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A Study on the Effect of Storage Periods and Some Packaging Materials on Some Cut Branches of Plants C-*Zanthoxylum beecheyanum* and *Ficus benjamina*

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Abstract: This study was conducted in the Postharvest Laboratory of Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., Giza, Egypt at two successive seasons 2019 and 2020, aiming to assess the efficiency ofthe packaging materials on cut foliage of *Zanthoxylum beecheyanum* and *Ficus benjamina* during long periods of cold storage to provide it to export as a new ones. Packaging materials in the study included, cellophane paper, news paper, kraft paper, foil paper and butter paper in addition to control (without packaging) and the three of the cold storage periods were five, twenty and sixty days at 5°C then, the holding solution containing citric acid at 0.2g/l + sucrose at 25g/l. The obtained resultsclarified that, wrapping cut branches ofzanthoxylum in foil paper prior to storage minimized the percentage of physiological loss from its tissuefurtherit achieved the highest percentage ofmoisture retention ratioas comparing with control and other treatments and used the butter paper for cut ficus is the best. The preferable packaging reduced the rate of water loss and enhanced the amount of water uptake werebutter paper and foil for cutzanthoxylum whilstthe butter and kraft paper were anexcellent wrapper for cut foliage of ficus. The relative fresh weight was improved by using most of packaging materials but the superiority was to foil paper whichmaintained the quality of general appearance, extended the shelf lifeand delayed the symptom of senescence of cutfoliage of zanthoxylum. The superlative packaging for cut foliage of ficus was butter paper, it improved theprevious attributes. All studied traits were negatively affected by increasing storage periods but storagestill plays a crucial role and appropriateness for long term shipment of cut foliage. Most of all utilized packaging materials in the study slow down the degradation of chlorophyll (a), (b) and carotenoids contents likewise improved the content of total sugars and total phenols incut branchesof both plant species under the experiment. It can be concluded that, packaging materials play an important role in improved all postharvest characteristics and it had main principles towards long storage and keeping the quality of cut branches.

Key words: *Zanthoxylum beecheyanum* · *Ficus benjamina* · Packaging materials · Physiological loss · Shelf life · Storage

INTRODUCTION

Ornamental filler crops are the basic and fundamental elements of any floral arrangements and provide a glamorous touch to floral designs. The perishable decorative greens, which were used earlier at about 5 percent as fillers inbouquet making have increased substantially to 20-25per cent [1].

Zanthoxylum beecheyanum K. Koch plant is one of 250 species approximately from Africa, Asia, America and Australia, which belongs to family Rutaceae. Chinese pepper is a common name that shared with several *Zanthoxylum* species and suggests it's medicinally and culinary use. It is around, dense, evergreen shrub up to 2 m tall with brownish bark with small spines up to 2.5-6.5 cm long. Its leaves are compound; each leaf has up to 15 green, glossy, entire, ovate 4-10 mm long leaflets with glands along the margins. The inflorescences are axillary fascicles of 1-2 mm yellow to green flowers and leaves have been used for treating bellyache and skin diseases as well as in activating thermogenic sympathetic nerve and effective for oral administration for inhibiting

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lipid accumulation. Chinese pepper above-ground organs such as stem wood and stem bark as well as sub-ground such as root wood and root bark contain several bioactive compounds including coumarins, furoquinoline alkaloids, lignans, steroids and terpenoids [2].

Ficus benjamina is a tall tree reaching 30 m and glossy leaves 6-13 cm, the inflorescences are spherical to egg-shaped, shiny green and have a diameter of 1.5 cm. *Ficus benjamina* is a spreading tree in different parts of the world including Australia, America, Asia and some European countries. For its therapeutic effects, it has long been used in folk medicine for treatments of many diseases, such as influenza and dysentery, malaria and other respiratory track diseases. Leaf extracts of *F.benjamina* tree showed richness of bioactive chemical compounds like cinnamic acid, naringenin and quercetin lactose. The fruit contains caffeic acid and the bark containsstigmasterol [3].

Storage and packaging are indispensable for advancing vase life and sustaining quality of cut flower and cut foliage. Significant improvement among various cut species have been reported by manipulating stage of harvesting, supplying preservative and alternative food material, proper packaging and storage conditions. Cold storage: It facilitates adjustment of flower stock and foliages to the market demand. It is most economical and widely used method of storage. The requirement of attributes of packaging material with respect to floral product are flower or foliage quality maintenance, water loss reduction, protection from physical injury, convenient to use, traceability and make the floral product easy to handle in transportation. The qualities of packaging material are strong enough, resistant to moisture, low cost or reusable and finally friendly with packing line machinery. The main principle of the packaging towardslong storage and keeping quality are to lower the rate of transpiration, respiration and cell division during transportation. Selection of a suitable packaging material to create an optimal passive modification of CO_2 and O_2 levels is of utmost importance for storage of cut foliages or flowers [4]. Thus, this research was initiated to investigate the effect of different packaging materials and storage periods on quality of new cut foliages.

MATERIALS AND METHODS

This experiment was conducted at the Postharvest Laboratory of Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt during the two successive seasons 2019 and 2020 to measure the extent to which the harvested cut branches of *Zanthoxylum beecheyanum* and *Ficus benjamina* were affected by the different wrapping materials during the storage period.

Plant Material: Cut branches (foliages) were obtained freshly from a well-known local commercial farm in Al-Qanater Alkhayriuh, Egypt, in the two seasons. Cut branches were picked in the early morning and directly wrapped in groups and transported quickly to the laboratory within nearly one hour. As soon as arrived to the Lab., these branches were firstly pre cooled by placing in cold water for half hour to remove the effect of high field heat. Thereafter, stem bases were re-cut under water to avoid air embolism before treatments and stems were adjusted to the same size and shape(tall of stem about 25 cm). Injury-free stems were selected for the experiment.

Experimental Conditions: Cut branches of*Zanthoxylum beecheyanum* and*Ficus benjamina*were placed in ambient conditions at 24±1°C, light level was about 15 µmol $m^{-2}S^{-1}$, partially from natural light and partially from fluorescent cool light 12h/day.

Experimental Design and Treatments: The cut branches of *Zanthoxylum beecheyanum* and *Ficus benjamina* were pulsed for half an hour in solution contained sucrose at 25 g/l + citric acid at 0.2g/l andwrapped in 5 types of packaging materials in addition to control with 3 replications under 3 storage periods that: Storage for five days ($St._1$); Storage for twenty days ($St._2$) and Storage for sixty days ($St._3$).

All cut branches of the plant species were stored at 5°C after wrapping and at the end of storage, it arranged in a completely randomized design and stems were inserted in glass bottles (500 ml) containing 400 ml of citric acid at 0.2g/l + sucrose at 25g/l after that, each bottle was covered at its mouth with cellophane wrap to prevent evaporation.

