CARPATHIAN JOURNAL OF FOOD SCIENCE AND TECHNOLOGY

journal homepage: **http://chimie-biologie.ubm.ro/carpathian_journal/index.html**

Research Article

COMPARATIVE STUDIES ON THE EFFECT OF HOUSEHOLD PACKAGING ON THE ANTIOXIDANT PARAMETERS OF THE ORGANIC AND CONVENTIONAL *CUCUMIS SATIVUS L.*

Suryatapa Das[1]✉, Annalakshmi Chatterjee[2] and Tapan Kumar Pal[3]

[1]Department of Food and Nutrition, Maharani Kasiswari College, University of Calcutta, Kolkata-700003, India,

[2]Laboratory of Food Chemistry and Microbiology, Food and Nutrition Division, Department of Home Science, University of Calcutta, Kolkata-700027, India, and

[3]Department of Biotechnology, Bengal Institute of Technology, Kolkata- 700150, India

✉dassuryatapa@gmail.com

https://doi.org/10.34302/crpjfst/2025.17.1.9

Article history:
Received:
June 26th , 2024
Accepted:
December 23th, 2024

Keywords:
Antioxidant;
Cucumis sativus;
PP Container;
LDPE Zipper bag;
Cling film Wrap.

ABSTRACT

Organic foods are becoming popular for the health benefits they provide to the consumers. But proper storage of organic fresh produce is essential to preserve its vital nutrients. The present study was framed to show the effect of domestic packaging on the antioxidant status of organic and conventionally grown *Cucumis sativus* L. stored at different temperatures. The organic and conventional *Cucumis* were stored without any packaging, in Polypropylene (PP) Container, in Low Density Polyethylene(LDPE) Zipper bag, and in Cling film wrap at ambient temperature (25^0C) and low (4^0C) for 3 and 7 days. The ascorbic acid content, total carotenoids, total polyphenols, total flavonoids, tannin contents, and DPPH, ABTS, and FRAP antioxidant capacities were estimated and compared by ANOVA test with p value <0.01. Results showed that the ascorbic acid, total carotenoids, tannin, and flavonoids were reduced during storage and more significantly that of DPPH and FRAP antioxidant capacities. Therefore, packaging at ambient and low temperatures creates a modified atmosphere within it, which can be considered as a devising strategy to preserve antioxidants in organic and conventional Cucumis at domestic level.

1.Introduction

In the modern society with abrupt changes in food habits and lifestyles, the development of chronic lifestyle disorders viz. cardiovascular diseases, cancer, type-II diabetes mellitus has been increasing at an alarming rate, which involves an increased rate of free radical generation leading to oxidative stress. A diet rich in fruits and vegetables has been associated with lower risk of chronic diseases owing to its high content of dietary bioactive compounds, the so-called phytochemicals, endowed with protective principles (Manach, et al., 2004 ; Cheen and kim, 2004 ;Kuskoski *et al*., 2005; Surh and Na, 2008 ; Basu and Imrham,2007). The protective health benefits of fruits and vegetables have been attributed to the

antioxidant properties of the phytochemicals they provide (Bjelakovic *et al*., 2007).

The levels of protective antioxidant chemicals in fruits and vegetables are strongly influenced by the genetic factor, edaphoclimatic conditions, developmental stage, and cultivation system (Aherne and O'Brien, 2002; Tsai et al., 2008). In respect to conventional farming with synthetic pesticides and chemical fertilizer, organic cultivation in general, is characterized by the absence of those products throughout the cultivation period (Winter and Davis, 2006).

Organic crops contain fewer nitrate, nitrites, and pesticide residue, but as a rule, more dry matter, vitamin C, essential amino acids, and total sugar than conventional crops (Rembialkowska, 2007).

A systematic review (Brant and MØlgaard, 2001) tentatively suggested that organic produce contain 10-15% higher phytochemicals (antioxidants) than non-organic produce. In absence of pesticides in organic farming the plants develop resistance power by generating more secondary metabolites such as polyphenols, flavonoids, carotenoids etc. which are considered as potent antioxidants.

For the presence of higher levels of bioactive antioxidants and of better nutritional quality, organic foods, especially fresh fruits and vegetables are becoming popular. Organic foods have become one of the fastest–growing food categories, with sales increasing nearly 20% each year since 1990. Consumer studies have shown that organic produce is perceived to be safer, more nutritious, and better tasting than conventional grown produce (Winter and Davis, 2006; Torjusen et al., 2001; Magnusson et al.,2003; Yiridoe et al., 2005). But plants cultivated through organic farming, as a rule, significantly have lower yields (on average 20% less) than conventionally produced crops, making organic foods as a high-priced produce (Rembialkowska, 2007). In a current review by Das et al (2020), the benefits of organic farming were discussed elaborately.

Cucumber (*Cucumis sativus* L.) is a fruit of immense economic importance. It can be used for consuming fresh and for pickling. Cucumbers are a good source of antioxidants, magnesium, and vitamin C, and are rich in dietary fibre(Shi et al., 2015). Cucumber showed antioxidant power in various in vitro methods such as DPPH radical scavenging activity, total radical-trapping antioxidant parameter (TRAP), ferric reducing antioxidant power (FRAP), and (Trolox equivalent antioxidant capacity (TEAC) (Stratil et al.,2006). The total phenolics, proanthocyanidins, vitamin C, and flavonols content in cucumber extract were estimated to be 9.05 ± 0.83, 2.06 ± 0.09 and 55.66 ± 1.52 mg/100g, respectively (Melo et al., 2006). It was observed in a study conducted by Jahan et al. (2020) that vitamin C lost during storage with the increasing duration. As antioxidants in fresh vegetables are reduced during storage therefore, proper storage methods at domestic level are needed.

Modified Atmosphere Packaging (MAP) and low temperature storage can increase the shelf life of cucumber. Low-Density Polyethylene (LDPE) and Polypropylene (PP) are generally used polymeric films for MAP (Soltani et al 2015). The current study was conducted to show the effectiveness of storage on the antioxidants and antioxidant capacities of Organic and Conventional *Cucumis* in domestic packaging (Polypropylene container, LDPE zipper bags, and cling film) stored at ambient and low temperatures, keeping in view the principles of MAP.

2.Materials and Methods

2.1.Sample Collection, Packaging and Storage

The fresh vegetable *Cucumis sativus* L. (*Cucumis*) of Poinsett 76 cultivar were collected carefully from two certified organic farms and conventional farms located at Baruipur and Mathurapur of south 24 Parganas, West Bengal, India and their average results were interpreted. The organic *Cucumis* was cultivated during the June to August (summer) or January to April (winter) months following the principles of organic farming system in sandy loam soil composed of organic matter, various organic fertilizers, such as vermicompost (1,000 kg per acre), Ghana Jeevamrutham, bone meal (50-75

kg per acre) rich in minerals like phosphorous, calcium, and nitrogen compost that were commonly used before cultivation with good drainage and pH range 6.5-7.5 at warm temperature (above 16ºC). As growth promoter, organic plant fertilizer containing Humic Acid, Seaweed extract, and Fulvic Acid were also applied.

For plant protection from pests, neem cakes (150 - 200 kg per acre), Trichoderma *viride* biofungicide (1.5% w.p), neem oil (1-2 ml/litre sprayed 1-2 times per week), *Bacillus thuringiensis* (Bt) powder or liquid inoculums (spray), Curcumin (spray), Pheromone trap (one trap per 25 square feet area) were applied. To enhance the soil fertility, cultivation of dhaincha (*Sesbania* spp.) as intercrop and crop rotation approach were also advocated.

The conventional *Cucumis* was grown at the same time by the conventional methods using mainly inorganic manure, such as Ammonium nitrate, Calcium phosphate, Muriate of potash for preparation of soil, and N:P: K -10:26:26 and urea, during mid-phase of farming for growth of plant and crop yield. For plant protection, specific pesticides and conventional fungicide were applied.

1.1. PP Container. 1.2. LDPE Zipper Bag. 1.3. Cling Film

Figure 1. Packaging of the Study

Three types of domestic packaging of polymeric box/bag/film such as Polypropylene or PP (of 0.23mm thickness) container, Low density polyethylene or LDPE (of 2.5 mm thickness) zipper bag, and Polyethylene cling film wrap (of 0.06mm thickness) were used for the study (Figure 1). The water vapor permeabilities of the PP container, LDPE zipper bag and Cling film were 0.058, 0.112, 0.450 $g.mm.m^{-2}d^{-1}$ respectively.

At first, the samples were chlorinated (100 ppm, 20°C) immediately to release the free heat and to disinfect (Safe Practices for Food Processes, 1998). The samples kept without packaging, PP airtight containers, in LDPE zipper, wrapped in cling film **(**Jacobsson et al., 2004**;** Thompson, 2010**)** at low (4^0C) with Relative Humidity (RH 60% and ambient temperature (25^0C) with RH 90% for specific period of time (3 days and 7 days). Then, the antioxidant levels and antioxidant capacities were estimated.

