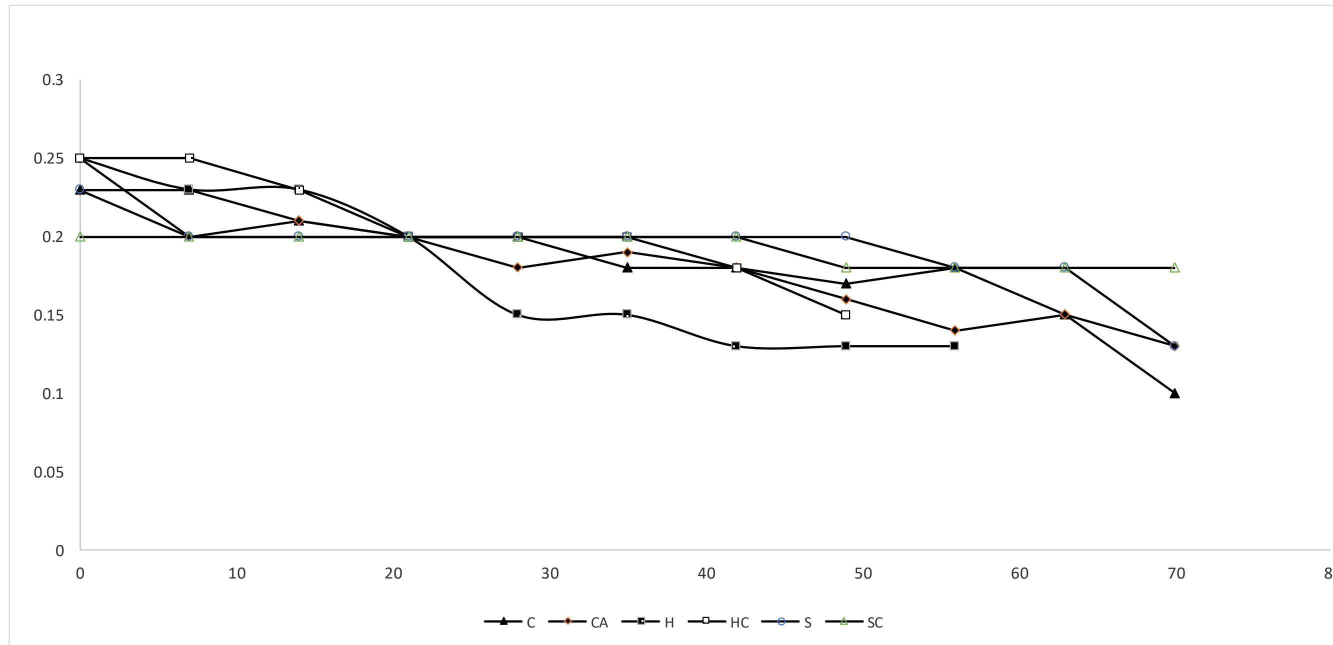

Fig. 2:- Effect of cold storage (5°C) on total acidity % (as citric acid) of carrots

C= CONTROL, CA= CITRIC ACID, HS= HOT SHOCK, CH= HOTSHOCK+CITRIC ACID, SC= STEAMING+CITRIC ACID, S= STEAMING. ND= not detected.

