Effect of Some Plant Extracts on Quality, Storability Ability and Some Pathogenic Fungi during Cold Storage of Husk Tomato

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ABSTRACT

Husk tomato fruits local variety were obtained from a private farm - Abu Al-Matamir, El- Behera governorate during two successive seasons of 2018 and 2019. This study aimed to evaluate the effect of plant extracts on the postharvest quality, storage ability and some postharvest pathogenic fungi growth of Husk tomato fruits during cold storage at 10 °C and 95% RH In this paper we studied the effect of edible coatings based for three plant extracts, such as Moringa, Basil and Dodonea *in vitro* and during cold storage conditions against the growth of three phytopathogenic fungi, these were collected from Husk tomato fruits, the isolates were identified through (PCR) amplification of the (ITS) region, the fungal isolates belonging to *Fusarium oxysporum* (MW854654), *Fusarium equiseti* (MW854655) and *Alternaria alternata* (MW85465). The *in vitro* outcomes demonstrated that, all studied plant extracts significantly inhibited the linear growth of fungal pathogens, the ethanolic extracts of Moringa, Basil and Dodonea were identified using (GC–MS) method. Fruits are harvested when they are ready for marketing, and postharvest procedures can be carried out. This study's goal was to ascertain how plant extracts affected the post-harvest quality, storage ability and some postharvest pathogenic fungi growth of Husk tomato fruits during cold storage at 10 °C and 95% RH. Results showed that all postharvest treatments of Husk tomato fruits reduced pathogens and fruit rot and slowed the rate of weight loss, decay and highest value of T.S.S, T.S, lowest value of peroxidase activity, preserved the fruit content of vitamin C and titratable acidity. Treatments maintained the excellent appearance until 15 days of storage period and the good appearance quality and firmness of the fruits at the end of storage period.

Key words: Husk tomato, Plant extracts, Postharvest, Cold storage.

INTRODUCTION

The husk tomato (Physalis pruinosa; L) is a tropical fruit that is often produced frequently employed in the Mediterranean area enjoyed fresh in most countries. (Thuy et al., 2020), it is a promising export and economic crop and one of the major exotic fruits in demand Egypt and It had a variety of English names, Husk cherry, it was a medicinal plant with a long history of enthnomedicinal use (Eman et al. 2021). Recently, Husk tomato has been showed high antioxidant activities, which were found using DPPH and ABTS assays (Giraldo et al., 2017). The fruit contained several minerals (University of Florida, 2021). This fruit has issues with a variety of microbiological fungi, including Alternaria, Fusarium, Aspergillus, Rhizopus, Penicillium, and Trichoderma species. These species are able to produce mycotoxins, which are food contaminants that cause losses of up to 30% throughout stage and post-harvest market storage. Subramoniam described post-harvest diseases brought on by *Fusarium equiseti*, which entered at points of soft rot *(*Villamizar et al., 1993). Additionally, discovered the fungus *Alternaria alternata* from cape gooseberries in the fruit market of Aligarh, India, which had a direct impact on storing fruit (Sharma; Khan, 1978). Several strategies have been explored to manage these degrading fungal diseases, but many of them, such as the chemical treatment, have been shown to have negative environmental consequences due to their non-

biodegradability and toxicity (Xu et al. 2018). According to Morales-Contreras et al. (2018), further downsides of employing chemicals include genotoxicity, reproductive problems, immunosuppression, and hepatotoxicity. As a result of these impacts, it is vital to seek non-toxic, environmentally friendly, and cost-effective alternative control strategies for the management of fungal diseases. According to Wang et al. (2012), plant extracts are known to include hazardous free chemicals such as glycosides, flavonoids, phenols, saponins, alkaloids, sterols, and so on. Conservation based on edible coatings of biopolymers integrating plant extracts has been proposed as an option for technologies (Tukur et al., 2020). As a result, the study focuses on the use of plant extracts in the in vitro suppression of pathogens isolated from husk tomato fruits and in storage such as Moringa oliefera, Basil and Dodonea leaf extracts. *Moringa (Moringa oleifera* L.) is one of 13 species in the Moringa genus and Moringnance family. Thanaa et al. (2017) discovered that its leaves are high in natural antioxidants (Ascorbate and Phenolics). Basil (*Ocimum basilicum* L.) is an annual herb belonging to the mint family (*Lamiaceae*) D. Lupton *et al* (2017). Taie et al. (2010) said that the sweet Basil is a popular culinary herbal crop for phenolic compounds, essential oils, flavonoids which are associated with decreasing risks of cancer and aging diseases, it serves as antioxidant and anticancer. Dodonea (Dodonea viscosa) is a flowering shrub of the Sapindaceae family with a worldwide range. According to Aliyu (2006), the plant contains antibacterial and insecticidal properties. The purpose of this study was to assess the impact of Moringa. Basil and Dodonea leaves extracts on the growth of some fungal diseases and the postharvest quality and storage ability of Husk tomato fruits during cold storage.

MATERIALS AND METHODS

Isolation of fungal pathogens:-

Husk tomato fruits showing symptoms of vascular wilt were obtained from a private farm-Abu Al-Matamir, El-Behera Governorate and were transferred to the laboratory. The pathogenic fungi have been isolated from fruit tissues using PDA medium (potato dextrose agar) for 7 days at 25°C according to the organisms' development requirements (Gamliel et al., 1996). The pure Fusarium and Alternaria species were identified based on the physical features of their mycelia and spore as described by Booth (1977) and Nelson et al. (1983).