Treatments (packaging materials)were as following:

(T_0) Without wrapping as control
(T_1) Wrapping with cellophane paper
(T_2) Wrapping with news paper
(T_3) Wrapping with kraft paper
(T_4) Wrapping with foil paper
(T_5) Wrapping with butter paper

Experimental Measurements

Physiological Loss in Weight (PLW): It was expressed as percentage of weight loss relative after storage to the initial weight.

PLW (%) = $\frac{IWa - FWa}{IWa}$ x 100, where IWa: initial fresh weight of cut foliage and FWa: final weight, according to Safeena *et al.* [5].

Moisture Retention Ratio: The percentage of plant retention of moisture.

Water Loss: It was expressed as water loss (ml.gfw^{-1}) = $\frac{Tt-1-Tt}{FW0}$

where: Tt= weight of flower plus vase containing water or solution (g) at days, T_{t-1}= the weight of flower plus vase containing water or solution (g) at the previous day, FW_0= the weight of flower (g) at day0. Pouri *et al.* [6].

Water Uptake: The amount of the solution (g) at the beginning of the experiment subtract the amount of the solution remaining at the end of the experiment, according to Safeena*et al.* [5].

Relative Fresh Weight (RFW): RFW (%) = (FWt / FW_0) ×100. Where FWt = weight of flower (g) at days after vase incubation, FW_0 = weight of flower (g) at day 0 [7].

General Appearance: Evaluated based on a scale ranging where 1= bad (25 %)greenish yellow, 2= moderate (25 to 50%) yellowish green, 3= good (50 to75 %) slightly yellowish and 4= excellent (75 to 100%) completely healthy, according to Sangwanangkul *et al.* [8].

Shelf Life: It was determined as the number of days from starting the experiment to the visible fading stage (days).

Chemical Analysis:

Photosynthetic Pigments: The contents of chlorophyll (a), (b) and carotenoids (mg/g fw) were determined according to Saric *et al.* [9].

Total Sugars: Determination of total sugars (%) in leaves was done according to Dubois *et al*. [10].

Total Phenols: Determination of total phenols percentage in leaves according to Ferrante *et al*. [11].

Statistical Analysis: Data were tabulated and subjected to analysis of variance as a factorial experiment using MSTAT-C statistical software [12]. Means of treatments were compared by Duncan's Multiple Range Test at 5% level as indicated by Waller and Duncan [13].

The present investigation was aimed to find out the effect of thepackaging material and storage periods on the cut branches of *Zanthoxylum beecheyanum* and *Ficus benjamina*.

RESULTS AND DISCUSSION

Physiological Loss in Weight (PLW): From data averaged in Tables (1 and 2) it was found that all tested packaging materials in this study decreased the physiological loss (PLW) parentagein cut branches compared to control (without packaging). Wrapping cut *Zanthoxylum beecheyanum* branches infoil paper recorded the minimum loss 18.26 and 18.24% compared to control 44.68 and 44.22% withhighly significant difference between them in both seasons as shown in Table (1). On the other side, the data in Table (2) showed that cut branches of *Ficus benjamina* which were wrapping in butter paper achieved the minimum values (15.14 and 16.75%) of physiological loss in weight comparing with all other packaging materials and specially for the control (40.05 and 41.97%) in thefirst and second seasons, respectively. This may be attributed to theeffect of packaging cut branches on maintaining humidity led to slow down the process of loss and control thebalance of oxygen and carbon dioxide concentrations in turn reduce the process of respiration. The previous results agree with those attained by Varu and Barad [14] who recorded the minimum physiological loss of weight of *Polianthestuberosa* was registered from metal paper due to modified atmosphere and the gaseous composition balance andagrees with viewpoint each of Khongwir *et al.* [15] on cut spike of tuberose and Gandhi [16] on cut flowers of rose.

In relation to the effect of storage periods, it cleared from Tables (1 and 2) that therate of percentage of physiological lossincreased with prolonging periods from 5, 20 to 60 days in this study. It was obvious that, the percentages in loss of weight in cut branches of zanthoxylumwere 18.72, 29.39 and 41.36% in the first season compared to 19.05, 28.22 and 40.97% in the second season, respectively. In the same matter, there was a significant difference between t he percentages in loss of weightin cut branches of ficus and gave 12.16, 18.80

Table 1: Influence of packaging materials on physiological loss (%)and moisture retention ratio(%) of *Zanthoxylum beecheyanum* cut branches under three cold storage periods during 2019 and 2020 seasons

	Physiological loss(%)				Moisture retention ratio(%)			
	Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
				First season				
T_0	32.34i	40.12d	61.59a	44.68A	67.66j	59.88o	38.41r	55.31F
T_1	26.18l	35.58f	42.28b	34.68B	73.82g	64.42m	57.72q	65.32E
T_2	15.03p	28.54k	39.56e	27.71D	84.97c	71.46h	60.44n	72.29C
T_3	20.26n	33.37h	41.19c	31.61C	79.77e	66.63k	58.81p	68.40D
T_4	8.28r	17.29o	29.20j	18.26F	91.72a	82.68d	70.80i	81.73A
T_5	10.20q	21.43m	34.34g	21.99E	89.80b	78.57f	65.66l	78.01B
Mean	18.72C	29.39B	41.36A		81.29A	70.60B	58.64C	
				Second season				
T_0	30.23g	40.18c	62.23a	44.22A	68.77h	59.83m	37.90o	55.50F
T_1	24.39j	33.32e	43.06b	33.59B	75.61e	66.68j	57.60n	66.63E
T_2	16.26l	27.14i	38.28d	27.23D	83.74c	72.86f	61.73k	72.78C
T_3	20.05k	32.30f	40.41c	30.92C	79.95d	67.67i	60.59l	69.40D
T_4	10.13n	16.20l	28.40h	18.24F	89.87a	83.80c	71.60g	81.76A
T_5	13.22m	20.16k	33.43e	22.27E	86.78b	79.84d	66.57j	77.73B
Mean	19.05C	28.22B	40.97A		80.79A	71.78B	59.33C	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days.