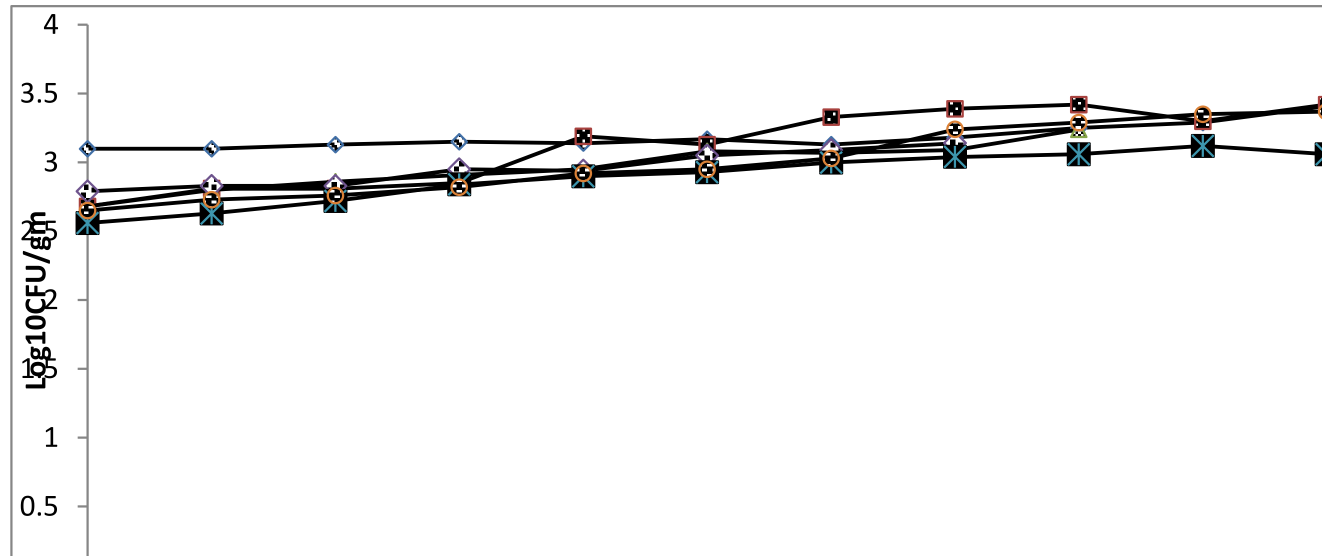

Fig. (3): Effect of cold storage (5°C) on total bacterial count

*Means (n=3).

C= CONTROL, CA= CITRIC ACID, HS= HOT SHOCK, CH= HOTSHOCK+CITRIC ACID, SC= STEAMING+CITRIC ACID, S= STEAMING.

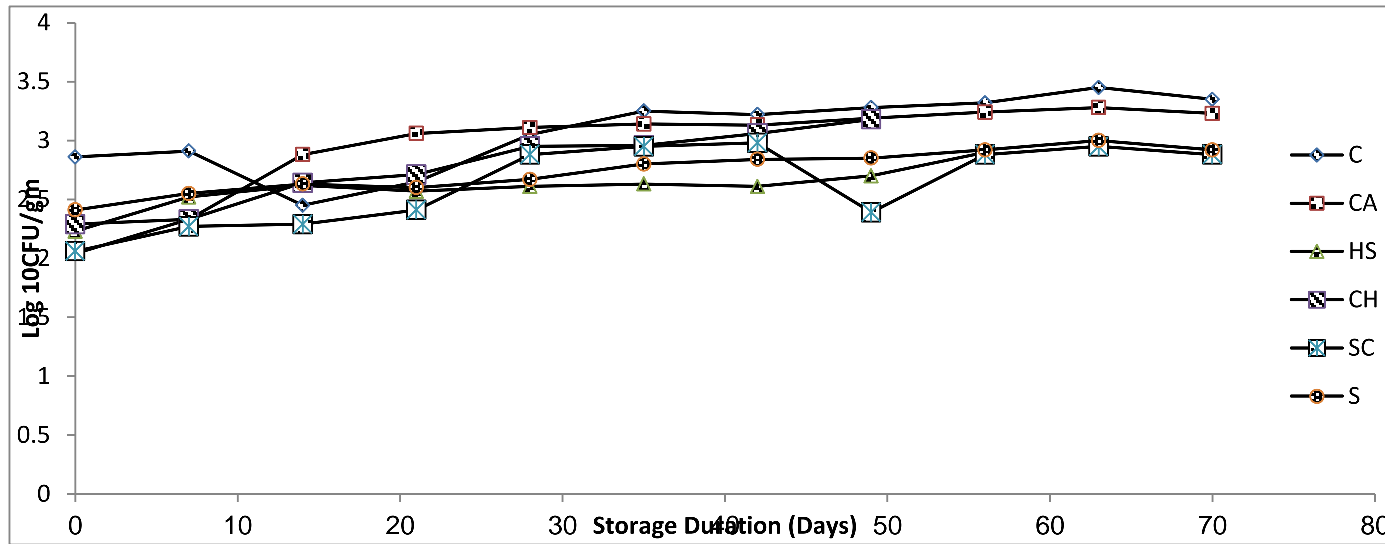

Fig. 4:- Effect of cold storage (5°C) on psychrophilic bacteria

*Means (n=3).