Molecular characterization of genomic DNA from fungal isolates:-

A quick micro preparation process was used to extract genomic DNA from three evaluated fungal isolates (Shahda et al., 2015; Mohamed and Gomaa 2019). The conserved ribosomal internal transcribed spacer (ITS) region was used to identify fungus cultures (Moore et al., 2011). Three isolates' amplified ITS1-5.8s and ITS2 regions (500-700 bp) were sent for sequencing (Macrogen, Scientific Services Company, Korea) (Kumar et al., 2016). The identification of the isolates was validated by utilizing the acquired sequences of the amplified areas in a BLAST search on the National Center for Biotechnology Information (NCBI). The program Molecular Evolutionary Genetics Analysis version 7 (MEGA 7) was used to perform the alignments.

Evaluation of some plant extracts on some of pathogenic fungi *in vitro* and quality, storability in refrigerators.

Plant extracts:-

The extracts were made from Moringa, Basil and Dodonea leaves plants (Anessing, and Perez (1993).

***In vitro*:-**

The antifungal activities of three different plant extracts: Moringa oliefera, Basil and Dodonea viscosa were tested on the *Fusarium* and *Alternaria* species. Extracts the plants are prepared at the concentrations of 2500, 1250 and 625 mg/L (Mohamed *et al*., 2021; Elbanoby *et al*., 2022; El-Hefny *et al*., 2023).

Was used to compute the proportion of fungal growth that is inhibited (IPFG) % of the investigated fungi by the following formula (Shakam et al., 2022; Abd-Elkader et al., 2022)

Proportion of fungal growth that is inhibited (IPFG) % = [(Growth in control - Growth in treatment)/Growth in control] × 100 .

The control and treatment growth values are the average diameters (mm) for fungal growth.

Role of botanical extracts in the quality and storability.

Husk tomato local variety was transported to the post-harvest laboratory, Faculty of Agriculture, Alexandria University. First, the covering (the peel) was removed from the husk tomato fruits. Secondly, the samples were set up in a fully randomized manner with three repetitions, each treatment contained 24 fruits, addition to control without spray. Thirdly, the peeled fruits were sprayed with plant extracts, and it was dried by using an electric fan, then the fruits were stored at a temperature of 10 °C and 95 % RH for 18 days. Three replicates from each treatment were tested for the following qualities at 3-day intervals: By visual examination, the proportion of rotted fruits was tallied and recorded; the percentage of decay was computed in relation to (the number of fruits - the decayed fruits/ the number of fruits x100). Loss in weight percentage was calculated by the following equation: Loss in weight % = original weight of fruit - weight of fruit at sampling date X 100. The overall appearance: as defined by Kader et al (1973), on a scale of 9 to 1, where (9) excellent, (7) good, (5) fair, (3) bad, and (1) unsalable fruits rated (5) or lower were regarded unmarketable.

The flesh firmness was determined by using the effigy pressure tester with a 3\5 plunger (Effigy, 48011 Alfonse, Italy) inside the pulp of fruits, two readings were taken for each fruit. Firmness was expressed per square inch (Ib/in^2). The total soluble solid percentage was calculated using an (Abbe Leica digital) refractometer. Each fruit sample's total sugars% were extracted from 20 gm. of thoroughly cut and blended flesh. Distilled water was used in the extraction (Loomis and Shull, 1937). Following hydrolysis with phenol sulfuric acid, the total sugar content was measured. Ascorbic acid (as specified for vitamin C) was evaluated using the titration technique published by A.O.A.C (1992) utilizing 2, 6 discolor phenol indophenols. Titratable acidity % was determined by titration of fruit juice with 0.1 N sodium hydroxide in the presence of phenolphthalein as an indicator. According to A.O.A.C (1992), titratable acidity was given as gram of citric acid per 100 ml of fruit juice. Qualitative test for the activity of the peroxidase enzyme is carried out by using (Ranganna 1991; Ranganna 1991; Hameda and Klein 1990).

GC/MS Analysis of the plant extracts

The temperature conditions in the separation program and the column oven were as follows (Okla et al. 2019; Abd-Elkader et al. 2022); To analyze the phytochemical profile of the plant isolated from Moringa oliefera, Sweet basil, and Dodonea viscosa, column capillary, the direct TG-5MS (30 m 0.25 mm 0.25 m film thickness) was employed in conjunction with a Trace GC Ultra-ISQ mass spectrometer (Thermo Scientific, Austin, TX, USA). The separation process and column oven temperature parameters described below were employed (Okla et al. 2019; Abd-Elkader et al. 2022). The initial temperature of the column oven is 70 °C. raised by 5 °C/min to 280 °C for 5 minutes, then increased by 5 °C/ min to 300 °C; The operating temperatures were maintained at 250 °C for the injector and MS transfer line; Helium a carrier gas, was kept at a flow rate constant of 1 mL/min; 1 L of the diluted samples were automatically injected with the Autosampler (AS1310) coupled with GC in the mode split, with a solvent delay of 2 min; the collected EI mass spectra were set at 70 eV ionization voltages (m/z 40–600) in the full mode scan; lastly, the ion source was set at 200 °C. The components were discovered by comparing the components' retention times and spectra mass to those in the WILEY 09 and NIST 11 spectral mass databases. All of the compounds' Standard Index and Reverse Standard Index were measured using the Xcalibur 3.0 data system of GC/MS, with a value of 650 being considered suitable for confirming the compounds (Abdel salam et al. 2019; Ali et al. 2021).

Statistical Analysis

Statistically were the data examined using Snedecor and Cochran's (1980), the analysis of variance. According to Waller and Duncan (1969), a variety of range testing techniques were used for mean comparison.

RESULTS AND DISCUSSIONS

Isolation of fungal pathogens

Pure cultures of three fungal isolates (one of *Alternaria* spp. and 2 of *Fusarium* spp.) were obtained from natural infected Husk tomato fruits Fig. (1) which collected from a private farm - Abu Al-Matamir, El-Behera governorate.