Table 2: Influence of packaging materials on physiological loss (%)and moisture retention ratio(%)of *Ficus benjamina*cut branches under three cold storage periods during 2019 and 2020 seasons

	Physiological loss(%)				Moisture retention ratio(%)			
	Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
				First season				
T_0	21.35g	33.26e	65.54a	40.05A	78.65k	66.74m	34.46r	59.95F
T_1	13.52l	20.68h	42.16b	25.45B	86.48f	79.34j	57.84q	74.55E
T_2	10.78n	16.52j	36.35c	21.21C	89.22d	83.48h	63.66o	78.79C
T_3	8.72p	14.35k	34.42d	19.16E	92.28b	85.45g	65.58n	81.10B
T_4	12.43m	18.50i	30.16f	20.36D	87.57e	81.50i	59.84p	76.30D
T_5	6.18q	9.48o	29.76f	15.14F	93.82a	90.52c	70.24l	84.86A
Mean	12.16C	18.80B	39.73A		88.00A	81.17B	58.60C	
				Second season				
T_0	22.20h	35.22f	68.49a	41.97A	77.80i	64.78k	31.51p	58.03F
T_1	14.20m	21.72h	44.12b	26.68B	85.80e	78.28i	55.88o	73.32E
T_2	11.01o	19.48j	39.62d	23.37D	89.03b	80.50g	60.38m	76.64C
T_3	9.53p	17.23k	38.41e	21.72E	89.91a	82.50f	61.59l	78.00B
T_4	15.19l	20.10i	42.38c	25.89C	86.64d	79.90h	57.62n	74.72D
T_5	7.77q	12.09n	30.40g	16.75F	89.88a	87.91c	69.60j	82.46A
Mean	13.32C	20.97B	43.90A		86.51A	78.98B	56.10C	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

and 39.73% in the first season while in the second one it gave 13.32, 20.97 and 43.90%. Data proves that prolonging the storage period increases the physiological loss gradually in both cut branches during the two seasons of the study. Similar resultswere supported by Beura and Singh [17] on cut spike of gladiolus.

Regarding to the interaction among treatments, data in the Table (1) showed that, the stored cutzanthoxylum branches for 5 days with wrapping in foil paper gave 8.28and 10.13 %, it had a minimum loss compared to 32.34 and 30.23 % from the cut branches without packaging in the first and second seasons, respectively, whereas

storing cut branchesfor cold storagefor 60 days gave the maximum rate of physiological loss 61.59 and 62.23 % from cut branches without packaging(control). On the other hand, Table (2) declared that, the stored cutficus branches for 5 days with wrapping in butter paper gave 6.18 and 7.27% compared to 21.35 and 22.20 % in cut branches without packaging in the first and second seasons, respectively. Meanwhile, stored cut branches for 60 days which warped in butter paper maintained it during cold storage compared to allthe rest of the transactionsin the same period. This may be due to the physiological loss in weight which was lower in minimum temperature thereby causing minimize the weight loss. Moreover, low the temperature incold storage **declinedtranspirational** loss of water and loss of carbohydrates which decreased the loss of weight. This finding was demonstratedbefore by Srivastava *et al.* [18] who found that the percent of weight loss significantly influenced by wrapping materials and storage conditions in cut chrysanthemum cultivars (Snowball Yellow and Snowball White) stems that wrapped in PP 200 gauge giving the minimum postharvest percent weight loss.

Moisture Retention Ratio: According to Tables (1 and 2) data showed that, all tested packaging materials enhanced the percent of moisture retention compared to control (cut branches without packaging). Wrappingcut *Zanthoxylum beecheyanum* branches in foil paper was thepreferable backing material under the cold storage circumstances, it increased parentage of moisture to 81.73 and 81.76 % in comparison to 55.31 and 55.50 % in cut branches without packaging, in the first and second seasons, respectively (Table 1). Otherwise butter paper was the best backing materialforcut branches of*Ficus benjamina* (Table 2). It gave 84.86 and 82.46% compared to control treatment which was 59.95 and 58.03% in the first and second seasons, respectively as studied by Naz [19] on cut rose and Shashikala and Singh [20] on cut spike of gladiolus and found that butter paper as wrapping materials gave the best results. Jawaharlal *et al*. [21] recommended butter paper packdendrobium cut flowers, it was betterthancellophane and news paper. Through this, it can be conclude that the packing materials has a positive effect on the cut branches during cold storage and that the different types of packing materials affect the state of the internal balance and this case varies from cut branch to another according to the type of material that is most appropriate. That may be due to the various types of packaging materials create different permeability and air balance inside the packaging materials.

In regarded to the effect of storage periods, Tables (1 and 2) the data revealed that, with increasing the durations of cold storage of the cut branches, the percentage of moisture retentionwithin the tissues decreased. Moreover, the moisture retention ratio values were significantly decreased with prolonging cold storage periods in cut branches in this experiment whereas after 5 days gave the maximum values that 81.29 and 80.79 % in *Zanthoxylum beecheyanum* and 88.00 and 86.51% in *Ficus benjamina* in the first and second seasons, respectively compared to the minimum values for those stored for long period (60 days) which were 58.64 and 59.33% in cut zanthoxylumfoliage and 58.60 and 56.10%in cut foliageof ficus in the first and second seasons, respectively. In this concern Jadhav [22] reported that cold storage **inhibitsmicroorganisms**, reduces ethylene production, respiration, certain enzymes and delays the processes of senescence unlessthe moisture retention ratio content decreased with increasing storage duration [23]. Also, Chore *et al.* [24] pointed that, the adverse effect of increasing cold storage on cut flowers probably due to microbial proliferation. Sharma *et al.* [25] declared that the marigold flowers had more moisture contentin case of storing them for three days than the six days storage.

In relation to the interaction treatments between the tested packaging materials and cold storage periods, it was significant in the two consecutive seasons. It is obvious from Table (1) that the greatest values from all periods of storage were recorded by warp cut branches of zanthoxylumin foil paper (thepre-eminentwrapper) followed by butter paperin both seasons. In the same line, data from Table (2) showed that, wrapping cut branches of ficus in butter paper was more effective in enhancing the moisture retention ratio during cold storage at 5, 20 and 60 days. This may be attributed to the fact that the cut branches which packed had higher moisture retention and at cold storage had lower metabolic activities as respiration, transpiration and maintained high humidity depend on the types of packaging and the gaseous components will be modified automatically through the respiration process that improving cut foliage.

Water Loss: The data in Tables (3 and 4) explained the importance of using packaging materials and showed their great efficiencyin lowering the water loss in cut foliages in this study. The control treatment (unwrapped cut branches) had high average of water loss compared to the average obtained by packing materials. As can be seen in Table (3) that, wrappingthe cut zanthoxylum branches infoil paper reduced the average of water loss

Table 3: Influence of packaging materials onwater loss(ml.gfw^{-1})andwater uptake(g)of *Zanthoxylum beecheyanum*cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Water loss(ml.gfw^{-})				Water uptake(g)			
	Storage periods				Storage periods			
Packaging materials	St. $_1$	St. $_2$	St. $_3$	Mean	St. $_1$	St. $_2$	St. $_3$	Mean
				First season				
T_0	2.05b	2.39a	2.25ab	2.23A	2.18h	2.01h	2.18h	2.12F
T_1	1.46c-f	1.58cd	1.67c	1.57B	3.52d-f	3.26fg	3.11g	3.30E
T_2	1.11g	1.21e-g	1.54cd	1.29C	4.37c	3.72de	3.66de	3.92C
T_3	1.31d-g	1.13g	1.62cd	1.35C	4.24c	3.35e-g	3.23fg	3.61D
T_4	1.05g	1.09g	1.45c-f	1.20C	5.93a	4.47c	4.32c	4.91A
T_5	1.09g	1.15fg	1.48c-e	1.24C	5.13b	3.81d	3.69de	4.21B
Mean	1.34B	1.43B	1.66A		4.23A	3.44B	3.37B	
				Second season				
T_0	1.99ab	2.22a	2.17a	2.13A	2.07g	1.96g	2.11g	2.05E
T_1	1.16e-g	1.42de	1.78bc	1.45B	3.41d-f	3.11f	3.06f	3.19D
T_2	1.05g	1.15fg	1.50d	1.23CD	4.22c	3.45d-f	3.28ef	3.65C
T_3	1.18e-g	1.18e-g	1.58cd	1.31C	4.11c	3.29ef	3.20ef	3.53C
T_4	1.01g	1.03g	1.40d-f	1.15D	5.50a	4.34c	4.20c	4.68A
T_5	1.02g	1.08g	1.42de	1.17D	4.90b	3.73d	3.56de	4.06B
Mean	1.24C	1.35B	1.64A		4.04A	3.31B	3.24B	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days.