2.2.Materials

Ethanol, methanol, metaphosphoric acid, acetic acid, 2,6-dichlorophenol indophenol, ascorbic acid, sodium bicarbonate, Folin-Ciocalteu reagent, gallic acid, sodium nitrite, aluminum trichloride, quercetin, tannic acid, sodium tungstate, phosphomolybdic acid, orthophosphoric acid, acetone, benzene hexa-toluene (BHT), DPPH (2,2-Diphenyl-1-picrylhydrazyl), ABTS(2,2,-azinobis (3-ethylbenzoline-6- sulfonic acid), ammonium persulphate, tri-pyridyl triazine (TPTZ), Ferric chloride, and ferrous sulphate heptahydrate. All the chemicals were purchased from reputed brands, viz., Merck, Hi-Media, Loba, and Sigma.

2.3.Methods

2.3.1.Ascorbic acid

Ascorbic acid content was measured by Dichlorophenol-indophenol dye titration method (AOAC, 2000)**.** The vegetable sample

was homogenized with a hand blender and the juice was extracted by pressing the vegetable pulp through a cheese cloth and then filtered through absorbent cotton. About 40 g of sample was taken in a 100ml volumetric flask and diluted to volume with metaphosphoric-acetic acid solution and mixed thoroughly and filtered through Whatman 541 filter paper. A representative amount of sample (approximately 2g) was weighed in a beaker and 25 ml of metaphosphoric- acetic acid was added to the sample. The pH of the sample was checked using pH meter to pH > 1.2 for presence of appreciable amounts of basic substances.

For the standardization of dye**,** 2ml of ascorbic acid standard solution (concentration of ascorbic acid 1mg/ml) aliquot was taken in a 50 ml Erlenmeyer flask containing 5ml metaphosphoric- acetic acid solution and titrated with indophenol dye solution from 50 ml graduated burette until the solution turns to light rose pink colour that persisted for >15 seconds. For the blank, 7 ml of metaphosphoric- acetic acid solution was taken into a 50ml conical flask and titrated with indophenol dye until rose pink colour persisted for ≥ 15 seconds. For sample titration, 1 to 5 ml of aliquot (containing 2 mg of ascorbic acid) was taken in each of three 100ml Erlenmeyer flask and required amount of metaphosphoric- acetic acid solution was added to a total volume of 7ml. The amount of ascorbic acid present in the standard solution aliquot(2mg) was divided by the number of ml of dye titrated to determine the amount of ascorbic acid equivalent to 1ml.

$$\text{Ascorbic acid(mg/ml)} = \frac{\text{Weight of Ascorbic acid (mg)}}{\text{Total dilution (ml)}} \quad (1)$$

$$\text{Dye Factor} = \frac{\text{2ml X mg/ml Ascorbic acid standard}}{\text{[Mean Volume(9ml) indophenol Standard - Mean Volume (ml) Blank]}} \quad (2)$$

$$\text{Ascorbic acid Content(g/100g)} = \frac{\text{[Titre volume of sample(ml) - Titre volume of Blank(ml)] X Dye Factor X Volume made up to] X 100}}{\text{Aliquot of extract taken for estimation X Weight or Volume of Sample of sample taken for estimation.}} \quad (3)$$

The ascorbic acid content was expressed in mg per100g of fresh weight.

2.3.2.Total Carotenoids

Total carotenoids of the fresh vegetable samples were measured according to the method of Talcott and Howard (1999). 1 g of fresh vegetable sample was extracted by homogenization with 12.5ml of 100% Acetone and 200mg of BHT under a yellow fluorescence light. After extraction the sample extract was centrifuged at 1500 x g for 15 minutes at 4°C. Then, the supernatant was collected, and the remaining residue was again re-extracted by following similar method until the residue became colourless. Finally, the combined supernatant was brought to 50ml with extraction solvent and the final combined supernatant was measured at 470nm, 645 nm, and 662 nm in spectrophotometer (Systronics make, Model: 166). The total carotenoids content was calculated following the formula given by Lichtenthaller(Lichtenthaller and Wellburn, 1987). When 100% Acetone was used as solvent:

When 100% Acetone is used as solvent:

$$\text{Chlorophyll a} = 11.75\ A_{662} - 2.350\ A_{645} \quad (4)$$

$$\text{Chlorophyll b} = 18.61\ A_{645} - 3.96\ A_{662} \quad (5)$$

$$\text{Total Carotenoids } (\mu g.mL^{-1}) = \frac{1000\ A_{470} - 2.27\ \text{Ch a} - 81.4\ \text{Ch b}}{227} \quad (6)$$

2.3.3.Tannin Content

Tannin in the fresh vegetable sample was determined by Folin-Denis's method (Polshettiwar and Ganjewale, 2007). 1 g of fresh sample was taken in a 150ml conical flask and 75ml of double distilled water was added to

it. Then the conical flask was covered with non-absorbent cotton plugging and boiled by placing on heating mantle for 30 minutes. After that, the conical flask was cooled and filtered through glass wool. The volume of the filtrate was made up to 100 ml by double distilled water.1 ml of sample extract or standard solution of Tannic acid (30 to 100µg/ml) was mixed with 0.5 ml Folin-Denis's reagent and 1 ml of saturated Na_2CO_3 solution ware added to it. The volume was made up to 10 ml with 7.5 ml double distilled water and allowed to stand for 30 minutes at 700 nm by Spectrophotometer (Systronics make, Model: 166). The total tannic acid content was expressed as mg of tannic acid equivalent per 100g of dry weight of the sample.

2.4. Total Polyphenol and Flavonoids

2.4.1. Preparation of sample Extract

0.5 g each of shade dried sample vegetable was homogenized with 50ml of 80% methanol and 50 ml of double distilled water separately to prepare methanolic and aqueous extract of the sample respectively. Both the sample extracts were kept overnight at 4°C. Then, the sample extracts were centrifuged at 4°C at 5000 rpm for 30 minutes. The supernatant after centrifugation was filtered through glass wool to get methanolic and aqueous extract of sample. The final concentration of the sample extract was 10 mg/ ml.

2.4.2.Total Polyphenol Assay

The total phenolic content was measured using Folin-Ciocalteu reagent based on procedures described by Singleton et al (1999), with some modifications. Briefly, 1 ml of sample extract was mixed with 1 ml (1:10 v/v diluted with distilled water) Folin-Ciocalteu's reagent and allowed to stand at room temperature for 5 min. Then 0.8 ml of sodium carbonate (Na_2CO_3, 7.5%, w/v) was added and the volume made up to 10ml by adding 7.2 ml of double distilled water. The mixture was allowed to stand for another 30 min in the dark with intermittent shaking. The absorbance of the blue colour developed was measured at 765 nm using spectrophotometer (Systronics make, Model no 166). Gallic acid was used for constructing the standard curve (5 to 30 mcg/ml) and the total phenolic compounds concentration in the vegetable extract was expressed as micrograms of gallic acid equivalent per gram of dry weight (mcg GAE/g) of extract.

2.4.3.Total Flavonoid content assay

Total flavonoid content of the flower extract was determined according to colorimetric method described by Zhishen et al (1999), with some modifications. Briefly 1 ml sample was mixed with 0.15 ml of sodium nitrite ($NaNO_2$, 5% w/v) and allowed to stand for 6 min. Then 0.15 ml aluminum trichloride($AlCl_3$,10% w/v) was added and allowed to stand again for 6 min, followed by addition of 2 ml of sodium hydroxide (NaOH, 4% w/v). The final volume was made up to 10ml with double distilled water. The reaction mixture was mixed thoroughly and allowed to stand for another 15 min. The absorbance of pink colour that developed was measured at 510 nm in spectrophotometer (Systronics make, Model: 166). The colour blank was prepared by adding 9ml of double distilled water to 1 ml of sample extract and read at 510nm against double distilled water. The reagent blank was prepared using 1ml of 80% methanol instead of sample extract. Quercetin (10 to 1000 mcg/g) was used for construction of standard curve and the total flavonoid content was expressed in mcg of quercetin per gram of dry weight of the sample.

2.5. Antioxidant Activity

The antioxidant activity was measured by DPPH, FRAP, and ABTS methods. For the DPPH and FRAP the sample extract for analysis was prepared by the same method.

2.5.1.Preparation of sample Extract:

0.5 g each of shade dried sample vegetable was homogenized with 50ml of 80% methanol and 50 ml of double distilled water separately to prepare methanolic and aqueous extract of the sample. Both the sample extracts were kept overnight at 4°C. Then, the sample extracts were centrifuged at 4°C at 5000 rpm for 30 minutes. The supernatant after centrifugation was filtered through glass wool to get methanolic and aqueous extract of sample. The final concentration of the sample extract was 10 mg/ ml.