Fig. (1): Symptoms of naturally infected Husk tomato caused by some fungal pathogenic

Molecular characterization of genomic DNA from fungal isolates

The ITS region was amplified and sequenced to identify the fungal isolates. The three isolates yielded a 500-700 bp PCR result, and the ITS sequences were sent to GenBank. The results of molecular identification showed that, the fungal isolates belonging to *Fusarium oxysporum* (accession no. MW854654), *Fusarium equiseti* (accession no. MW854655) and *Alternaria alternata* (accession no. MW85465).

Chemical composition and antifungal susceptibility of Moringa, Basil and Dodonea against *F. oxysporum*, *F. equiseti* and *A. alternate*: Table (1) showed the chemical compounds identified by GC-MS.

Table (1): Phytochemical constituents of Moringa, Basil and Dodonea

Constituent	Percentage in the plant extracts (%)		
	Moringa	Basil	Dodonea
Oxygen	98.81*	97.26	94.50
Hydrazinecarboxamide	0.98	0.98	1.02
Carbohydrazide	0.22	0.59	1.42
Aceticacid hydroxy[(1-oxo-2-propenyl) amino]	0.97	--	--
N-Lauroylsarcosine	0.66	--	--
3-Aminobutanoic acid	75.63	91.47	--
L-Alanine	2.97	6.92	--
Nà-Acetyl-L-lysine	0.24	--	--
Ala-Gly	3.82	91.95	--
Bergaptol	0.22	--	--
trans-2-Hydroxycinnamic acid	0.16	--	--
Curcumin	1.59	--	--
Luminol	1.15	--	--
N-Aminomorpholine	1.36	--	--
Arecoline	90.24	--	--
Hydroxyurea	0.86	--	--
Methyl Alcohol	0.85	--	--
Dextroamphetamine	0.17	5.37	--
n-Hexadecanoic acid	14.54	--	8.85
Tetradecanoic acid	5.46	--	--
Pentadecanoic acid	6.18	--	5.54
Hexadecanoic acid, ethyl ester	28.05	--	--
Octadecanoic acid, ethyl ester	8.10	--	--
Ethyl tridecanoate	6.04	--	--
Oxalic acid, allyl hexadecyl ester	6.31	--	18.78
Phytol	6.07	22.16	6.86
9,12,15-Octadecatrienoic acid, ethyl ester	6.06	--	--
Phthalic acid	3.54	3.04	

Vitamin E	65.02	--	--
Methyl cis-cinnamate	--	36.67	--
Phthalic acid, heptadecyl 2-propylpentyl ester	--	29.55	--
Hexa-t-butylselenatrisileta ne	--	3.44	--
2-Propenoic acid, 3-phenyl-, methyl ester	--	47.98	--
Benzocyclobutene, 1,1'-bis-	--	6.27	--
Cyclohexene, 6-butyl-1-nitro-	--	4.38	--
1-Dodecen-3-yne	--	3.73	--
Citronellic acid	--	6.78	--
Urea	--	14.12	--
6-Ethyl-3-formylchromone	--	8.28	--
Creatinine	--	12.48	--
Creatine	--	6.43	--
Angelicin	--	3.94	--
4-Dimethylamino-2',4',6'-trimethoxychalcone	--	74.18	--
Methyl 2-phenyl-prop-2-enoate	--	18.96	--
Genipin	--	8.75	--
Murolan-3,9(11)-diene-10-peroxy	--	--	40.51
Isopropyl-1-methyl-2-methylene-5-oxatricyclo[5.4 .0.0 (3,8)]undecane	--	--	28.60
Trichothec-9-en-8-one,12,13-epoxy-4-hydroxy-,(4á)	--	--	9.12
Carbazol-1(2H)-one, 3,4-dihydro-6-chloro	--	--	4.03
Apomorphine	--	--	3.72
Dehydroxy-isocalamendiol	--	--	13.56
Alloaromadendrene oxide-(2)	--	--	11.20
Aromadendrene oxide-(1)	--	--	9.13
Butyl myristate	--	--	12.20
Aristol-1(10)-en-9-yl isovalerate	--	--	36.44
Oxalic acid, 2TMS derivative	--	--	18.78
Dithioerythritol,O,O',S,S'-tetrakis(trimethylsilyl)	--	--	9.93
Mercaptoacetic acid,2TMS derivative	--	--	7.60
Hexadecane	--	--	6.27
Octacosane	--	--	9.09
Hexacosane	--	--	5.04
Heptasiloxane, hexadecamethyl	--	--	14.32

*Values are relative percentages (RSI: Reverse Standard Index- SI: Standard Index).

Evaluation of plant extracts on some pathogenic fungi *in vitro* and quality, storability in refrigerators

It is evident that, all studied plant extracts significantly inhibited the linear growth of fungal pathogens. Moringa was the most effective against all of the isolates, with an inhibition percentage of fungal growth (IPFG) of 78.37%, 89.63% and 85.23% against the *F. oxysporum*, *F. equiseti* and *A. alternata* respectively at a concentration 2500 mg/L. Basil was 75.19%, 88.89% and 79.23% against the *F. oxysporum*, *F. equiseti* and *A. alternata* respectively at the same concentration, While Dodonea was effect against *F. oxysporum*, *F. equiseti* and *A. alternata* at the same concentration 72.36%, 86.3% and 74.24% as shown in Fig. (2) and Table (2).

Table (2): Inhibition percentage of fungal growth of *F. oxysporum*, *F. equiseti* and *A. alternata* affected by three plant extracts, Moringa, Basil and Dodonea.