C= CONTROL, CA= CITRIC ACID, HS= HOT SHOCK, CH= HOTSHOCK+CITRIC ACID, SC= STEAMING+CITRIC ACID, S= STEAMING.

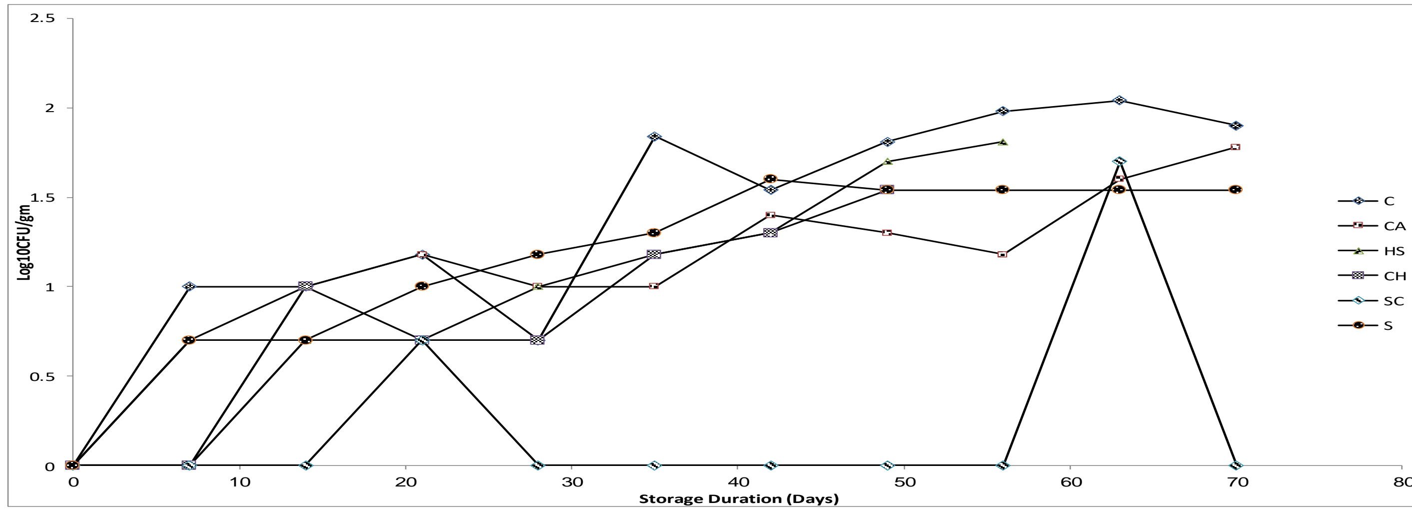

Fig. 5:- Effect of cold storage (5°C) on yeast and mold

*Means (n=3).

C= CONTROL, CA= CITRIC ACID, HS= HOT SHOCK, CH= HOTSHOCK+CITRIC ACID, SC= STEAMING+CITRIC ACID, S= STEAMING.

The onset of visual microbial decay was not directly related to the overall microbial contamination degree of the carrot roots. As shown below, the total count for HS and CH samples didn't exceed the recommended level but they showed visual microbial decay at the 56th and 49th day, respectively. These results may be due to the affection of texture during thermal treatment, since the subjection to elevated temperatures entail trigger loss due to mechanical damage and loss of cell adhesion (Greve *et al.* 1994; Sila *et al.* 2006 and Van Buggenhout *et al.* 2009). This tissue damage caused by heat will also result in increased decay development (Jacobi and Wong, 1992; Jacobi et al., 1993). One negative aspect of this treatment, is that some of the effects contributing to decay control may not persist long-term (Escribano& Mitcham, 2014).

In addition, SC had the lowest microbial count at the initiation of the storage duration and due to 70 days of storage indicating that the combination treatment performed best in terms of reducing the total bacterial, psychrophilic, yeast and mold counts. Using steam as a postharvest treatment against pathogens in carrots, or may be in other fresh produce, is friendly to the environment, easy to implement and inexpensive.

However, the significantly lower microbial development rates found in S and SC samples prove that steaming is an effective decontamination alternative to microbial control in fresh-cut carrot.

REFERENCES:-

A.O.A.C (2005).Official methods of analyses. Washington, D.C. USA Association of official analytical chemists.