2.5.2.The DPPH Antioxidant Activity

The DPPH Antioxidant activity of the sample was measured according to the method of Sasidharan et al (2007). 2ml of sample of different concentrations (250- 5000 mcg/ml) were taken in different test tubes in dark and 2ml of 0.1mM DPPH (2,2-Diphenyl-1-picrylhydrazyl) was added to each test tubes. Then the tubes were allowed to stand for 30 minutes in dark. After 30 minutes, the samples were read at 517nm against 80% methanol in spectrophotometer (Systronics make, Model: 166). The reagent blank was prepared using 2ml of 80% methanol instead of sample extract. BHT was used as standard in the experiment.

The results were expressed as DPPH

Radical Scavenging Activity(%)=

$$\frac{\text{(Absorbance of Control- Absorbance of Sample/ Standard)X 100}}{\text{Absorbance of Control}} \quad (7)$$

IC_{50} value was calculated which denotes the concentration of the sample which is required to scavenge 50% of DPPH free radicals.

2.5.3.ABTS Total Antioxidant Activity

2.5.3.1.Preparation of Sample Extract

Methanol extract of the samples was obtained according to the methods of Roy et al(2016) with minor modifications. 1 gm sample was extracted with 20 ml aqueous methanol (60%, v/v) for 30 min in an orbital shaker (Bionics BST-AS35) at 70°C in the dark. The mixture was filtered through Whatman No.1 and the volume was made up again to 20 ml with aqueous methanol (60%, v/v). This sample was prepared to adjudicate the maximum antioxidant capacity that would be provided by the samples.

2.5.4.FRAP Antioxidant Activity

FRAP values of vegetable samples were evaluated according to the method described of Benzie and Strain(1996). To prepare the working FRAP reagent, 50 mL of 300 mM acetate buffer (pH-3.6) was mixed with 5 mL of 40 mM TPTZ (2, 4, 6-tripyridyl-s-triazine) dissolved in 40 mM HCl and 5 mL of 20 mM ferric chloride. 100 µL of sample extract (10mg/ml) was added to 3 mL of freshly prepared working FRAP reagent. The absorbance at 593 nm was spectrophotometrically measured immediately and after 4 min of incubation at 37 ºC. The change in absorbance was recorded as the final absorbance. For plotting calibration curve, ferrous sulphate (FeSO4.7H2O) was used as standard at various concentration (200-1000 µM). The ferric reducing ability of the sample was expressed as FRAP value (µM of FeII) of 10mg/ml vegetable extract. Ascorbic acid is used as standard in this experiment.

2.5.4.1.Procedure

The ABTS total antioxidant activity assay was conducted according to the method described by Baskar et al (2007). In this method, $ABTS^{\cdot -}$, the oxidant is generated by persulfate oxidation of 2,2,-azinobis (3-ethylbenzoline-6- sulfonic acid)–($ABTS^{2-}$). ABTS radical cation ($ABTS^{\cdot +}$) was produced by reacting ABTS solution (7mM) with 2.45 mM ammonium persulphate and the mixture was allowed to stand in dark at room temperature for 12 – 16 hr before use. For the study, different concentrations (100 – 500 µg/ml) of ethanolic extract (0.5 ml) were added to 0.3 ml of ABTS solution and the final volume was made up with ethanol to make 1 ml. 100 µl of sample extract(10-50µg/ml) was gently mixed with 0.9 ml of the ABTS working solution . The mixture was then kept in dark for 5 minutes for the reaction to take place and the absorbance was read at 745 nm and the percentage inhibition calculated as:

ABTS Scavenging Activity (%) or Percent Inhibition =

$$\frac{\text{(Absorbance of Control- Absorbance of Sample)X100}}{\text{Absorbance of Control}} \quad (8)$$

Where, Absorbance control = Absorbance of ABTS radical in 60% methanol; Absorbance sample = Absorbance of ABTS radical solution mixed with sample.

IC_{50} value was calculated which denotes concentration of sample where the absorbance of ABTS decreases 50% with respect to absorbance of blank. Control was prepared with

60% methanol and BHT was used as standard in the experiment.

2.6.Statistical Analysis

The study was a completely randomized design (CRD) study, conducted on 2 locations with 2 varieties of *Cucumis*(organic and conventional) in 4 types of packaging at 2 storage temperatures for 2 storage durations. Fresh *Cucumis* of both organic and conventional varieties were also experimented. Therefore, the total number of samples of the study was 68. All the experiments were studied in three replicas. Statistical analysis was performed with standard technique of multivariate analysis using SPSS 20 software. Multivariate analysis of variance (ANOVA) was performed to evaluate the significant differences between sample means, with significant level being considered at $P < 0.01$. The values expressed as means ± standard errors.

2.6.1.Percentage analysis:

The percentage was calculated for making simple comparison. For calculating percentage, the frequency of a particular cell was divided by the total number of respondents in that category and multiplied by 100. The percentage was calculated up to two places after decimal point.

2.6.2.ANOVA (Analysis of Variance)

The effect of the different comparative changes in physicochemical and nutritional values between organic and conventional cucumber stored in PP airtight container, LDPE zipper bags and cling film on the variability of different temperatures were estimated by analysis of variance (Snedecor and Cochran, 1994).

Statistical analysis was performed with standard technique of multivariate analysis using SPSS 20 software.

3.Results and discussion

Results were derived from both organic and conventional *Cucumis* before and after storing without packaging, in PP airtight containers, LDPE zipper, and wrapped in cling film packaging (at 25°C at RH 90% and 4° C at RH 70%) for both 3 days and 7days. The antioxidant levels and antioxidant status of the *Cucumis* are affected by the types of packaging, temperature, and duration of storage. Packaging created a changed environment within it leading to changes in antioxidants and antioxidant capacities. The results for organic and conventional *Cucumis* stored in experimental conditions were discussed below. The following abbreviations were applied for farming type and packaging types in the article thereafter: ORGN= Organic *Cucumis*, CONV= Conventional *Cucumis*, WP= Without Packaging, CONT= PP container, ZIPPER= LDPE zipper bags & CF= Cling Film wrap. Similar study on changes in physico-chemical and nutrients was published recently by Das et al.(2022).

Table 1. Comparison between Organic and Conventional *Cucumis* in Ascorbic Acid Content (mg/ 100g FW)

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY	3 DAYS				7 DAYS			
		FRESH MEAN ± SE	WP MEAN ± SE	CONT MEAN ± SE	ZIPPER MEAN ± SE	CF MEAN ± SE	WP MEAN ±SE	CONT MEAN ± SE	ZIPPER MEAN ± SE	CF MEAN ±SE
ORGN	25ºC	11.37±0.22	2.96±0.01^{a}	2.86±0.06^{b}	1.94±0.003^{c}	2.38±0.17^{d}	2.81±0.01^{a}	2.90±0.003^{b}	1.82±0.01^{c}	2.05±0.03^{d}
	4ºC		2.91±0.003^{a}	2.95±0.49^{b}	1.90±0.49^{b}	2.73±0.01^{c}	2.83±0.01^{a}	2.94±0.01^{b}	1.92±0.003^{c}	2.52±0.03^{d}
CONV	25ºC	8.13±0.07	1.39±0.003^{a}	1.83±0.003^{b}	1.40±0.03^{a}	2.55±0.22^{c}	1.36±0.02^{a}	1.72±0.002^{b}	1.35±0.02^{a}	2.29±0.26^{c}
	4 º C		1.34±0.01^{a}	1.56±0.10^{b}	1.36±0.03^{a}	1.63±0.03^{b}	1.27±0.03	1.74±0.01^{b}	1.24±0.027	1.63±0.03^{c}

Values bearing the same or no superscript between columns do not differ significantly.

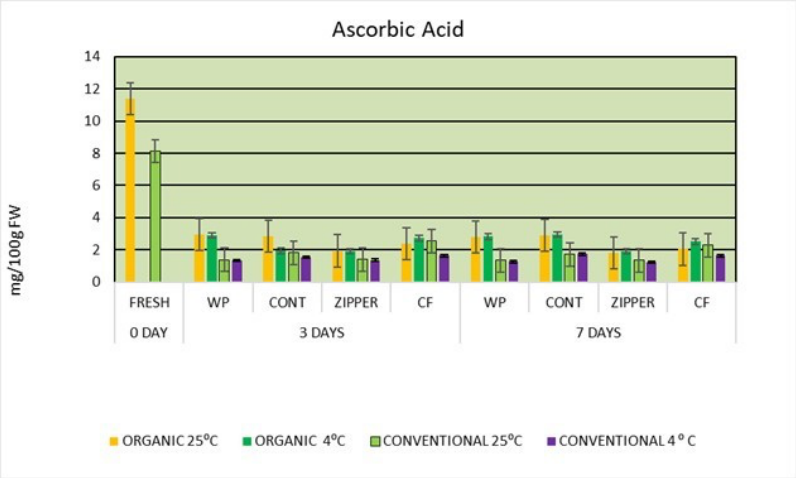

Figure 2. Comparison between Organic and Conventional *Cucumis* in Ascorbic Acid Content (mg/ 100 g)

3.1.Effect of Household Packaging on Ascorbic Acid Content

The Comparison between organic and conventional *Cucumis* in Ascorbic acid, Total Carotenoids and Tannin content were represented in Table 1, 2, and 3.Table 1 and Figure 2 showed the comparison between organic and conventional *Cucumis* in Ascorbic acid stored in experimental conditions. Ascorbic acid content was decreased significantly during storage of organic and conventional *Cucumis*. The ascorbic acid content of organic *Cucumis* was greater than conventional *Cucumis* i.e., 11.37±0.22mg/100g and 8.13±0.07mg/100g, respectively. The result was in an agreement with the findings of Jahan et al. (2020) on conventional *Cucumis* stored in plastic bag.