Plant extracts	Inhibition percentage of fungal growth (IPFG)%			
	Concentration mg/L	*F. oxysporum*	*F. equiseti*	*A. alternata*
Control	**0 .00**	0.00h	0.00 h	0.00 h
Moringa	**2500**	78.37 a	89.63 a	85.23 a
	1250	76.04 b	89.26 a	82.20 b
	625	72.63 c	86.67 b	79.93 c
Basil	**2500**	75.19 b	88.89 a	79.23 c
	1250	67.86 d	84.51 c	76.14 d
	625	63.67 f	82.92 d	72.35 f
Dodonea	**2500**	72.36 c	86.3 b	74.24 e

	1250	66.30 e	85.56 b c	71.59 f
	625	61.11 g	80.74 e	66.44 g

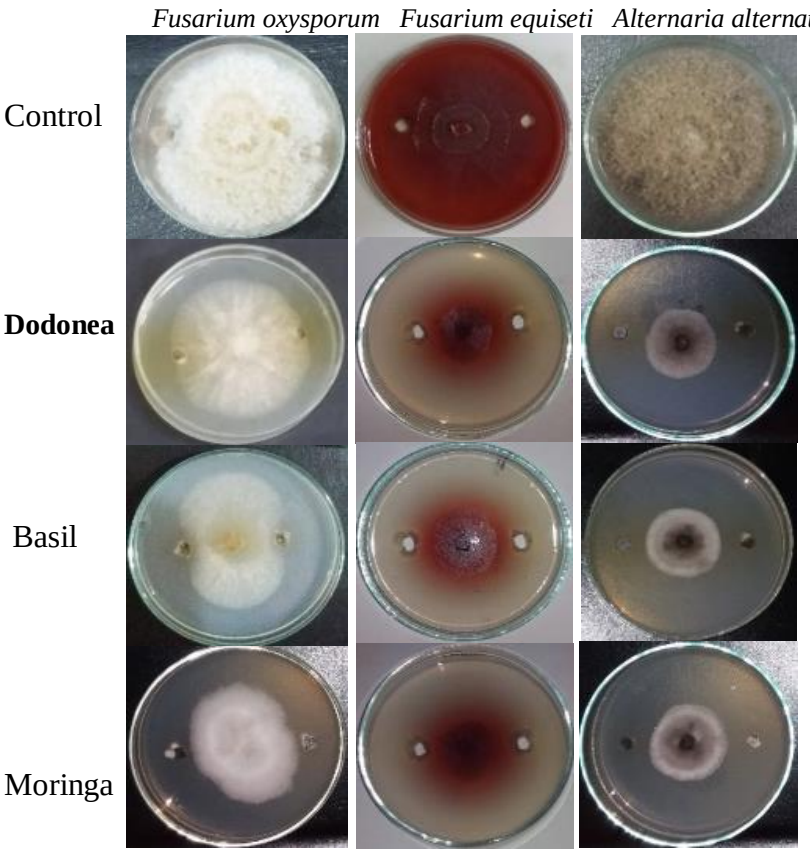

Fig. (2): Antifungal bioassay of Moringa, Basil and Dodonea against the mycelial growth of *Fusarium oxysporum*, *Fusarium equiseti* and *Alternaria alternata* at the concentration 2500 mg/L.

Decay percentage:

Table (3) and Fig. (3) showed the impact of plant extracts treatments on decay percentage., Data cleared that the decay percentage increased with extending storage period. The data revealed considerable disparities between all postharvest treatments and untreated control. There were considerable variations in effect on the percentage of decay fruits percentage using Moringa and Basil and Dodonia extract, the results also showed that the largest percentage of damage to the fruits was from the control treatment after 18 days of storage, and that was in the two seasons. Liamngee et al (2019) indicated that there was significant reduction in disease development postharvest decay due to the dipping of the fruits in aqueous extracts of the selected plant species and decided that the higher postharvest decay was recorded on the untreated fruits (control).This was due to the fact that the leaf extract possess phytochemicals such as tannins, alkaloids, flavonoids which are inhibitory to most fungi pathogens. Kumar et al. (2016) added that all of the extracts showed various degrees of antibacterial activity against the microorganisms tested. This plant (Moringa) has the potential to provide novel antibiotic chemicals. According to El-Mohamedy (2014), Moringa leaves contain a rich and unique mix of zeatin, quercetin, b-sitsterol, caffeoylquinic acid, and kaempferol, all of which have antifungal and antibacterial properties. Dodonea viscosa var. may have caused substantial cellular damage, including cell wall destruction. Damage to the cell wall may have resulted in some malfunction impacting cell division, budding, and hyphae production. According to Orpin et al (2018), the Phytochemical analysis of Dodonea leaf extract revealed that Alkaloids, Saponins, Tannins, Flavonoids, Volatile oil, and Phenols were detected in ethanolic extracts; these bioactive components are known to be

bactericidal, pesticides, or fungicidal in nature, conferring plants with antimicrobial properties.

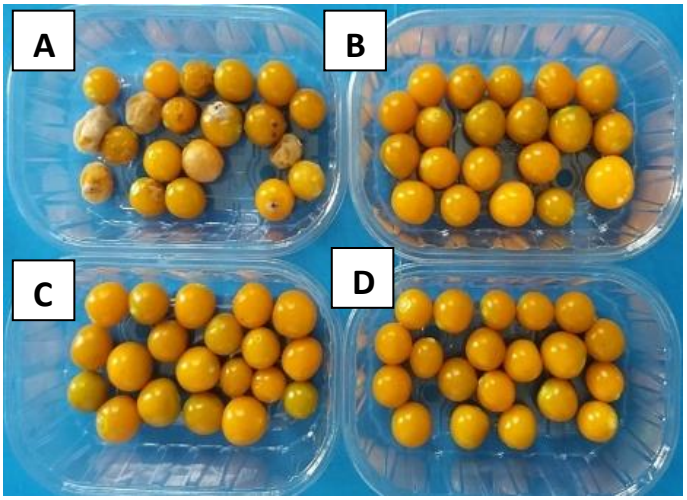

Fig. (3): Effect of Extract plants Moringa (B), Basil (C) and Dodonea (D) control (A) on Decay % during storage period.