Alasalvar, C.; Al-Farsi, M.; Quantick, P.C.; Shahidi, F.; Wiktorowicz, R. (2005). Effect of chill storage and modified atmosphere packaging (map) on antioxidant activity, anthocyanins, carotenoids, phenolics and sensory quality of ready-to-eat shredded orange and purple carrots. Food Chemistry, 89(1), 69–76.

Alasalvar, C.; Grigor, J.M.; Zhang , D.; Quantick, P.C. and Shahidi, F. (2001). Comparison of volatiles, phenolics, sugars, antioxidant vitamins, and sensory quality of different colored carrot varieties. Journal of Agricultural and Food Chemistry 49(3), 1410-1416.

Ames, B. N., Shigenaga, M. K., & Hagen, T. M. (1993).Oxidants, antioxidants, and the degenerative diseases of aging. Proceedings of the National Academy of Sciences of the United States of America, 90, 7915–7922.

APHA. (1976). American Public Health Association of Methods

for the Microbiological Examination of Foods. Speck, M.L. Ed; Washington, D.C., USA.

APHA. (1985). American Public Health Association (15th ed.), pp.97-98.USA.

Arscott, S.A. and Tanumihardjo, S.A. (2010). Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. Comprehensive Reviews in Food Science and Food Safety, 9(2), 223-239.

Azam, A., Khan, I., Mahmood, A., & Hameed, A. (2013). Yield, chemical composition and nutritional quality responses of carrot, radish and turnip to elevated atmospheric carbon dioxide. Journal of the Science of Food and Agriculture, 93(13), 3237-3244.

Block, G., Patterson, B., &Subar, A. (1992). Fruit, vegetables, and cancer prevention: A review of the epidemiological evidence. Nutrition and Cancer, 18, 1–29.

Cao, G.; Sofic, E. Prior R. L. (1996) Antioxidant Capacity of Tea and Common Vegetables. J. Agric. Food Chem., 44, 3426-3431.

Cosoreci, Diana Alexandra; Moldovan, Mirela -Viorica Popa Camelia; Raba, Diana-Nicoleta; Donici, Mădălina and Dumbravă, Delia-Gabriela (2014). Influence of some thermal treatments on carotenoids content of carrots (Daucus carota L.). Journal of Agro alimentary Processes and Technologies, 20(4), 373-375.

DGHM, 2002. Deutsche Gesellschaft für Hygiene und mikrobiologie, Fachgruppe Lebensmittel Mikrobiologie und–hygiene. Veröffentlichte mikrobiologische Richt- und Warnwerte. c.f. Klaibera,R.G.; Baur, S.; Wolf, G.; Hammes, W.; Carlea, P.R. (2005). Quality of minimally processed carrots as affected by warm water washing and chlorination. Innovative Food Science and Emerging Technologies, 6:351–362.

Difco-Manual, (1984): Dehydrated Culture Media and Reagents Microbiological and Clinical Laboratory Procedures, Pub- Difco - Lab - Detroits Michigan, USA.

Escribano, S. and Mitcham, E.J. (2014). Progress in heat treatments. Stewart Postharvest Review 3(2).

Fikselova, M.; Silhar, S.; Marecek, J. and Francakova, H. (2008). Extraction of Carrot (Daucus carota L.) Carotenes under Different Conditions. Czech J. Food Sci., 26: 268–274.

Greve, L.C.; Shackel, K.A.; Ahmadi, H,; McArdle, R.N.; Gohlke, J.R.; Labavitch, J.M. (1994). Impact of heating on carrot firmness: Contribution of cellular turgor. J. Agric. Food Chem., 42(12), 2896–2899.

Herrmann, K. (2001). Inhaltstoffe von Obst und Gemüse. Verlag Eugen

Ulmer GmbH & Co., Stuttgart pp. 95–98. c.f. Kun, S.; Rezessy-Szabó, J. M.; Nguyen, Q. D.; Hoschke, Á. (2008) . Changes of microbial population and some components in carrot juice during fermentation with selected Bifidobacterium strains. Process Biochemistry, 43, 816–821.

Jacobi, K.K., Wong, L.S., & Giles, J.E. (1993). Lychee (litchi chinensis sonn.) fruit quality following vapour heat treatment and cool storage. Postharvest Biology and Technology, 3(2), 111-119.