Organic *Cucumis*, when stored at 25ºC, RH 90% without packaging and different packaging, ascorbic acid was best retained without any packaging (2.96±0.01mg/100g) and poorly stored in LDPE zipper (1.94±0.003mg/100g) when stored for 3 days. when stored for 7 days, the ascorbic acid content of organic *Cucumis* was best retained in PP container(2.90±0.003 mg/100g) and poorly retained in LDPE zipper(1.82±0.01mg/100g). When organic *Cucumis* stored at 4º C, RH 70% without any packaging and in different packaging, it was observed that ascorbic acid retention was highest in PP container (2.95±0.49 mg/100g and 2.94±0.01mg/100g) and lowest in LDPE zipper(1.90±0.49 mg/100g and 1.92±0.003 mg/100g) after 3 days and 7 days of storage, respectively.

Whereas, for conventional *Cucumis*, the ascorbic acid content was best retained in cling film wrap (2.55±0.22 mg/100g and 2.29±0.26 mg/100g) and poorly retained when stored without packaging (1.39±0.003 mg/100g and 1.36±0.02 mg/100g) at 25ºC, RH 90% for 3 days and 7 days, respectively. The conventional *Cucumis* when stored at 4º C with 70% RH, it was found that ascorbic acid was best retained in Cling film wrapped vegetable (1.63±0.03 mg/ 100g) and in PP container (1.74±0.01 mg/ 100g) when stored for 3 days and 7 days, respectively.

It was observed from the multivariate ANOVA results that the ascorbic acid content of different vegetables *Cucumis* of different types of farming (organic and conventional), stored in different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) for different days (3 days and 7 days) had a significant effect. There were no scientific studies in literature available regarding the present research findings.

3.2.Effect of Household Packaging on Total Carotenoids

The comparison between organic and conventional *Cucumis* in total carotenoids contents was represented in Table 2 and Figure

3. It was found that the conventional *Cucumis* contains more carotenoids (291.77±1.13 mcg/ 100g FW) than organic *Cucumis* (211.36±0.43 mcg/100g FW). The Carotenoids contents were decreased during storage in different experimental conditions. For both organic and conventional *Cucumis*, total carotenoids were best preserved in LDPE zipper bags and least preserved when stored without any packaging at 25ºC, RH 90%, and 4ºC without packaging and different packaging for 3 days and 7 days both.

It was also found from multivariate ANOVA that the total carotenoids content of *Cucumis* of different types of farming (organic and conventional), stored in different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) at different temperatures (25ºC and 4ºC) for different days (3 days and 7 days) had a significant effect. There were no scientific studies in literature available regarding the present research findings.

3.3.Effect of Household Packaging on Tannin Content

Table 3 and Figure 4 represented the comparison of organic and conventional Cucumis in Tannin content in different experimental conditions. Results showed that the tannin content is higher in fresh organic *Cucumis*(323.97±0.96 mg/100g) than fresh conventional *Cucumis* (291.77±1.13mg/100g FW). Tannin content was decreased during storage. In a study conducted by Agatemor, Fred, and Nwodo (2018) found that the tannin content of conventional Cucumis was 1.26 ± 0.07 mg/g of fresh weight which is lesser than the value found in the current study. This may be due to differences in the genetic factor, edaphoclimatic conditions, developmental stage, and cultivation system (Aherne and O'Brien, 2002, & Tsai et al., 2008), as stated earlier. It was observed for organic *Cucumis* the retention of tannin was highest in LDPE zipper packaging (292.95±5.88 mg/ 100g) when stored at 25ºC with RH 90% for 3 days and in cling film wrap (181.07±0.89 mg/100g) when stored at the same temperature and RH for 7 days. Whereas, for conventional Cucumis stored at 25ºC with RH 90%, showed best preservation of tannin when stored without any packaging(215.63±2.89 after 3 days of storage and was highest when stored without any packaging(209.94±0.47mg/100g) and in cling film wrap(209.94±0.47mg/100g) for 7 days storage duration.

Table 2. Comparison between Organic and Conventional Cucumis in Total Carotenoids Content [mcg/ 100g FW]

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	211.36±0.43	13.77±0.03^{a}	38.57±0.16^{b}	57.36±0.03^{c}	22.51±0.08^{c}	25.13±0.02^{a}	40.44±0.04^{b}	52.87±0.02^{c}	47.40±0.06^{b}
	4 ºC		12.40±0.06^{a}	41.87±0.22^{b}	59.54±0.03^{c}	54.11±0.12^{c}	24.81±0.01^{a}	40.4±0.15^{b}	56.89±2.03^{c}	49.52±0.64^{b}
CONV	25ºC	291.77±1.13	26.91±0.02^{a}	42.72±1.76^{b}	81.39±0.89^{c}	70.94±1.35^{c}	24.87±0.06^{a}	38.96±0.12^{b}	40.33±0.15^{b}	32.36±0.39^{c}
	4º C		25.98±0.08^{a}	41.23±0.27^{b}	59.55±0.05^{c}	52.52±0.02^{c}	23.63±0.23^{a}	37.85±0.07^{b}	39.41±0.06^{b}	32.44±0.05^{b}

Values bearing same or no superscript between column does not differ significantly

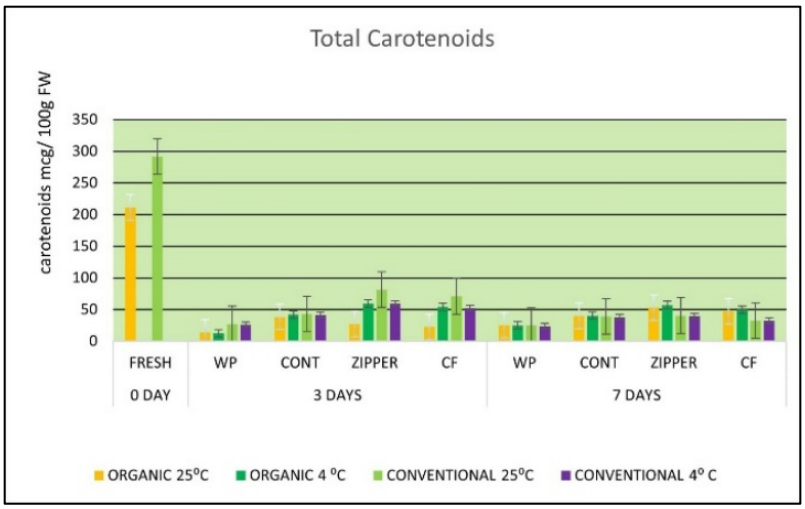

Figure 3. Comparison between Organic and Conventional *Cucumis* in Total Carotenoids Content (mcg/ 100g F

Table 3. Comparison between Organic and Conventional Cucumis in Tannin Content (mg tannic acid/100g of FW)

TYPE OF VEG.	TEMP OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	323.97±0.96	282.74±0.34^{a}	135.07±0.49^{b}	292.95±5.88^{c}	278.44±1.90^{a}	164.06±1.59^{a}	172.40±12.28^{a}	170.60±6.34^{a}	181.07±0.89^{b}
	4 ºC		196.25±12.66^{a}	114.99±6.50^{b}	301.92±12.44^{c}	283.10±1.13^{d}	183.72±0.59^{a}	135.16±0.09^{b}	193.63±0.85^{c}	200.79±0.57^{c}
CONV	25ºC	291.77±1.13	215.63±2.89^{a}	186.43±0.37^{b}	102.24±0.18^{c}	195.36±0.45^{d}	209.94±0.47^{a}	147.06±1.16^{b}	113.46±0.84^{c}	209.94±0.81^{a}
	4 ºC		114.98±2.07^{a}	98.34±0.30^{b}	103.58±1.10^{b}	100.21±1.06^{b}	225.92±7.65^{a}	144.84±15.87^{b}	138.09±12.30^{b}	229.25±9.30^{a}

#Values bearing same or no superscript between column does not differ significantly.