Table 4: Influence of packaging materials onwater loss (ml.gfw^{-})andwater uptake (g)of *Ficus benjamina*cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Water loss(ml.gfw^{-1})				Water uptake(g)			
	Storage periods				Storage periods			
Packaging materials	St. $_1$	St. $_2$	St. $_3$	Mean	St. $_1$	St. $_2$	St. $_3$	Mean
				First season				
T_0	1.77a	1.84a	1.95a	1.85A	2.47h	2.19hi	2.04i	2.23F
T_1	0.90bc	0.89bc	0.95b	0.91B	3.58fg	3.66fg	3.45g	3.56E
T_2	0.65ef	0.67d-f	0.70c-f	0.67C	4.32cd	4.15de	4.04de	4.17C
T_3	0.43g	0.42g	0.50fg	0.45D	5.07ab	5.01b	4.32cd	4.80B
T_4	0.83b-e	0.87b-d	0.92b	0.87B	4.01de	3.88ef	3.35g	3.75D
T_5	0.35g	0.38g	0.49fg	0.41D	5.34a	5.15ab	4.58c	5.02A
Mean	0.82B	0.85AB	0.92A		4.13A	4.01B	3.63C	
				Second season				
T_0	1.70ab	1.66b	1.88a	1.75A	2.03i	2.05i	1.99i	2.02F
T_1	0.88cd	0.84c-e	0.90c	0.87B	3.41gh	3.38gh	3.37gh	3.39E
T_2	0.63f-h	0.66e-g	0.68d-f	0.66C	4.32cd	4.06c-e	3.89d-f	4.09C
T_3	0.42i	0.44hi	0.48g-i	0.45D	4.96ab	4.78b	4.11c-e	4.62B
T_4	0.76c-f	0.78c-f	0.85c-e	0.80B	3.82ef	3.61fg	3.24h	3.56D
T_5	0.30i	0.33i	0.43i	0.35D	5.19a	4.96ab	4.18cd	4.78A
Mean	0.78B	0.79B	0.87A		3.96A	3.81B	3.46C	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

and minimized the rate to 1.20 and 1.15ml.gfw^{-1} with no significant difference with the average that obtained from wrappedcut branches by butter paper which gave 1.24 and 1.17ml.gfw^{-1} compared to control which had 2.23 and 2.13 ml.gfw^{-1} in the first and second seasons, respectively. In the same line, data in Table (4) appeared that wrapping the cut ficus foliage inbutter paper reduced the average of water loss and gave 0.41 and 0.35 with nosignificant difference with the average obtained from wrapping in kraft paper which gave 0.45 and 0.45 in comparison with 1.85 and 1.74 ml.gfw^{-1} from the control in the first and second seasons, respectively.

The obtained results reflected the importance of packing materials to maintain the cut branches and reduce the loss of water under short and long cold storage periods. Dastagiri *et al*. [26] confirmed that using an appropriate packaging of cut flowers for optimum duration offer the protection against water loss and external environmental conditions.

Considering the influence of storage periods on water loss, it turns out thatthe deficiency in water content of cutzanthoxylum and ficusfoliagesgradually increased with increasing the storage durations whereas, storing the cut branches for five days (short duration) gave the lowest average of water loss. On the contrary, storing cut foliages for sixty days (long duration), it had the highest rates of water loss in both seasons. Decreased temperature and increased the relative humidity prevent water loss in cut flowers [27]. In addition, cold storage at low temperature slows down transpirational loss of water and carbohydrates which reduces the loss of weight during storage.

The interaction between storage periods and wrapping materials, Table (3) exhibited that wrapping the harvested cutzanthoxylum foliage in foil paper showed progress in terms of lowering the rate of water loss, it recorded the minimum value compared to control and other treatments at the five, twenty and sixty cold storage periodsin the first and second seasons respectively and treatment by butter paper had a second rank. It can be concluded from Table (4) that, wrapping the cut ficus foliage in butter paper followed by wrapped cut foliages by kraft paper at cold storage for five daysreduced water loss with no significant differencein the two seasons in this study.

Water Uptake: Illustrated data in Table (3) data showed that, cut branches ofzanthoxylumwhich wrapped in foil paper at the different cold storage periods had the greatest amount of water uptake 4.91 and 4.68 compared to control treatment (without packaging) which gave 2.12 and 2.05g with significant differencein the first and second seasons, respectively. The order of efficiency and keep the water content in balance in cut branches that, is the following transactions (after foil paper) was butter paper, news paper, kraft paper and finally cellophane paper. As for the effect of the wrapping materials on the rate of absorption of the cut ficus branches, using the butter paper showed the superiority (5.02 and 4.78g) over the control (2.23 and 2.02g) with significant difference in the first and second seasons, respectively and theconsecutive treatments in enhancing the amount of water uptake were news paper, kraft paper foil paperthen the last one was cellophane paper (Table 4). These findings were supported by those discovered by Patel *et al.* [28] who found that, wrapping spider lily in tissue paper and news paper and stored for 5 days increased the water absorption. Makhwana *et al.* [29] found that, using the butter paper as packing material gave the highest amount of water uptake in rose cv. Passion.

There was obvious different between the amounts of the water uptake meantime at the three cold storage periods in this study. Data mentioned in Table (3) cleared that, the maximum amount of water uptake obtained by cut branches of zanthoxylum whichstored at 5°C for five days is 4.23 and 4.04g while when it stored for sixty days in cold storage recorded 3.37 and 3.24g in the first and second seasons, respectively.Whilstdata presented in Table (4) showed that the water absorption of cut ficus was gradually decreased with increasing periods of cold storage, whears in the first season it were 4.13, 4.01 and 3.63g vs. 3.96, 3.81 and 3.46g in the second one at three periods 5, 20 and 60 days, respectively. These may be attributed to the ability to absorb water decreased with increase in storage duration may be relatied to occlusion of the vessels and the ability of xylem cells to absorb water continuously decreased with the duration of storage increased. The present finding got the support from the findings of Palanikumar and Bhattacharjee [30] found that, prolonged storage periods of cut roses reduced the water uptake. Teixeira [31] who pointed out that, the long duration of dry storage led to decreasing in the water uptake of cut flowers due to the sample flowers response to prolonged chilled storage using passive refrigeration system.