Table (3): Effect of plant extracts treatments on Decay % during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	0.00h	0.00h	1.80f	4.50d	8.66c	16.5b	25.2a	8.09A
Moringa	0.00h	0.00h	0.00h	0.00h	0.00h	0.00h	0.87g	0.12C
Basil	0.00h	0.00h	0.00h	0.00h	0.00h	0.00h	0.77g	0.11C
Dodonea	0.00h	0.00h	0.00h	0.00h	0.00h	0.73g	2.90e	0.52B
Mean	0.00F	0.00F	0.45E	1.12D	2.17C	4.31B	7.43A	
				Season; 2019				
Control	0.00j	0.00j	1.40f	3.80d	7.73c	14.40b	20.95a	6.89A
Moringa	0.00j	0.00j	0.00j	0.00j	0.00j	0.00j	0.73h	0.10C
Basil	0.00j	0.00j	0.00j	0.00j	0.00j	0.00j	0.80g	0.11C
Dodonea	0.00j	0.00j	0.00j	0.00j	0.00j	0.50i	2.33e	0.40B
Mean	0.00F	0.00F	0.35E	0.95D	1.93C	3.72B	6.20A	

Means in same column having the same letter are not significantly different at the 0.05 level of the Duncan's multiple range test.

Effect of plant extracts on some quality Attributes of Husk tomato fruits during storage period in both seasons

Weight Loss Percentage: As seen in Table (4), the weight loss percentage rose when the cold storage duration was extended. The greatest weight losses occurred at the conclusion of the storage period; weight loss generally occurred during fruit storage as a result of the respiration process, humidity transfer, and some oxidation processes. In terms of the influence of postharvest treatments, data indicated that there were substantial disparities in weight loss % during storage among treatments in both seasons. When compared to the untreated control, all postharvest treatments-maintained fruit weight during storage. Moreover, husk tomato fruits treated by Moringa extract had the lowest weight loss percentages, so the Moringa extract was the most successful therapy in terms of weight loss%. then the basil extract, while the Dodonea extract therapy resulted in the highest weight loss % when compared to Moringa and Basil extract treatments in the end of the storage duration. These achieved the outcomes of the two seasons were consistent with Yusuf et al. (2021) for Moringa extract, who explained that the extract was able to form a coating on tomato fruit which reduced the fruit metabolic and respiration rates and therefore lowered the weight loss. As a result of decreasing of metabolic rate and low rate of weight loss and

the moisture preservation from the fruit, it was decided that the Moringa extract increase the shelf life of tomatoes during storage. Hoda et al. (2013) and Pourshaab et al. (2021) treated tomato fruits by Basil gum and observed that Basil gum keeping the weight of the fruits from decreasing throughout the storage period, and established that the Basil gum coating treatments were the most effective of all coatings, exhibiting the lowest weight loss over storage time, The reduction in weight loss is attributed to the coating's actions as a semi-permeable barrier against O_2, CO_2, moisture, and solute transport, which reduces respiration, water loss, and oxidation rate of reaction.

Table (4): Effect of plant extracts treatments on weight loss % during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	0.00h	0.94gh	4.43e-h	10.58d	18.22c	25.92b	32.37a	13.21A
Moringa	0.00h	0.41gh	0.62gh	0.97gh	1.45f-h	2.84f-h	4.94efg	1.60D
Basil	0.00h	0.58gh	0.81gh	1.21gh	1.64f-h	2.64f-h	5.94ef	1.83C
Dodonea	0.00h	0.68gh	0.98gh	2.65f-h	4.84efg	6.87de	8.97de	3.57B
Mean	0.00G	0.62F	1.71E	3.85D	6.54C	9.57B	13.05A	
				Season; 2019				
Control	0.00x	0.87s	4.33j	9.87d	16.95c	23.93b	29.4a	12.19A
Moringa	0.00x	0.34w	0.57uv	0.95r	1.38p	2.65l	4.64i	1.50D
Basil	0.00x	0.54v	0.74t	1.12q	1.57o	2.53m	5.25h	1.68C
Dodonea	0.00x	0.62u	0.92r	2.35h	4.24k	6.21f	8.34e	3.24B
Mean	0.00G	0.59F	1.64E	3.57D	6.03C	8.83B	11.91A	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

General Appearance (GA): Table (5) shows that extending the storage duration reduced the general appearance (score) of husk tomato fruits. In terms of the influence of postharvest treatments, data indicated that there were significant differences in storage across postharvest treatments and untreated controls. When compared to the untreated control, all postharvest treatments were applied to husk tomato fruits obtained the greatest aesthetic score. During the first year, there were no significant variations in the general look of the fruits between the extraction methods, while the fruits treated with Moringa extract in the second year outperformed both of the fruits treated with Basil and Dodonea extracts. Regarding postharvest treatments and storage durations, there was a substantial interaction in two years. According to Nxumalo, (2021) and Nxumalo et al. (2021), diverse medicinal plant parts include different phytochemicals and antioxidants that may be employed in crop protection and preservation of horticulture crops. Adding, Nasira et al. (2016) whom said that the Moringa leaf extract delayed the fruit senescence, because it contains amino acids, fatty acids, phenolic and its leaves contain high zeatin and cytokinin.