Jacobi, K.K.; Wong, L.S. (1992). Quality of Kensington mango (Mangifera indica Linn.), following hot water and vapor heat treatments. Postharvest Biology and Technology 1: 349-359.

Joseph, J. A., Shukitt-Hale, B., Denisova, N. A., Bielinski, D., Martin,A., McEwen, J. J., & Bickford, P. C. (1999). Reversals of age-related declines in neuronal signal transduction, cognitive, and motor behavioral deficits with blueberry, spinach, or strawberry dietary supplementation. Journal of Neuroscience, 19, 8114–8121.

Kader, A.A. (1986). Biochemical and physiological basis for effects of controlled and modified atmospheres on fruits and vegetables. Food Technology, 4(2), 99-100 & 102-104.

Krinsky, N.I.; Johnson,E.J. (2005). Carotenoid actions and their relation to health and disease. Molecular Aspects of Medicine, 26, 459–516.

Mastromatteo, M.; Conte, A.and Matteo, A.D.N. (2012). Packaging strategies to prolong the shelf life of fresh carrots (Daucus carota L.). Innovative Food Science and Emerging Technologies, 13:215–220.

Moustafa , Y.M.M.; Abd El-Aal, H.A.; Abd El-Wahab. M.A. (2016). Introduction of purple and deep purple f1 carrot hybrids to egypt showed high antioxidant activity and high content of total flavonoids and phenols. J. basic appl. Res, 2(2), 148-156.

Nauman Ahamad, M.; Saleemullah, M.; Shah, H. U.; Khalil, I.A. and Saljoqi, A.U.R. (2007). Determination of beta carotene content in fresh vegetables using high performance liquid chromatography. Sarhad J. Agric., 23(3).

Olalude C.B, Oyedeji F.O and Adegboyega A.M. (2015). Physico-chemical analysis of daucus carota (carrot) juice for possible industrial applications. IOSR Journal of Applied Chemistry, 8(8), 110-113.

Phan, C. T.; Hsu, H.; and Sarkar, S. K. (1973). Physical and chemical changes accurance in the carrot root during storage. Canadian

journal of plant science, 53:635:641.

PILON, Lucimeire; OETTERER, Marília; GALLO, Cláudio R.; SPOTO, Marta H. F. (2006). SHELF LIFE OF MINIMALLY PROCESSED CARROT AND GREEN PEPPER. Ciênc. Tecnol. Aliment., Campinas, 26(1): 150-158.

Pushkala, R.; Parvathy, K.R.; Srividya, N.(2012). Chitosan powder coating, a novel simple technique for enhancement of shelf life quality of carrot shreds stored in macro perforated ldpe packs. Innovative Food Science and Emerging Technologies, 16, 11–20.

Ranganna, S. (1979). Manual of analysis of fruit and vegetable products. Tata McGraw-Hill publishing company limited, New Delhi, pp.73-75.316-317.

Rocha, A. M. C. N., Ferreira, J. F. F. C., Silva, A. M. M., Almeida, G. N., &Morais, A. M. M. B.(2007). Quality of grated carrot (var. Nantes) packed under vacuum. Journal of the Science of Food and Agriculture, 87, 447–451.

SILA, D.N.; E., DOUNGLA; SMOUT, C.; VAN LOEY, A. AND HENDRICKX, M. (2006). Pectin fraction interconversions: Insight into understanding texture evolution of thermally processed carrots. Journal of Agricultural and Food Chemistry, 54(22), 8471–8479.

Snowdon AL (1991). Post-harvest disease and disorders in fruits and vegetables. Vol. 2. Vegetables. Wolfe Scientific, London.

Steinmetz, K. A., & Potter, J. D. (1991).Vegetables, fruit and cancer. I. Epidemiology. Cancer Causes and Control, 2, 325–357.

Su, M. and Silva, J.L. (2006). Antioxidant activity, anthocyanins and phenolics of rabbiteye blueberrymby products as affected by fermentation. Food Chemistry, 97:447-451.

Surh, Y. J. (2003). Cancer chemo-prevention with dietary pyhtochemicals. Nature, 3, 768–780.