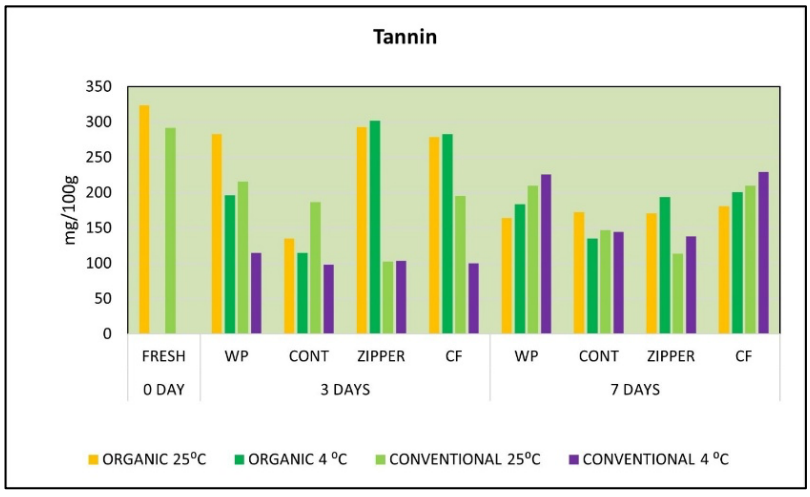

Figure 4. Comparison between Organic and Conventional *Cucumis* in Tannin Content (mg tannic acid/100g of FW

Tannin content of organic *Cucumis* was found highest in LDPE zipper bag (301.92±12.44 mg/100g) and in cling film wrap (200.79±0.57 mg/100g) when stored at for 4ºC (RH 70%) for 3 days and 7 days, respectively. It was also observed that conventional *Cucumis,* stored at 4ºC with RH 70%, showed highest retention of tannin when stored without any packaging (114.98±2.07 mg/100g) for 3 days and in cling film wrap (229.25±9.30 mg/100g) when stored for 7 days.

It was observed from multivariate ANOVA that different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) had a significant effect on the tannin content. There was no previous study available in literature regarding the agreement or disagreement of the current findings.

3.4.Effect of Household Packaging on Total Polyphenols

Table 4 and Figure 5.1 and 5.2 showed the comparison between organic and conventional *Cucumis* in total polyphenol (methanol extract and aqueous extract, respectively) in all experimental conditions. It was found that polyphenol content more in methanol extract than aqueous extract. Similar results were found in a study conducted by Vilas-Boas et al. (2020).

With the increase in temperature the polyphenol breakdown decreased. This result was supported by the observations found in studies by Lima et al. (2009) on vegetables of both organic and conventional varieties.

From the results, it was observed that LDPE zipper is mostly effective to retain the polyphenol in both organic and conventional *Cucumis*. It was observed from Multivariate ANOVA that the total polyphenol in both the methanol and aqueous extract of *Cucumis* of different types of farming (organic and conventional), stored in different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) at different temperatures (25ºC and 4ºC) for different days (3 days and 7 days) had a significant effect. There was no study in the previous literature available in support or disagreement of the present research findings.

3.5.Effect of Household Packaging on Total Flavonoids

Table 5 and Figure 6.1 and 6.2 showed that the comparison between organic and conventional *Cucumis* in Total Flavonoids (methanol extract and aqueous extract, respectively) in all experimental conditions. It was found that for methanol extract of *Cucumis*, the retention of total flavonoids was highest for cling film wrap packaging both for organic and conventional *Cucumis* in all experimental conditions. It was also observed that LDPE zipper showed least flavonoids retention among all packaging when the *Cucumis* was extracted in methanol. When the water extract, it was found that the PP container had highest flavonoids retention capacity and Cling film wrap showed lowest retention both for 3 days and 7 days of storage for both storage temperatures. Whereas, for conventionally grown *Cucumis*, maximum retention of flavonoids was found in LDPE zipper bag and cling film wrap packaging, both for 3 days and 7 days of storage for both storage temperatures. It was found from Multivariate ANOVA that the total flavonoid content (methanol extract) of *Cucumis when* stored in different packaging (without packaging, PP container, LDPE zipper bags, and Cling film wrap) had a significant effect. It was observed that the total flavonoid content (aqueous extract) of *Cucumis* of both organically and conventionally grown, stored in different packaging (PP container, LDPE zipper bags, and Cling film wrap) and without any packaging at different temperatures (25ºC and 4ºC) for different days (3 days and 7 days) had a significant effect. There were no scientific studies in literature available regarding the present research findings.

Table 4. Comparison between Organic and Conventional *Cucumis* in Total Polyphenol (Methanol) Content and Total Polyphenol(Aqueous)

Total Polyphenol (Methanol) Content (mcg Gallic acid/g of DW)

TYPE OF VEG	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	0.31±0.003	0.22±0.00	0.19±0.001	0.26±0.001	0.20±0.004	0.21±0.001	0.18±0.00	0.26±0.001	0.21±0.01
ORGN	4 ºC		0.27±0.00	0.22±0.002	0.27±0.001	0.21±0.002	0.17±0.001	0.13±0.00	0.24±0.001	0.25±0.00
CONV	25ºC	0.26±0.002	0.18±0.00	0.17±0.001	0.25±0.001	0.24±0.01	0.19± 0.00	0.18±0.001	0.26±0.001	0.24±0.002
CONV	4 º C		0.25±0.0	0.19±0.001	0.26±0.001	0.22±0.00	0.20±0.001	0.19±0.001	0.28±0.001	0.27±0.004

Total Polyphenol (Methanol) Content (mcg Gallic acid/g of DW)

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	0.28±0.00	0.16±0.002^{a}	0.17±0.01^{a}	0.27±0.003^{b}	0.20±0.01^{a}	0.21±0.00^{a}	0.14±0.002^{b}	0.23±0.01^{a}	0.20±0.00^{a}
ORGN	4 ºC		0.24±0.002^{a}	0.19±0.001^{b}	0.30±0.001^{a}	0.21±0.00^{b}	0.22±0.00^{a}	0.18±0.001^{a}	0.26±0.00^{b}	0.25±0.00^{b}
CONV	25ºC	0.26±0.00	0.18±0.002^{a}	0.16±0.001^{a}	0.25±0.003^{b}	0.2±0.01^{b}	0.19±0.02^{a}	0.18±0.002^{a}	0.25±0.00^{b}	0.24±0.00^{b}
CONV	4 º C		0.24±0.001^{a}	0.19±0.01^{b}	0.26±0.002^{a}	0.22±0.00^{b}	0.19±0.00^{a}	0.14±0.001^{a}	0.25±0.00^{b}	0.27±0.00^{b}

#Values bearing same or no superscript between column does not differ significantly

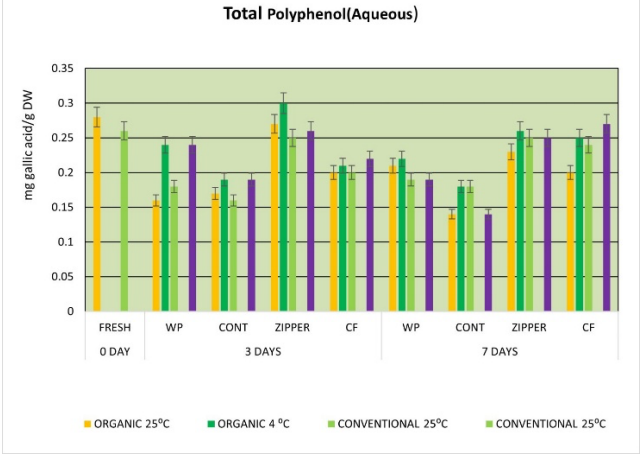

Figure 5.1. Comparison between Organic and Conventional *Cucumis* in Total Polyphenol (Methanol) Content (mcg Gallic acid/g of DW)

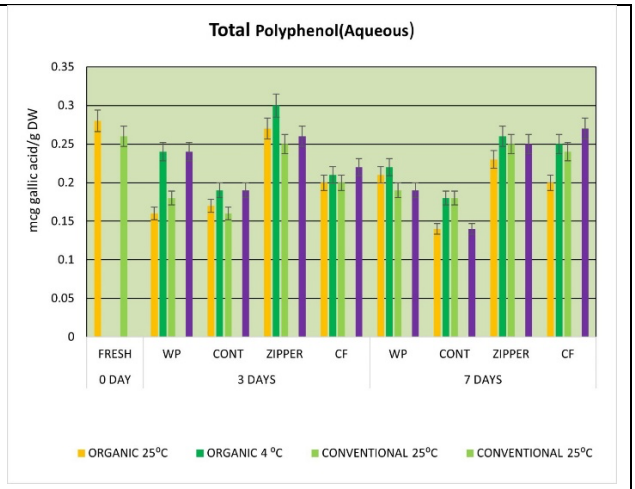

Figure 5.2. Comparison between Organic and Conventional *Cucumis* in Total Polyphenol (Aqueous) Content (mcg Gallic acid/g of DW)

3.6.Effect of Household Packaging on Antioxidant Status

3.6.1.DPPH Antioxidant Activity

Table 6 and Figure 7 represented the comparison between organic and conventional *Cucumis* in DPPH Antioxidant Capacity, and the results were expressed as IC_{50} value as mcg/ml. From the results it was found that the DPPH antioxidant capacity organic *Cucumis*(125.26±0.003mcg/ml) is greater than conventional *Cucumis* (130.21±0.02 mcg/ml). The DPPH Antioxidant Capacity of

conventional *Cucumis* in the present study was substantially lower than findings reported in the literature where the IC_{50} value is 182.25 ± 9.22 mcg/ml (Husni et al., 2020). In comparison, the DPPH antioxidant capacity of standard BHT was 17.76 mcg/ml.