Table (5): Effect of plant extracts treatments on General Appearance during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	9.00a	9.00a	7.66bc	5.66e	3.66f	1.66g	1.00g	5.38B
Moringa	9.00a	9.00a	9.00a	9.00a	9.00a	8.33ab	7.00cd	8.62A
Basil	9.00a	9.00a	9.00a	9.00a	9.00a	8.33ab	6.33de	8.52A
Dodonea	9.00a	9.00a	9.00a	9.00a	9.00a	7.66bc	5.66e	8.33A
Mean	9.00A	9.00A	8.66AB	8.17BC	7.66C	6.50D	5.00E	
				Season; 2019				
Control	9.00a	9.00a	8.33ab	6.33de	4.33f	2.33g	1.00h	5.76C
Moringa	9.00a	9.00a	9.00a	9.00a	9.00a	9.00a	7.00cd	8.71A
Basil	9.00a	9.00a	9.00a	9.00a	9.00a	8.33ab	6.33de	8.52AB
Dodonea	9.00a	9.00a	9.00a	9.00a	9.00a	7.66bc	5.66e	8.33B
Mean	9.00A	9.00A	8.33A	B	7.83C	6.83D	5.00E	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Firmness:

Table (6) shown the influence of plant extracts on stiffness, the findings demonstrated that the firmness of the fruits decreased as storage time increased. In terms of the effect of postharvest therapies, the findings revealed that all postharvest therapies clearly and powerfully maintained the firmness of the fruits until the end of the trial as compared to the untreated control treatments during the two seasons. In terms of the impact of Moringa leaf extract on fruit firmness, According to Thanaa et al. (2017), the improved fruit firmness may be due to the high calcium concentration of Moringa leaf extract. Because calcium is essential for cell wall formation, it contributes to fruit tissue firmness, protects against physiological diseases, decreases respiration rates, preserves firmness, and delays the ripening process, which promotes fruit firmness and extends fruit shelf life. Hoda et al (2013) indicated that the firmness of tomato fruits decreased with increase in the storage period, it might result from one of three mechanisms: turgor loss, starch degradation, or fruit cell wall disintegration, and noticed that the treated tomato fruits with Basil gum were firm than the others treatments and control.

Table (6): Effect of plant extracts treatments on firmness during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	6.00a	5.20c-e	4.50i-k	3.83m	3.12h	1.50o	1.00p	3.61C
Moringa	6.00a	5.70ab	5.36b-d	5.06c-f	4.63g-i	4.30j-l	3.70m	4.98A
Basil	6.00a	5.63ab	5.40bc	5.00d-g	4.60h-k	4.23kl	3.66m	4.93A
Dodonea	6.00a	5.36b-d	4.96e-h	4.70f-i	4.33i-k	3.93l-m	3.60m	4.70B
Mean	6.00A	5.48B	5.06C	4.65D	4.18E	3.51F	3.00G	
				Season; 2019				
Control	6.05a	5.53d	4.93e	4.50f	3.60h	1.83hi	1.06i	3.99D
Moringa	6.05a	6.06b	5.86bc	5.60d	5.06e	4.56f	4.16g	5.40A
Basil	6.05a	5.93b	5.63cd	5.20e	4.63f	4.20g	3.76h	5.12B
Dodonea	6.05a	5.93b	5.50d	5.00e	4.50f	4.06g	3.53hi	5.00C
Mean	6.05A	5.87B	5.48C	5.07D	4.45E	3.66F	3.13G	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Effect of plant extracts on some chemical components of Husk tomato fruits throughout the storage phase in both seasons: -

Total soluble solids:

Table (7) showed the impact of plant extraction treatment on total soluble solids. Data obtained that the total soluble solids decreased with extending storage period. All postharvest treatment excelled the untreated control treatment in both seasons. According to the data, the greatest value of T.S.S derived from the Moringa extract then Basil extract, while Dodonea extract treatment showed the lowest T.S.S value in both seasons. According to Thanaa et al. (2017), Moringa leaf extract increased the total soluble solids content of fruits in response to Moringa leaf aqueous extract applications due to the high sugar and starch content of Moringa oleifera leaves. Furthermore, the leaf extract is high in cytokinins. Cytokinins stimulate glucose metabolism and create new links between sources, increasing the quantity of fruit soluble solids. The impact of Basil leaf extract on T.S.S. is consistent with Hoda et al. (2013).

Table (7): Effect of Plant Extract Treatments Total soluble solids during the storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	10.00i	10.20 f-i	10.36f-h	10.46e-g	9.40j	6.40l	4.40m	8.75D
Moringa	10.00i	10.50ef	11.10c	12.20a	11.50b	10.50ef	10.13ghi	10.85A
Basil	10.00i	10.40f-h	10.76de	11.96a	11.40b	10.10hi	9.10j	10.53B
Dodonea	10.00i	10.23f-i	10.50ef	11.16c	10.90cd	9.23j	8.20k	10.03C
Mean	10.00D	10.33C	10.68B	11.45A	10.80B	9.06E	7.96F	
				Season; 2019				
Control	9.90h	10.10g	10.30ef	10.50cd	9.63i	6.23j	4.20k	8.69D
Moringa	9.90h	10.30ef	10.50cd	11.10a	10.76b	10.45cde	10.10g	10.44A
Basil	9.90h	10.23fg	10.33def	11.00a	10.60bc	10.23fg	9.90h	10.31B
Dodonea	9.90h	10.10g	10.33def	10.96a	10.56c	10.20fg	9.60i	10.24C
Mean	9.90D	10.18C	10.36B	10.89A	10.39B	9.28E	8.45F	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Total sugars: Table (8) showed the impact of plant extraction treatment on total sugar, the total of sugars revealed a significant decrease at the end of the storage period. However, the total sugars followed the path of increase at three days after the beginning of the test until the ninth day of the life of the experiment, and then began to follow the path of decrease after twelve days until the end of the storage period. Because Moringa oleifera leaves have a high sugar and starch content, Thanaa et al. (2017) concluded that the Moringa leaf extract maintains the fruit's sugar level. In addition, the leaf extract contains a lot of cytokinins. Cytokinins encourage the metabolism of carbohydrates and establish new connections between sources, increasing the sugar content of fruits.