Interaction between the wrapping materials and cold storagedurations had asignificant effect on maintaining the water uptake, it can be seen from Table (3) that the combination of wrap cut branches in foil paper (as bestwrapping material) 5.93 and 5.50g and storing for 5 days as a cold storage period had more efficiency in this concern, it gave a maximum value compared to control treatment (2.18 and 2.07g) in the first and second seasons, respectively. Furthermore data in Table (4) revealed that, wrappingthe cut foliage of ficus inbutter paper was the best packing practice compared with all the rest materials and control through the cold storage for 5, 20 and 60 days, it gave 5.34, 5.15 and 4.58 g in the first season and 5.19, 4.96 and 4.18g in the second one, respectively.

This may be attributed to fact thatwrapping materials createsthe optimum conditions that maintain physiological systems leading to enhanced water uptake during the vaselife after storage [26]. The present finding also got support from other findings of Pranuthi *et al*. [32] who mentioned that, the cut flowers of *Dianthus caryophyllus* packed in polypropylene at 5°C cold storage under wet condition recorded significantly the highest water uptake.

Relative Fresh Weight: The data in Table (5) pointed out thatamongst various packaging materials in the study, utilized the foil paper was more convenient packaging materials for cut foliage of *Zanthoxylum beecheyanum*, it maintainedthe percentage of relative fresh weight during cold storage and increased it after storage periods compared to other treatments and control. It gained 82.09 and 80.26% conversely with control which had 58.40 and 56.89% in the first and second seasons, respectively. Data presented in Table (6) showed that, wrapping the cut foliage of*Ficus benjamina*inbutter paper recorded the maximum percentage of fresh weight thenkraft paper. It gained 76.47 and 74.32%compared to the control which had 45.86 and 44.81% in the first season and second seasons, respectively. This confirms the importance and exigency of using packaging materials during cold storage of cut branches to improve the relative weight after holding them in the solution. These results are in accordance with observation by Baidya and Chakrabarty [33] decided that packaging enhanced fresh weight cut spike of *Polianthestuberosa* throughout the storage periods.

The obtained resultsfrom Tables (5 and 6) impartedthe impact of storage periods on relative fresh weight of cut *Zanthoxylum beecheyanum* and *Ficus benjamina*. The gradual prolonging the storage period had an adverse effectson the relative fresh weight of the cut branches in the two seasons. In cut branches of zanthoxylum, the relative fresh weight percentage recorded 78.27, 74.68 and 62.77%in first season while in the second one it recorded 77.03, 73.32 and 61.17% at three periods of storage 5, 20 and 60 days at 5°C under study (Table 5). Also, the previously mentioned data was parallel with that from cut foliage of ficus in Table (6), it had 70.64 and 69.97% at storage for five days, 68.07 and 65.79% at storage period for twenty days and at sixty days it gave 59.40 and 58.40% in the first and second seasons, respectively.This may be due to carbohydrate depletion and oxidative stress during cold storage that explain the mechanism for the decrease in fresh weight of stored cut branches then rapid senescence. These results proved by Chore *et al.* [24] found that the decrease in fresh weightof *Gladiolus grandiflorus* consequence to the storage duration increased from 4 to 5 days.

Concerning to the interaction effect of packaging materials and cold storage periods, the results in Table (5) revealed that wrappingcut branches ofzanthoxylum in foil papers gave the highest percentage of fresh weight during all cold storage periods. On the other side Table (6) cleared that wrapped cut branchesof ficus by butter paper prior stored for five days in cold storage maintained fresh weight (80.52 and 79.35% in the first and second seasons, respectively) compare to control as gave least percentage (50.29 and 49.78 % in the first and second seasons, respectively). The use of different wrapping materials during storage creates a modified atmosphere which reduces metabolism during storage thereby minimize carbohydrate consumption. This might be based on the verity that wrapping materials decrease the rate of respirationlimits the oxygen and highly carbon dioxide concentrations which reduce the rate of respiration and decrease the loss of stored energy and maintain percentage of fresh weight.

General Appearance: It cleared from data in Table (5) that the values of general appearance increased by all tested packaging materials in the study. The preferable of packaging materials achieved by wrapped cut branches by foil paper (3.66 and 3.67) and butter paper (3.37 and 3.48) as consecutive transactions were the best treatments in improving the quality of cut zanthoxylum compared to the control (1.26 and 1.33) in the first season and second seasons, respectively. In addition data in Table (6) explicated the preferable of packaging materials that used to improve the quality of cut ficus was butter paper (3.29 and 3.15) followed by karft paper (3.26 and 3.00) without significant difference, while control (without any packaging) recorded a minimum value (1.15 and 1.11) in the first season and second seasons, respectively. Dineshbabu *et al.* [34] stated that, packing the spikes of dendrobiumin low-gauge polyfilm recorded the highest values for all postharvest quality parameters. Ahmad *et al*. [35] found that, packaging cut rose improved the quality of flowers. This may be indicates an important fact that effective packaging systemshelps to maintain the turgidity by retaining the moisture apart from lack of photosynthesis led to preserve carbohydrates thereby decreasing the deterioration rate.

Table 5: Influence of packaging materials onrelative fresh weight(%), general appearance andshelf life(days)e of *Zanthoxylum beecheyanum*cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Relative weight(%)				General appearance				Shelf life(days)			
	Storage periods				Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
					First season							
T_0	63.32l	59.52n	52.35p	58.40F	1.22hi	1.44h	1.11i	1.26F	1.22i	1.11i	1.00i	1.11E
T_1	71.39h	68.69j	58.64o	66.24E	1.89g	1.77g	2.00g	1.89E	1.89h	2.00gh	2.11gh	2.00D
T_2	81.35d	78.48e	65.28k	75.03C	3.00d	3.33c	2.67e	3.00C	3.33cd	2.67ef	2.33fg	2.78C
T_3	77.28f	74.46g	61.51m	71.08D	3.33c	2.67e	2.33f	2.78D	2.11gh	2.33fg	2.00gh	2.15D
T_4	91.25a	84.61b	70.40i	82.09A	3.89a	3.89a	3.22cd	3.66A	4.67a	3.67bc	3.00de	3.78A
T_5	85.02b	82.33c	68.47j	78.61B	3.67ab	3.4bc	3.00d	3.37B	4.00b	3.33cd	2.67ef	3.33B
Mean	78.27A	74.68B	62.77C		2.83A	2.75A	2.39B		2.87A	2.52B	2.19C	
					Second season							
T_0	62.32m	58.14o	50.21q	56.89F	1.55f	1.22g	1.22g	1.33F	1.11j	1.00j	1.00j	1.04E
T_1	70.48i	68.10j	57.57p	65.38E	2.15e	1.66f	2.11e	1.97E	1.78i	1.77i	2.00hi	1.85D
T_2	80.44e	77.20f	64.41l	74.02C	3.22bc	3.22bc	3.00c	3.15C	3.00de	2.44fg	2.11g-i	2.52C
T_3	75.15g	72.45h	60.41n	68.34D	3.11bc	2.22de	2.44d	2.59D	2.00hi	2.00hi	1.89i	1.96D
T_4	90.36a	82.30c	68.12j	80.26A	4.00a	3.78a	3.22bc	3.67A	4.33a	3.55bc	2.67ef	3.52A
T_5	83.41b	81.74d	66.27k	77.14B	3.89a	3.33b	3.22bc	3.48B	3.67b	3.22cd	2.33f-h	3.07B
Mean	77.03A	73.32B	61.17C		2.99A	2.57B	2.54B		2.65A	2.33B	2.00C	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