Table 5. Comparison between Organic and Conventional Cucumis in Total Flavonoids **(Methanol)**

Total Flavonoids (Aqueous) Content [mcg Quercetin/ g of DW]

TYPE OF VEG	TEMP OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	0.26±0.00	0.16±0.00^{a}	0.22±0.002^{a}	0.13±0.01^{a}	0.10±0.002^{b}	0.13±0.001^{a}	0.18±0.001^{b}	0.11±0.002^{a}	0.08±0.002^{c}
	4 ºC		0.14±0.01^{a}	0.18±0.002^{a}	0.16±0.00^{a}	0.11±0.003^{a}	0.15±0.002^{a}	0.18±0.002^{a}	0.16±0.001^{a}	0.12±0.003^{a}
CONV	25ºC	0.12±0.00	0.08±0.001^{a}	0.09±0.001^{a}	0.11±0.00^{a}	0.11±0.004^{a}	0.05±0.004^{a}	0.08±0.001^{a}	0.11±0.006^{b}	0.10±0.003^{b}
	4 º C		0.09±0.001^{a}	0.08±0.002^{a}	0.12±0.00^{b}	0.12±0.002^{b}	0.09±0.001^{a}	0.11±0.001^{a}	0.12±0.001^{a}	0.11±0.001^{a}

Flavonoids (Methanol) Content [mcg Quercetin/g of DW]

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	0.70±0.003	0.27±0.002^{a}	0.29±0.002^{a}	0.29±0.0001^{a}	0.51±0.17^{b}	0.21±0.002^{a}	0.28±0.001^{b}	0.29±0.001^{b}	0.51±0.02^{c}
	4 º C		0.29±0.003^{a}	0.30±0.003^{a}	0.12±0.093^{b}	0.65±0.02^{c}	0.21±0.00^{a}	0.28±0.001^{b}	0.30±0.0003^{b}	0.35±0.06^{c}
CONV	25ºC	0.62±0.001	0.19±0.003^{a}	0.19±0.001^{a}	0.12±0.0003^{b}	0.70±0.20^{c}	0.19±0.001^{a}	0.21±0.004^{a}	0.13±0.0003^{b}	0.56±0.01^{c}
	4 ºC		0.21±0.001^{a}	0.19±0.001^{a}	0.13±0.0001^{b}	0.57±0.02^{c}	0.53±0.32^{a}	0.21±0.001^{b}	0.14±0.0003^{c}	0.55±0.03^{a}

Values bearing same or no superscript between column do not differ significantly

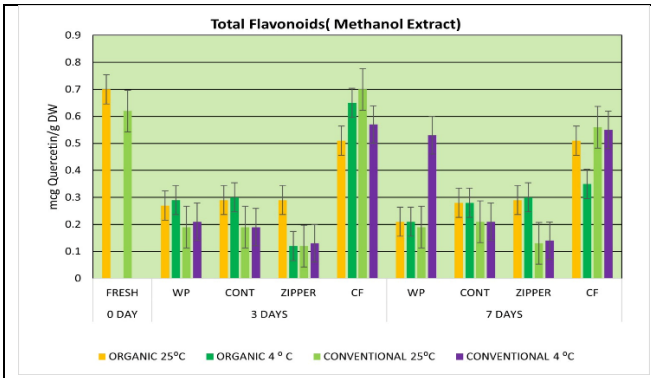

Figure 6.1. Comparison between Organic and Conventional *Cucumis* in Total Flavonoids (Methanol) Content[mcg Quercetin/g of DW]

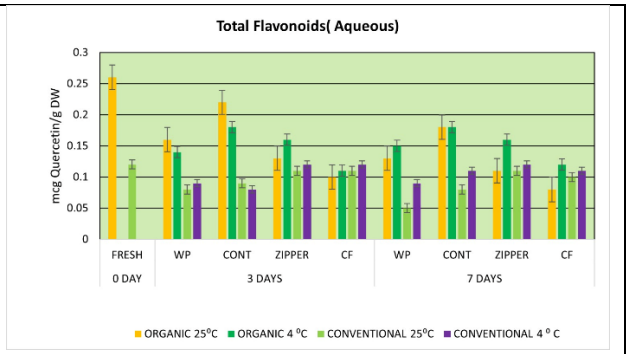

Figure 6.2. Comparison between Organic and Conventional *Cucumis* in Total Flavonoids (Aqueous) Content[mcg Quercetin/g of DW]

It was also observed that the maximum DPPH activity was found when both organic and conventional *Cucumis* were stored without any packaging at both experimental temperatures (25º C with RH 90% and 4º C with RH 70%) for 3 days and 7 days both in comparison to different packaging.

It was observed from multivariate ANOVA that the DPPH antioxidant capacity of *Cucumis* of different types of farming (organic and conventional), stored in different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) at different temperatures (25ºC and 4ºC) for different days (3 days and 7 days) had a significant effect. No studies are available in the literature regarding these research findings.

3.6.2.ABTS Antioxidant Capacity

The results of ABTS activity of organic and conventional Cucumis was represented in Table 7 and Figure 8. It was observed from multivariate ANOVA that there was no significant change in ABTS antioxidant activity in the experimental conditions. No or very limited number of literature available in the literatures to support or disagree the results found.

3.6.3.FRAP Antioxidant Activity

It was observed from Table 8 and Figure 9 that The FRAP antioxidant activity of organic and conventional *Cucumis* were 0.08±0.001 and 0.06±0.002 mmol Fe^{2+}/ g Dry Weight (DW), respectively in comparison to ascorbic acid standard with FRAP value of 1396.89 mmol Fe^{2+}/ g DW. Similar FRAP value was obtained in a study conducted by Yunusa et al. (2018) on conventional *Cucumis* with the FRAP value 0.06 ± 0.01 mmol Fe^{2+}/ g DW.

Multivariate ANOVA showed that the FRAP antioxidant capacity of *Cucumis* of different types of farming (organic and conventional), stored in different packaging (without packaging, PP container, Polyethylene zipper bags, and Cling film wrap) at different temperatures (25ºC and 4ºC) for different days (3 days and 7 days) had a significant effect. There was no mention of similar studies available in the literature for agreement or disagreement of the current findings.

Table 6. Comparison between Organic and Conventional Cucumis in DPPH Antioxidant Capacity [IC_{50} value mcg/ml]

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	125.26±0.003	117.59±0.31^{a}	119.75±0.21^{a}	121.26±0.03^{a}	124.60±0.04^{b}	110.54±0.01^{a}	112.48±0.04^{a}	115.34±0.06^{a}	118.38±0.04^{b}
	4 ºC		115.74±0.19^{a}	118.38±0.08^{a}	120.38±0.10^{a}	123.00±0.12^{b}	108.28±0.03^{a}	110.23±0.03^{a}	113.29±0.04^{a}	115.37±0.03^{b}
CONV	25ºC	130.21±0.02	128.23± 0.06^{a}	129.17±0.33^{a}	128.46±0.02^{a}	128.06±0.02^{a}	123.52±0.29^{a}	123.34±0.04^{a}	125.03±1.54^{a}	123.28±0.02^{a}
	4º C		127.28±0.03^{a}	128.42±0.15^{a}	128.10±0.07^{a}	127.43±0.08^{a}	122.38±0.02^{a}	122.94±0.01^{a}	120.35±0.02^{a}	121.29±0.04^{a}

DPPH IC50 value of standard BHT is 17.76 mcg/ml
#Values bearing same or no superscript between column does not differ significantly.