Suslow, T.V.; Mitchell, J. and Cantwell, M. (2002). Carrot. Recommendations for maintaining postharvest quality. http://postharvest.ucdavis.edu/Commodity_Resources/Storage_Recommendations/.

Ting, S. V. and Rouseff, R. L. (1986). Citrus fruits and their products-Analysis- Technology. Marcel Dekker, Inc, New York.

Tsang, M. M. C.; Hara, A.H.; Hata,T. Y.; Hu, B. K. S.; Kaneko, R. T. and Tenbrink, V. (1995). Hot-water immersion unit for disinfestation of tropical floral commodities. Applied Engineering in Agriculture. , 11(3), 397-402.

Umeil, K. and Gabelman, W.H.(1971). Analytical procedures for detecting carotenoids of carrot (Daucus carota L.) roots and

tomato (Lycopersicum esculentum) fruits. J. Amer. Soc. Hort. Sci. 96(6):702-704.

Vaderzant, C. and Splittoesser.D.F. (1992). Compendium of methods for the microbiological examination of food (3rd ed.). American Public Health Association .Washington, D.C.

Van Buggenhout, S.; SILA, D.N.; Duvetter,T.; Van Loey, A. and Hendrickx, M.. (2009). Pectins in processed fruits and vegetables: Part iii—texture engineering. COMPREHENSIVE REVIEWS IN FOOD SCIENCE AND FOOD SAFETY, 8(2): 105-117.

Velišek J. (1999): Chemie potravin (II). OSSIS, Tabor. www.wikipatents.com/6056962.html. Isolations and formulationsof nutrient-rich carotenoids. United States Patent: 6056962.c.f. Fikselova, M.; Silhar, S.; Marecek, J. and Francakova, H. (2008). Extraction of Carrot (Daucus carota L.) Carotenes under Different Conditions. Czech J. Food Sci., 26: 268–274.

Vibhakara, H. S. J., Gupta, D. K. D., Jayaraman, K. S., & Mohan, M. S. (2006). Development of a high moisture shelf stable grated carrot product using hurdle technology. Journal of Food Processing and Preservation, 30, 134–144.

Yanmaz, R.; Halloran, N.; Ufuk Kas, M.; Ağaoğ lu, Y.S.. (1999). The effect of different storage conditions and package size on storage duration of carrots * TARIM BILIMLERI DERGISİ 5(3), 1-6.

Zhishen, J.; Mengcheng, T.; Jianming, W. (1999). The determination of flavonoid contents in mulberry and their scavenging effects on superoxide radicals. Food Chem. 64: 555-559.

الملخص العربي

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فى هذا العمل، تم تقدير التركيب الكيميائى و المركبات الحيويه فى الجزر الطازج (Daucus Carota L.). اوضحت النتائج ان الجزر غنى بالكربوهيدرات و الالياف و الكاروتينات و تصل نسبة مضادات الاكسده فى الجزر الطازج الى 4.76%. كما يقدم هذا البحث بعض الاستراتيجيات المختلفه والتى تهدف لزيادة العمر التخزيني للجزر الطازج. تم تخزين الجزربعد غسله، تجفيفه و تقسيمه لاجزاء للمعاملات الاتيه: 1- المعامله بالصدمه الحراريه (66°م، 2 دق)، 2- محلول حامض الستريك (2%، 10 دق) و 3- التعرض لبخار الماء (70°م، 2، 5 ثوانى) كل معامله على حده او باشتراك 4- المعامله الحرارية+ محلول حمض الستريك و5- محملول حمض الستريك + التعرض لبخار الماء بالمقارنه مع الكنترول. تم تعبئة كل العينات في اكياس البولى اثيلين و تخزينها على درجة حراره 5°م ±1 ورطوبه نسبيه 70% لمدة 70 يوم. اثناء فترة التخزين ارتفعت قيمه pH فى كل العينات و الذي كان مصحوبا بانخفاض الحموضه. وعلى الجانب الاخر، فان العد الكلى البكتيري، البكتريا المحبه للبروده ، الخمائر و الفطريات لم تتعدى الحدود الموصى بها، الا ان العينات التى تم معاملتها ببخار الماء كان لها اطول عمر تخزيني بافضل معايير للجوده.

كلمات مفتاحيه:- جزر، تخزين، تجفيف، كاروتين، النشاط مضاد للاكسده