Table 6: Influence of packaging materials onrelative fresh weight(%), general appearance andshelf life(days) of *Ficus benjamina*cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Relative weight(%)				General appearance				Shelf life(days)			
	Storage periods				Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
					First season							
T_0	50.29o	49.04p	38.24q	45.86F	1.33f	1.11f	1.00f	1.15E	1.22h	1.11h	1.00h	1.11E
T_1	69.13hi	64.22l	58.20m	63.85E	2.33c-e	2.22de	2.11de	2.22D	2.22f	2.11f	2.11f	2.15D
T_2	75.35e	71.20f	65.55k	70.70C	3.33a	3.00ab	2.44cd	2.92B	2.89de	2.33f	2.33f	2.52C
T_3	78.30c	76.25d	68.50ij	74.35B	3.33a	3.33a	3.11a	3.26A	3.67b	3.33c	3.00de	3.33B
T_4	70.27g	68.35j	56.35n	64.99D	3.11a	2.67bc	2.00e	2.59C	2.77e	2.44f	1.67g	2.29D
T_5	80.52a	79.37b	69.53h	76.47A	3.44a	3.33a	3.11a	3.29A	4.11a	3.67b	3.11cd	3.63A
Mean	70.64A	68.07B	59.40C		2.81A	2.61B	2.30C		2.81A	2.50B	2.20C	
					Second season							
T_0	49.78n	47.20o	37.44p	44.81F	1.33f	1.00f	1.00f	1.11E	1.00g	1.00g	1.00g	1.00E
T_1	68.59fg	62.34k	57.66l	62.86E	2.22e	2.11e	2.00e	2.11D	2.11e	2.00e	2.00e	2.04D
T_2	74.67cd	69.25f	64.34j	69.42C	3.00a-c	2.67cd	2.33de	2.67B	2.67d	2.33de	2.11e	2.37C
T_3	77.36b	74.39d	67.19h	72.98B	3.11ab	3.00a-c	2.89bc	3.00A	3.55b	3.00c	2.67d	3.07B
T_4	70.07e	66.30i	55.41m	63.93D	3.00a-c	2.33de	2.00e	2.44C	2.55d	2.33de	1.67f	2.18D
T_5	79.35a	75.27c	68.35g	74.32A	3.33a	3.11ab	3.00a-c	3.15A	3.89a	3.33b	3.00c	3.41A
Mean	69.97A	65.79B	58.40C		2.67A	2.37B	2.20C		2.63A	2.33B	2.07C	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

Thepackaging under cold storage is a fundamental tool for post harvest management of highly perishable commodities and adequate packaging protects the produce from physical, physiological and pathological deterioration during transport and marketing by retaining their attractiveness in *Polianthestuberosa* and *Jasminumsambac* [15, 36, 37].

With regarding to influence of cold storage periods, the data from Table (5) showed that, extending storage periods minimize values of general appearance on cut zanthoxylum, it had a negative effect (2.83, 2.75 and 2.39 in the first season and 2.99, 2.57 and 2.54 in the second one, respectively). It is evident from results presented in Table (6) that, the quality of general appearance had been

raised as a result to minimize the duration of stored cut ficus and gave 2.81, 2.61 and 2.30 in first season arranging the storage periods in ascending order. Also, in the second season it was in a smellier trend and recorded 2.67, 2.37 and 2.20 at the three durations of storage. This may be attributed to the role of the microbial damage occurring in the cut branches during storage that seems to be influenced much by long storage periods. Storage of cut flowers at the optimum temperatures and high percentage of relative humidity in the storage conditions, delays senescence and improves the quality of tuberose and *Strelitziareginae* cut flowers [38-40]. Jagadale *et al.* [23] noticed that, spoilage of chrysanthemum cut flowers was increased with increasing their storage. Where as the maximum flower spoilage was noted when stored up to nine days.

Interaction between wrapping materials and the durations of cold storage periods in Table (5) showed that the significantly highest general appearance values resulted from wrapping cut zanthoxylum branches in almost all treatments then stored in three different storage periods except control. Results from Table (6) showed that, wrapping cut ficus in butter paper had a superiority effect on the quality of general appearance at all the storage periods in the study. These findings were supported by those discovered byRashed and Younis [41] who stated that, wrapping *Origanumsyriacum* reduced chilling injury and maintainedthe internal quality even under optimum storage conditions. Dastagiri*et al.* [26] indicated that, stored cut stems of *Ornithogalum thyrsoides* for 12 days significantly reduced their appearance. This explains that flowers stored for longer duration cannot score well for freshness and color as compared to short term stored flowers. Bhuvaneswari and Sangama [42] pointed out that, the stored crossandra flower bulk packaged in polymeric retained freshness colour and marketable.Similar results reported by Waithaka*et al*. [43] on tuberose and Sharma *et al.* [44] on Asiatic lily cv. 'Apeldoorn'.

Shelf Life: As shown in Tables (5 and 6) data showed theimportance of using different packaging materials in this investigation and their effect on the survival period of the cut branches after placing them in the holding solution (citric acid at 0.2g/l +sucrose at 20%). Generally, all the packaging materialsgave a great positive effect and extend the shelf life. Results from Table (5) clarify that, *Zanthoxylum beecheyanum* wrapped in foil paperhad the most effective and enhanced the quality and prolonged the shelf life of cut branches recorded 3.78 and 3.52 days compared to control which recorded 1.11 and 1.04 days in the first and second seasons, respectively. After that, the sort of placing the packaging materials in terms of the highest ability to increase the survival period was as following order: butter paper>news paper>kraft paper > cellophane paper, finally the control treatment was the lowest one. From data averaged in Table (6) it cleared that, packed cut ficus in butter paper was the most accurate and efficient compared to the rest of the packaging materials, as well as control treatments (without packaging). It can be concluded that, the sort of placing the packaging materials in terms of the highest ability to increase the survival period was as follows: butter paper, kraft paper, news paper, foil paper and cellophanepaper and the least one in value was the control treatment, it had the lowest number of days of shelf life in *Ficus benjamina*. This finding was demonstrated before by Sankar and Bhattacharjee [45] who postulated that, the gladiolus spikes cv. Little Prince showed better vase life and quality with wrapping materials. Beside, He *et al.* [7] declared thatall bagging treatments prolonged the vase-life of cut stems of grevillea. Also, Sunanda [46] on cut carnation. Sisodia *et al.* [47] found that, the maximum weight of spike of gladiolus cv. Punjab Dawn stored in cellophane paper followed by brown paper and news paper treatments and control gave reduction in weight of spikes. Packaging materials reduce the amount of production of O_2 and increase the production of CO_2. This mechanism checks the metabolic process led to extending the shelf life.