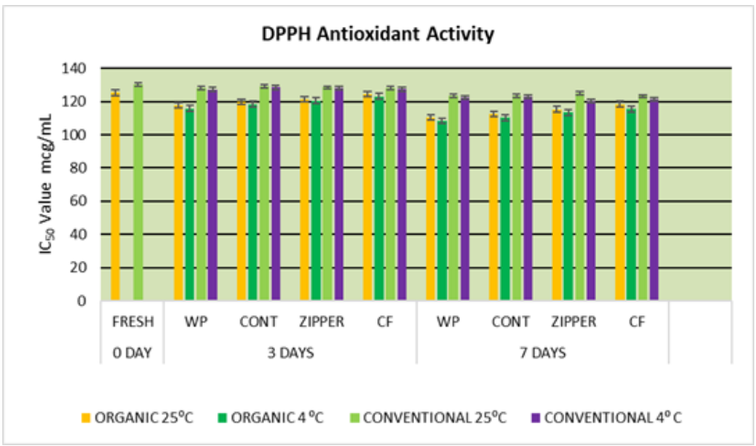

Figure 7. Comparison between Organic and Conventional Cucumis in DPPH Antioxidant Capacity [IC_{50} value mcg/ml]

Table 7. Comparison between Organic and Conventional *Cucumis* in ABTS Antioxidant Capacity [IC_{50} value mcg/ml]

TYPE OF VEG.	TEMP. OF STORAGE	0 DAY FRESH MEAN ± SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGANIC	25ºC	18.83±0.003	37.31±0.03	22.37±0.03	61.25±0.02	41.27±0.03	35.36± 0.08	20.42±0.01	58.25±0.02	38.04±0.06
	4 ºC		34.27±0.03	19.26±0.02	57.36±0.07	37.64±0.01	32.62±0.02	19.23±0.02	56.32±0.02	36.98±0.30
CONVENTIONAL	25ºC	21.78±0.01	39.81± 0.02	25.32±0.02	64.93±0.06	44.52±0.02	36.78±0.02	23.47±0.12	63.09±0.02	42.19±0.16
	4º C		37.28±0.02	23.83±0.01	64.42±0.23	42.44±0.93	34.75±0.01	22.82±0.01	62.07±0.46	41.12±0.48

ABTS IC50 value of Standard BHT is 6.16mcg/ml
#Values bearing same or no superscript between column does not differ significantly.

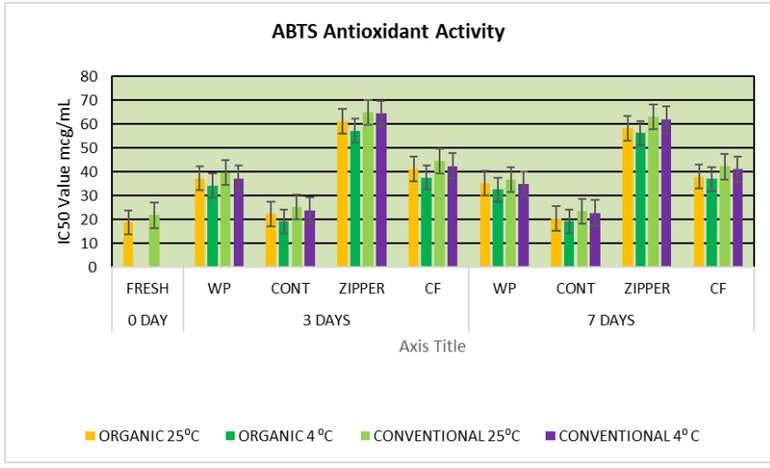

Figure 8. Comparison between Organic and Conventional Cucumis in ABTS Antioxidant Capacity [IC_{50} value mcg/ml]

Table 8. Comparison between Organic and Conventional *Luffa* in FRAP Antioxidant Capacity [mmol Fe^{2+}/ g DW]

TYPE OF VEG	TEMP. OF STORAGE	0 DAY FRESH MEAN ±SE	3 DAYS WP MEAN ± SE	3 DAYS CONT MEAN ± SE	3 DAYS ZIPPER MEAN ± SE	3 DAYS CF MEAN ± SE	7 DAYS WP MEAN ± SE	7 DAYS CONT MEAN ± SE	7 DAYS ZIPPER MEAN ± SE	7 DAYS CF MEAN ± SE
ORGN	25ºC	0.08±0.001	0.07±0.001^a	0.08±0.000^a	0.04±0.001^b	0.05±0.001^a	0.06±0.00^a	0.07±0.001^a	0.03±0.001^b	0.05±0.00^a
	4 ºC		0.07±0.00^a	0.08±0.001^a	0.05±0.00^a	0.06±0.001^a	0.07±0.00^a	0.07±0.001^a	0.04±0.002^b	0.05±0.001^a
CONV	25ºC	0.06±0.002	0.05± 0.00^a	0.05±0.001^a	0.03±0.001^a	0.05±0.001^a	0.05±0.00^a	0.05±0.00^a	0.03±0.00^a	0.05±0.001^a
	4º C		0.05±0.001^a	0.06±0.001^a	0.04±0.00^a	0.05±0.001^a	0.05±0.00^a	0.05±0.00^a	0.03±0.001^a	0.05± 0.00^a

Standard Ascorbic acid FRAP value is 1396.89 mmolFe^{2+}/ g DW
#Values bearing same or no superscript between column does not differ significantly

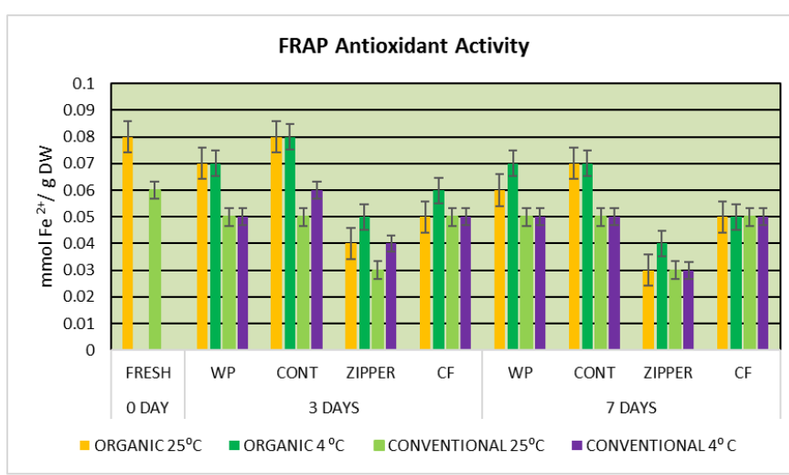

Figure 9. Comparison between Organic and Conventional Cucumis in FRAP Antioxidant Capacity [mmol Fe^{2+}/ g DW]

4.Conclusions

From the study, it can be concluded that the ascorbic acid content of organic *Cucumis* was greater than conventional *Cucumis* and ascorbic acid content decreased significantly during storage both in organic and conventional *Cucumis.* The ascorbic acid, total carotenoids, and total polyphenol contents of *Cucumis* of both organic and conventional varieties, stored in different packaging (without packaging, PP container, LDPE zipper bags, and Cling film wrap) for different storage durations had a significant effect. The tannin and total flavonoid contents of *Cucumis,* stored in different packaging had a significant effect. From the antioxidant status assays, DPPH and FRAP antioxidant capacities of organic and conventional *Cucumis* stored in different packaging at different storage temperatures and durations had a significant effect. From the present study it can be concluded that packaging creates a modified atmosphere within it, thereby can be considered as a devising strategy to extend the storability of organic and conventional *Cucumis* at domestic level

5.References

Agatemor, U.M., Fred, O., Nwodo, C. (2018). Phytochemical and proximate composition of cucumber (Cucumis sativus)fruit from Nsukka,Nigeria. *African Journal of Biotechnology*, 17(38),1215–1219, DOI: https://doi.org/10.5897/AJB2018.16410

Aherne, S.A., O'Brien, N.M. (2002).Dietary flavonoids: Chemistry, food content, and metabolism. *Nutrition* 18, 75-81, DOI: http://dx.doi.org/10.1016/S0899-9007(01)00695-5

AOAC.(2000). Official Methods of Analysis. 17th Edition, The Association of Official Analytical Chemists, Gaithersburg, MD, USA.

Baskar, R., Rajeswari, V., Kumar, T.S. (2007). In vitro antioxidant studies in leaves of Annona species. *Indian Journal of Experimental Biology*, 45, 480-485.