Table (8): Effect of plant extracts treatments on Total Sugar during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	5.70q	6.03	6.39l	6.73h	6.16h	3.07t	1.10u	5.03D
Moringa	5.70q	6.41k	7.03e	7.62a	7.25c	7.38b	5.82p	6.74A
Basil	5.70q	6.39l	6.64i	7.24d	7.08e	6.93f	5.63r	6.52B
Dodonea	5.70q	6.30m	6.48j	6.92f	6.87fg	6.82g	4.21s	6.19C
Mean	5.70Q	6.28D	6.63C	7.13A	6.84B	6.05E	4.19G	
				Season; 2019				
Control	5.90m	6.08l	7.07g	7.10g	6.24k	3.51p	1.3r	5.32D
Moringa	5.90m	6.59h	7.52d	8.01a	7.81c	7.51d	5.92m	7.04A
Basil	5.90m	6.48i	7.32f	7.92b	7.53d	7.41e	5.75h	6.90B
Dodonea	5.90m	6.34j	7.07g	7.83c	7.42e	7.33f	5.04	6.70C
Mean	5.90E	6.37D	7.24B	7.71A	7.25B	6.44c	4.51F	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Vitamin C: Table (9) revealed the effect of plant extract treatments on V.C in two seasons during storage. By lengthening the storage duration over the two seasons, the results clearly demonstrated that there was a severe shortage in vitamin C. The results also revealed that all postharvest treatments preserved V.C to a greater extent than the control treatment, which exhibited a noticeable decline in V.C content in both seasons. According to Thanee et al., the impact of Moringa leaf extract on V.C. (2017), Moringa increased the ascorbic acid content of the fruits. Because Moringa contains ascorbate, using it exogenously may induce ascorbate to be created internally. (Nouman et al., 2012) and was engaged in sugar metabolism, which is directly connected to vitamin C synthesis. These findings are consistent with those of Nasira et al. (2016) on 'Kinnow' The study indicated that foliar application of Moringa leaf aqueous extract

boosted vitamin C levels. In terms of the effect of V.C. Basil extract on Ascorbic acid, (vitamin C) levels in both basil gum-coated and uncoated tomatoes dropped after storage, with basil gum-coated tomatoes having the highest amounts of ascorbic acid, according to research by Pourshaab et al., in the year (2021).

Table (9): Effect of plant extracts treatments on V.C during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	39.57a	37.85c	35.26h	33.84k	23.12n	16.26	9.46p	27.91D
Moringa	39.57a	39.47a	38.00c	37.57d	36.77f	35.58g	34.17j	37.35A
Basil	39.57a	39.45a	38.23b	37.37d	36.56f	34.58i	33.56l	37.04B
Dodonea	39.57a	39.41a	38.07bc	37.07e	35.48gh	33.64kl	31.25m	36.35C
Mean	39.57A	39.04B	37.47C	36.46D	32.98E	30.01F	27.11G	
				Season; 2019				
Control	39.8a	37.41i	35.61n	33.72p	24.24r	18.56s	11.63t	28.71D
Moringa	39.8a	39.69ab	39.56bc	38.86e	37.91gh	36.84k	35.53n	38.31A
Basil	39.8a	39.65ab	39.21d	38.07g	37.12j	36.02m	34.76o	37.80B
Dodonea	39.8a	39.41cd	38.61f	37.72h	36.24l	34.56o	32.22q	36.93C
Mean	39.8A	39.04B	38.25C	37.09D	33.87E	31.49F	28.53G	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Titratable acidity: Table (10) reveled the effect of plant extract treatments during storage period on titratable acidity (T.A) in both seasons. It is noticeable from the results that the total acidity decreases with the increase in the storage period in both seasons. All postharvest treatments of plant extracts significantly able to reduce the speed of decrease of titratable acidity during the storage period compared to the control in the two seasons. Hoda et al., (2013) showed that the organic acids make up the majority of tomatoes' flavour. Acid levels in fruit often drop as it ripens. Tiratable acidity decreased significantly with storage period for all treatments studied. All of the applied treatments using Basil gum were also determined to be significant. Tomatoes' metabolic activity and the amount of accessible acid reserves lead their titratable acidity to fall dramatically as storage duration rises. Because acids are employed as respiratory substrates, they should be predicted to decrease when metabolic activity increases as a result of their utilization. Acids might be considered of as a fruit's energy store. This finding was supported by Pourshaab et al., (2021).

Table (10): Effect of plant extracts treatments on titratable acidity during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	0.99a	0.87a	0.75a	0.64a	0.54a	0.43a	0.34a	0.65D
Moringa	0.99a	0.97a	0.95	0.93a	0.91a	0.88a	0.76a	0.91A
Basil	0.99a	0.95a	0.92a	0.89a	0.86a	0.73a	0.66a	0.86B
Dodonea	0.99a	0.95a	0.90a	0.86a	0.78a	0.66a	0.55a	0.81C
Mean	0.99A	0.94B	0.88C	0.83D	0.77E	0.68F	0.58G	
				Season; 2019				
Control	0.96a	0.84a	0.74a	0.61a	0.52a	0.39a	0.28a	0.62D
Moringa	0.96a	0.93a	0.89a	0.85a	0.81a	0.70a	0.59a	0.82A
Basil	0.96a	0.91a	0.84a	0.72a	0.62a	0.58a	0.48a	0.73B
Dodonea	0.96a	0.88a	0.76a	0.65a	0.54a	0.43a	0.37a	0.66C
Mean	0.96A	0.89B	0.81C	0.71D	0.62E	0.52F	0.43G	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Peroxidase activity: Table (11) regarding the influence of plant extract treatments on peroxidase activity, the results showed that peroxidase activity increased with storage time extension in both seasons. In terms of postharvest treatments, the results determined