Concerning the effect of storage periods on the shelf life of cut zanthoxylum branches, it can be seen in Table (5) that, prolonging storage durations ultimately hasan adverse effect on the shelf life. The shelf life of stored cut branches (for 5, 20 and 60 days in cold storage) were 2.87, 2.52 and 2.19 days, while they were 2.65, 2.33 and 2.00 days in the second one. Data shown in Table (6) confirmed that, the cut ficus which stored for short period (five days) gained more days to reaching the deterioration than the other periods. It can be inferred out that short storage duration maximized the benefits from wrapping materials than long one. These results are in agreement with those obtained by Nelofar and Paul [48] cited that, with increasing storage duration the quality and vase life of gladiolus decreased significantly. Similar results were obtained on cut rose Bayleyegn *et al.* [49] and Makhwana *et al.* [29].

The shelf life was influenced by interaction between the packaging materials and storage durations, wrapping cut branches of zanthoxylum in foil paper and stored it for five days gave the highest value of shelf life compared to control and other treatments. Best wrapper after foil paper

was butter paper then news paper (Table 5). Butter paper was the best wrapper for cut branches of ficus as it used in different storage even in short or long periods (Table 6). It can be mentioned that different wrapping materials in this study increased the shelf life of cut foliage under cold storage. The results are in conformity with the findings of Choudhury *et al.* [37] on *Jasminumsambac* and Happy *et al.* [50] on cut spikes *Polianthestuberosa* which were wrapped in butter paper resulted in maximum longevity than newspaper. These may be attributed to wrapped cut branches has higher moisture retention and further storing them at low temperature resulted in lower metabolic activities like respiration, transpiration and maintained high humidity.

Photosynthetic Pigments

Chlorophyll (a), (b) Andcarotenoids: From the presented data in Tables (7 and 8), it can be concluded that, almost all tested packaging materials reduced the degradation of chlorophyll (a), (b) and carotenoids content in the cut branches. Wrapping cut branches of *Zanthoxylum beecheyanum* in butter paper was the superior, it recorded a highest amount of chlorophyll (a), (b) and carotenoids. It recorded 0.64 and 0.61 mg/g f.w asmaximal amounts of chlorophyll (a) compared to 0.36 and 0.35 mg/g f.w obtained from control (without packaging) in both seasons. Moreover, the same treatment gave 0.44 and 0.43 mg/g f.w compared to control which gave 0.27 and 0.26 mg/g f.w chlorophyll (b) in the first and second seasons, respectively. In addition to, the carotenoids contents were in the highest value with the packaging by butter paper (0.25 and 0.23 mg/g f.w) compared tocontrol (0.13 and 0.12 mg/g f.w) in the two seasons. Wrapped cut branches of *Ficus benjamina* by foil paper gave 0.58 compared to 0.29 mg/g f.wfrom control in the first season and 0.58 compared to 0.28 mg/g f.w from control treatment in the second season; these may be attributed to packaging technology which lead to different rates of respiration and thus lead to color changes and loss of green color in cut branches. These results are in accordance with Rashed and Younis [41] who found that, The polypropylene package recorded the highest significant chlorophyll (a) and (b) delayed the degradation of chlorophyll of the herbs.

It was observed in the same Tables that chlorophyll (a), (b)and carotenoids content followed a decreasing trend with increasing the duration of cold storage. The data presented in Table (7) showed that, chlorophyll(a) content recorded a highest amount after stored cut zanthoxylum for 5 days at cold storage 0.57 and 0.54mg /g fw, while stored cut branches for 20 days in cold storage recorded 0.54 and 0.52 mg /g fw. The lowest amount of chlorophyll (a) was obtained by storing cut branches for 60 days cold storage which was 0.49 and 0.47 mg /g f w in the first and second seasons, respectively. On the other side, the data in Table (8) clarified that, stored cut ficus for a short time (5days) recorded the utmost values of chlorophyll (a) in comparison to other long periods of cold storage, it gained 0.49 and 0.48 compared to 0.31 and 0.30 mg /g fw. from control. Furthermore, cut branches stored for 20 days gave 0.47 and 0.46 while control had 0.29 and 0.28 mg /g fw., also long period of storage (60days) had the least amount of chlorophyll (a) and recorded 0.43 and 0.42 compared to control 0.27 and 0.26 mg /g fw. In the same pattern, the results obtained cleared that the amount of chlorophyll (b) and the carotenoids decreased with increasing storage periods. These results were in accordance with observations noticed by Byun *et al*. [51] on *Dianthus caryophyllus*cvs. Desio and Fillandero, they found that the lowest carotenoids content was obrained in the longest storage period. Also, Singh and Kumar [52] on *Phyllanthusemblica* cv. Chakaiya, who found that the chlorophyll content in leaves decreased with increasing the storage period. These may be due to the rapid decline in chlorophyll content form high oxidative damage at long periods of storage. In the matter of interactions effect, wrapped cut branches of *Zanthoxylum beecheyanum* by butter paper and stored for 5 days recorded the highest amount of chlorophyll (a), (b) and the carotenoids content compared to other treatments as well as during the longest storage periods. Wrapped cut branches of *Ficus benjamina* by foil paper was the supreme influence from the rest of the packaging materials in this regard.

Total Sugars: It is obvious from data averaged in Tables (9 and 10) that all tested packaging materials had a best influence in protecting sugars content of cut branches in the two seasons under this study. Wrapping cut branches of *Zanthoxylum beecheyanum* in butter paper scored the highest amount of total sugars contents (4.03 and 4.02 %) in comparison with control (2.36 and 2.32%) in t he first and second season, respectively. On the other hand, *Ficus benjamina* cut branches stored under low temperatures with warped by foil paper had the first rank and gave 3.07 and 2.99% in comparison with 1.85 and 1.83% from cut branches without packaging in both seasons, respectively. The influence of various packaging materials may be due to modified atmosphere by reduction rate of O_2 and raised CO_2 then it reduced the respiration development.