Basu, A., Imrham, V. (2007). Tomatoes versus lycopene in oxidative stress and carcinogenesis: Conclusions from clinical trials. *European Journal of Clinical Nutrition*, 61, 295-303. DOI: https://doi.org/10.1038/sj.ejcn.1602510

Benzie, I.F.F., Strain, J.J. (1996). The ferric reducing ability of plasma (FRAP) as a measure of " antioxidant power" : The FRAP assay. *Annals of Biochemistry*, 239, 70-76. DOI: https://doi.org/10.1006/abio.1996.0292

Bjelakovic, G., Nikolova, D., Gluud, L.L., Simonetti, R.G., Gluud, C.(2007). Mortality in randomized trials of antioxidant supplements of primary and secondary prevention: Systematic review and meta-analysis. *Journal of American Medical Association,* 297, 842-857. DOI: https://doi.org/10.1001/jama.297.8.842

Brant, K., Mølgaard, J.P. (2001). Organic agriculture: Does it enhance or reduce the nutritional value of plant foods ? *Journal Science of Food and Agriculture,* 81, 924-931. DOI: https://doi.org/10.1002/jsfa.903

Cheen, O.K., Kim, D.O. (2004) Consideration on equivalent chemicals in total phenolic assay of chlorogenic acid-rich plums. *Food Research International*, 37,337-342. DOI:http://dx.doi.org/10.1016/j.foodres.2004.02.001

Das, S., Chatterjee, A., Pal, T.K.(2020). Organic farming in India : a vision towards a healthy nation. *Food Quality and Safety* 20, 1–8. DOI: https://doi.org/10.1093/fqsafe/fyaa018

Das, S., Chatterjee, A., Pal, T.K. (2022). Comparative studies on physicochemical and nutritional values of organically and conventionally grown Cucumis sativus stored at different temperatures in different household packaging. *Organic Agriculture*, *12, 563–579. DOI:* https://doi.org/10.1007/s13165-022-00409-y

Husni, A., Shariff, M., Noor, P., Megat, Z., Abdul, M., Jahurul, A.H., Huda, N., Romes, N.B., Zakaria, M., Roslan, J., Wahab, R.A., Huyop, F.(2021). Nutrient composition , total phenolic content, and antioxidant activity of tropical Kundasang-grown cucumber at two growth stages. Chilean *Journal of Agricultural Research*, 81(2)), 220–227. DOI: https://doi.org/10.4067/S0718-58392021000200220

Jacobsson, A., Nielsen, T., Sjöholm, I., Wendin, K. (2004). Influence of packaging material and storage condition on the sensory quality of broccoli. *Food Quality and Preference,* 15(4),301-309. DOI: http://dx.doi.org/10.1016/S0950-3293(03)00070-3

Jahan, S.E., Hassan, M.K. Roy, S., Ahmed, Q.M., Hasan, G.N., Muna, A.Y., Sarkar, M.N. (2020). Effects of different postharvest treatments on nutritional quality and shelf life of cucumber. Asian *Journal of Crop, Soil Science and Plant Nutrition*, 2(1), 51–61. DOI: https://doi.org/10.18801/ajcsp.020120.08

Kuskoski, M., Asuero, A., Troncoso, A. (2005). Aplicación de diversosmétodo químicos para determiner actividadantioxidante en pulpa de frutos. *Ciênciae Tecnologia de Alimentos*, 25(4), 726–732. DOI: https://doi.org/10.1590/S0101-20612005000400016

Lichtenthaller, H.K., Wellburn, A.R. (1987). Determinations of total carotenoids and chlorophylls *a* and *b* of leaf extracts in different solvents. *Biochemical Society Transactions*,11(5),591–592. DOI: http://dx.doi.org/10.1042/bst0110591

Lima, G.P.P., Lopes, T.D.V.C., Rossetto, M.R.M., Vianello, F. (2009). Nutritional composition, phenolic compounds, nitrate content in eatable vegetables obtained by conventional and certified organic grown culture subject to thermal treatment. *International Journal of Food Science and Technology*, 44, 1118-1124. DOI: http://dx.doi.org/10.1111/j.1365-2621.2009.01928.x

Magnusson, M.K., Arvola, A., Hursti, U.K.K., Aberg, L., Sjoden, P.O. (2003). Choice of organic foods is related to perceived consequences for human Health and to environmentally friendly behaviour. *Appetite,* 4,109-117. DOI: 10.1016/s0195-6663(03)00002-3.

Manach, C., Scalbert, A., Morand, C., Remesy, C., Jimenez, L. (2004). Polyphenols: Food sources and bioavailability. *American Journal of Clinical Nutrition*, 79, 727-747. DOI: 10.1093/ajcn/79.5.727.

Melo, E.D.A., Lima, V.L.A.G., Maciel, M.I.S., Caetano, A.C.S., Leal, F.L.L. (2006). Polyphenol, ascorbic acid and total carotenoid contents in common fruits and vegetables. *Brazilian Journal of Food Technology*, 9, 89-94.

Polshettiwar, S.A., Ganjewale, R.O. (2007). Spectrophotometric estimation of total tannins in tannins in some ayurvedic eye drops. *Indian Journal of Pharmacological Sciences*, 69(4), 774-776. DOI: 10.4103/0250-474X.36949

Rembialkowska, E. (2007). Quality of plant products from organic agriculture. *Journal of Science of Food and Agriculture*,87,2757-2762. DOI: https://doi.org/10.1002/jsfa.3000

Roy, P., Bhattacharjee, S., Bhattacharyya, S. (2016). Influence of preparation methods on antioxidant profile and phytochemical constituents of commercial tea (*Camellia sinensis*) infusions. *Annals of Experimental Biology,* 4(3), 6-12.

Safe Practices for Food Processes.(September 30, 1998). Analysis and Evaluation of Preventive Control Measures for the Control and Reduction/Elimination of Microbial Hazards on Fresh and Fresh-Cut Produce Safe, Chapter V. Methods to Reduce / Eliminate Pathogens from Produce and Fresh- Cut Produce, Practices for Food Processes www.fda.gov/Food/Food Science Research/Safe Practices for Food Processes/ucm091363.html. (Accessed on February10, 2023).

Sasidharan, S., Darah, I., Mohd. Jain Noordin, M.K. (2007). Free radical scavenging activity and total phenolic compounds of *Gracilaria changii*. *International Journal of Natural and Engineering Sciences*, 1 (3), 115-117.

Shi, J., Wang, J., Li, R., Li, D., Xu, F., Sun, Q., Zhao, B., Mao, A., Guo, Y. (2015). Expression patterns of genes encoding plasma membrane aquaporins during fruit development in cucumber (Cucumis sativus L.). *Plant Physiology and Biochemistry* 96, 329–336. DOI: 10.1016/j.plaphy.2015.08.018

Singleton, V.L., Orthofer, R., Lamuela-Roventos, R.M. (1999). Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin- Ciocaltu reagent. *Methods in Enzymology*, 299, 152-178. DOI: https://doi.org/10.1016/S0076-6879(99)99017-1

Soltani, M., Alimardani, R.. Mobli, H Mohtasebi H., Modi, S.S.(2015). Atmosphere packaging: A progressive technology for shelf-life extension of fruits and vegetables. *Journal of Applied Packaging Research*, 3(7), 33-59.

Stratil, P., Klejdus, B., Kuban, V. (2006). Determination of total content of phenolic compounds and their antioxidant activity in vegetables evaluation of spectrophotometric methods. *Journal of Agricultural Food Chemistry,* 54, 607–616. DOI:10.1021/jf052334j

Surh, Y.J., Na, H.K. (2008). NF-κB and Nrf 2 as prime molecular targets of chemoprevention and cytoprotection with anti- inflammatory and antioxidant phytochemicals. *Genes and Nutrition,*2313-317. DOI: 10.1007/s12263-007-0063-0

Talcott, S.T., Howard, L.R. (1999).Chemical and sensory quality of processed tomato puree as influenced by stress induced phenolic compounds. *Food Chemistry*, 47: 1362- 1366. DOI: https://doi.org/10.1021/jf981135f

Thompson, A.K. (2010). Controlled atmosphere storage of fruits and vegetables. Second edition.CAB International, Oxford, UK. DOI: 10.1079/9781845936464.0000

Torjusen, H., Lieblein, G., Wandel, M., Francis, C.A. (2001). Food system orientation and quality perception among consumers and producers of organic food in Hedmark country, Norway. *Food Quality and Preference,* 12, 207- 216. DOI: http://dx.doi.org/10.1016/S0950-3293(00)00047-1

Tsai, P.J., Wu, S.C., Chen, Y.K. (2008).Role of polyphenols in antioxidant capacity of napier grass from different grown seasons. *Food Chemistry*, 106, 27-32. DOI: http://dx.doi.org/10.1016/j.foodchem.2007.05.037

Vilas-Boas, A.A., Campos, D.A., Nunes, C., Ribeiro,. S, Nunes, J., Oliveira, A., Pintado, M. (2020). Polyphenol extraction by different techniques for valorisation of non-compliant portuguese sweet cherries towards a novel antioxidant extract. *Sustainability* (Switzerland), 12(14) 5556. DOI: https://doi.org/10.3390/su12145556

Winter, C.K., Davis, S.F. (2006). Organic foods. *Journal of Food Science*, 71, 117-124.DOI: https://doi.org/10.1111/j.1750-3841.2006.00196.x

Yiridoe, E.K., Bonti-Ankamah, S., Martin, R.C. (2005). Comparison of consumer perceptions and preference toward organic versus conventionally produced foods: A review and update to the literature. *Renewable Agriculture and Food Systems*,20, 93-205. DOI: http://dx.doi.org/10.1079/RAF2005113

Zhishen, J., Mengcheng, T., Jianming, W. (1999). Determination of flavonoids contents in mulberry and their scavenging effects on superoxide radicals, *Food Chemistry*,64,555-559. DOI: https://doi.org/10.1016/S0308-8146(98)00102-2

Funding

This study was funded by the University Grants Commission, Government of India[Ref No. F.PSW-053/14-15(ERO)].

Declarations of interest

None declared