that all plant extracts were able to considerably reduce the increase in peroxidase compared to the control treatment in both seasons. Noting that Moringa extract was the most efficient in lowering peroxidase activity, followed by Basil extract, while Dodonia extract was the least effective. The results acquired for the interaction treatments demonstrate that there were no significant changes between them over the storage duration in both seasons. According to Thanaa et al. (2017) the increase in antioxidant activity might be attributed to Moringa leaf extract's high antioxidant content of tocopherols, carotenoids, ascorbic acid, flavonoids, and several other phenolic compounds that inhibit peroxidase activity. Filip claims that the effect of basil leaf extract on peroxidase activity is significant. (2017), Polyphenols are abundant in basil. Polyphenols cover a wide range of chemical classes, including phenolic acids and simple or complex flavonoids. In terms of pharmacology, they inhibit peroxide oxidation. When phenolic acids are supplied, their major role is as antioxidants. According to Filip (2017), Antioxidants are important chemicals that can protect the cell membrane from oxidative stress produced by free radicals. Polyphenols' antioxidant properties are due to their high reactivity as hydrogen or electron donors, as well as the polyphenol-derived radical's ability to stabilize and delocalize the unpaired electron (a function known as "chain breaking") and their ability to bind transition metal ions.

Table (11): Effect of plant extracts treatments on peroxidase activity during storage period (day).

Treatment	0	3	6	9	12	15	18	Mean
				Season; 2018				
Control	2.00a	2.57a	2.80a	2.98a	3.24a	3.41a	3.96a	2.99A
Moringa	2.00a	2.18a	2.27a	2.47a	2.58a	2.74a	2.93a	2.45D
Basil	2.00a	2.23a	2.47a	6.62a	2.84a	2.96a	3.22a	2.62C
Dodonea	2.00a	2.33a	2.51a	2.77a	2.92a	3.14a	3.36a	2.72B
Mean	2.00G	2.32F	2.51E	2.89C	2.89C	3.06B	3.37A	
				Season; 2019				
Control	1.85a	2.52a	2.72a	2.92a	3.06a	3.32a	3.92a	2.89A
Moringa	1.85a	1.97a	2.14a	2.35a	2.45a	2.64a	2.87a	2.32D
Basil	1.85a	2.02a	2.25a	2.38a	2.53a	2.74a	2.98a	2.39C
Dodonea	1.85a	2.19a	2.42a	2.65a	2.76a	2.86a	3.09a	2.54B
Mean	1.85G	2.17F	2.38E	2.57D	2.57C	2.86B	3.21A	

Means in same column having the same letter are not significantly different at 0.05 level of the Duncan's multiple range test.

Conclusion

Husk tomato fruits treated with Moringa, Basil, and Dodonea extracts improved fruit quality; it reduced weight loss percentage, decay percentage, and maintained fruit firmness, ascorbic acid, T.S, T.S.S, T.A, lowered peroxidase activity, and showed no change in general appearance until 15 days of storage and showed good appearance at the end of storage period 18 days of storage at 10 0C and 95% RH.

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تاثير بعض المستخلصات النباتيه علي الجودة والقدرةالتخزينيه وبعض الفطريات الممرضه خلال التخزين المبرد لثمار الحرنكش.

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أجريت الدراسة علي صنف محلي من ثمار الحرنكش من مزرعة خاصة (أبو المطامير بمحافظة البحيرة) خلال موسمين متتاليين 2018 و2019. في هذا البحث تم دراسة تأثير بعض المغلفات الصالحة للأكل لثلاثة مستخلصات نباتية مثل المورينجا ، الريحان والدودونيا في المختبر وأثناء ظروف التخزين البارد ضد نمو ثلاثة فطريات ممرضة للنبات ، تم جمعها من ثمار الحرنكش ، وتم التعرف على العزلات من خلال تضخيم (PCR) لمنطقة (ITS) ، والعزلات الفطرية التي تنتمي إليها كانت *Fusarium oxysporum* (MW854654) و *Fusarium equiseti* (MW854655) و *Alternaria alternata* (MW85465). أظهرت النتائج في المختبر أن جميع المستخلصات النباتية المدروسة تثبط بشكل كبير النمو الخطي لمسببات الأمراض الفطرية ، وقد تم توصيف المستخلصات الإيثانولية للمورينجا والريحان والدودونيا باستخدام جهاز(GC-MS) ، تم حصاد الثمار في مرحلة النضج المناسبة للتسويق لإجراء معاملات ما بعد الحصاد، هدفت هذه الدراسة إلى تقييم تأثير المستخلصات النباتية على جودة ما بعد الحصاد ، والقدرة التخزينية ، ونمو بعض الفطريات المسببة للأمراض بعد الحصاد لثمار الحرنكش أثناء التخزين البارد عند 10 درجة مئوية و 95٪ رطوبة نسبية. أظهرت النتائج أن جميع معاملات ما بعد الحصاد لثمار الحرنكش تحت الدراسة قللت من مسببات الأمراض وتعفن الثمار وقللت من معدل فقدان الوزن والتلف وأعلى قيمة لـ T.SS و T.S ، أقل قيمة لنشاط إنزيم البيروكسيداز، وحافظت معاملات الدراسة على محتوى الثمار من فيتامين C والحموضة القابلة للمعايرة. حافظت المعاملات محل الدراسة على المظهر العام للثمار حتى 15 يومًا من فترة التخزين وحسن المظهر وجودة الثمار لنهاية فترة التخزين.