Table 7: Influence of packaging materials on chlorophyll (a), (b) and the carotenoids (mg/g f.w)of *Zanthoxylum beecheyanum*cut branches under three cold storage periods during 2019 and 2020 seasons

	Chlorophyll a				Chlorophyll b				Carotenoids			
	Storage periods				Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
						First season						
T_0	0.41	0.38	0.30	0.36	0.30	0.28	0.24	0.27	0.16	0.13	0.11	0.13
T_1	0.52	0.50	0.45	0.49	0.39	0.35	0.30	0.34	0.19	0.14	0.12	0.15
T_2	0.60	0.59	0.53	0.57	0.45	0.41	0.38	0.41	0.25	0.21	0.20	0.22
T_3	0.64	0.60	0.58	0.60	0.47	0.43	0.39	0.43	0.26	0.24	0.20	0.23
T_4	0.60	0.56	0.51	0.55	0.42	0.40	0.37	0.39	0.21	0.20	0.18	0.19
T_5	0.69	0.63	0.60	0.64	0.49	0.44	0.41	0.44	0.29	0.25	0.21	0.25
Mean	0.57	0.54	0.49		0.42	0.38	0.34		0.22	0.19	0.17	
						Second season						
T_0	0.40	0.37	0.29	0.35	0.30	0.27	0.22	0.26	0.15	0.12	0.10	0.12
T_1	0.50	0.48	0.42	0.46	0.38	0.33	0.30	0.33	0.18	0.14	0.11	0.14
T_2	0.58	0.54	0.50	0.54	0.44	0.40	0.38	0.40	0.24	0.20	0.18	0.20
T_3	0.58	0.59	0.55	0.57	0.46	0.42	0.37	0.41	0.25	0.22	0.20	0.22
T_4	0.57	0.53	0.50	0.53	0.41	0.39	0.35	0.38	0.20	0.19	0.17	0.18
T_5	0.63	0.62	0.59	0.61	0.47	0.43	0.39	0.43	0.28	0.23	0.20	0.23
Mean	0.54	0.52	0.47		0.41	0.37	0.33		0.21	0.18	0.16	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.1): five days. (St.2): twenty days. (St.3): sixty days.

Table 8: Influence of packaging materials on chlorophyll (a), (b) and the carotenoids (mg/g f.w)of *Ficus benjamina* cut branches under three cold storage periods during 2019 and 2020 seasons

	Chlorophyll a				Chlorophyll b				Carotenoids			
	Storage periods				Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
						First season						
T_0	0.31	0.29	0.27	0.29	0.27	0.22	0.20	0.23	0.18	0.14	0.12	0.14
T_1	0.43	0.40	0.39	0.40	0.33	0.30	0.30	0.31	0.24	0.20	0.19	0.21
T_2	0.52	0.50	0.46	0.49	0.38	0.35	0.32	0.35	0.30	0.27	0.25	0.27
T_3	0.50	0.47	0.45	0.47	0.37	0.34	0.38	0.36	0.28	0.26	0.25	0.26
T_4	0.64	0.61	0.50	0.58	0.43	0.41	0.40	0.41	0.32	0.30	0.29	0.30
T_5	0.59	0.57	0.54	0.56	0.40	0.38	0.35	0.37	0.30	0.28	0.26	0.28
Mean	0.49	0.47	0.43		0.36	0.33	0.32		0.27	0.24	0.22	
						Second season						
T_0	0.30	0.28	0.26	0.28	0.25	0.21	0.20	0.22	0.18	0.15	0.12	0.15
T_1	0.40	0.38	0.35	0.37	0.32	0.30	0.29	0.30	0.23	0.20	0.19	0.20
T_2	0.51	0.50	0.47	0.49	0.37	0.35	0.31	0.34	0.30	0.28	0.24	0.27
T_3	0.49	0.46	0.42	0.45	0.36	0.34	0.31	0.33	0.27	0.25	0.22	0.24
T_4	0.63	0.61	0.52	0.58	0.42	0.41	0.40	0.41	0.32	0.30	0.28	0.30
T_5	0.57	0.56	0.52	0.55	0.40	0.37	0.34	0.36	0.31	0.28	0.25	0.28
Mean	0.48	0.46	0.42		0.35	0.33	0.30		0.26	0.24	0.21	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.1): five days. (St.2): twenty days. (St.3): sixty days.

Table 9: Influence of packaging materials on total sugars (%)andtotal phenols (%) of *Zanthoxylum beecheyanum*cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Total sugars (%)				Total phenols (%)			
	Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
				First season				
T_0	2.45	2.34	2.29	2.36	0.28	0.23	0.19	0.23
T_1	3.67	3.59	3.48	3.58	0.30	0.28	0.24	0.27
T_2	3.90	3.82	3.71	3.81	0.39	0.33	0.29	0.33
T_3	3.97	3.91	3.82	3.90	0.42	0.39	0.32	0.37
T_4	3.73	3.68	3.59	3.66	0.34	0.30	0.27	0.30
T_5	4.15	4.00	3.94	4.03	0.48	0.42	0.38	0.42
Mean	3.64	3.55	3.47		0.36	0.32	0.28	
				Second season				
T_0	2.41	2.31	2.25	2.32	0.27	0.22	0.19	0.22
T_1	3.65	3.54	3.46	3.55	0.30	0.27	0.23	0.26
T_2	3.87	3.79	3.68	3.78	0.37	0.32	0.27	0.32
T_3	3.94	3.89	3.80	3.87	0.40	0.37	0.31	0.36
T_4	3.70	3.65	3.58	3.64	0.32	0.30	0.26	0.29
T_5	4.12	4.01	3.93	4.02	0.47	0.40	0.35	0.40
Mean	3.61	3.53	3.45		0.35	0.31	0.26	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

Table 10: Influence of packaging materials on total sugars andtotal phenols (%) of *Ficus benjamina* cut branches under three cold storage periodsduring 2019 and 2020 seasons

	Total sugars (%)				Total phenols(%)			
	Storage periods				Storage periods			
Packaging materials	St. 1	St. 2	St. 3	Mean	St. 1	St. 2	St. 3	Mean
				First season				
T_0	1.93	1.85	1.79	1.85	0.21	0.19	0.18	0.19
T_1	2.00	1.98	1.81	1.93	0.27	0.25	0.23	0.25
T_2	2.99	2.93	2.86	2.92	0.34	0.32	0.30	0.32
T_3	2.91	2.89	2.80	2.86	0.31	0.29	0.26	0.28
T_4	3.14	3.10	2.99	3.07	0.38	0.36	0.32	0.35
T_5	3.11	3.00	2.95	3.02	0.37	0.34	0.32	0.34
Mean	2.68	2.62	2.53		0.31	0.29	0.26	
				Second season				
T_0	1.92	1.83	1.77	1.83	0.20	0.19	0.17	0.18
T_1	2.00	1.97	1.80	1.92	0.26	0.23	0.22	0.23
T_2	2.95	2.90	2.84	2.89	0.33	0.31	0.28	0.30
T_3	2.89	2.84	2.78	2.83	0.31	0.27	0.25	0.27
T_4	3.09	2.98	2.90	2.99	0.37	0.34	0.31	0.34
T_5	3.02	2.93	2.89	2.94	0.36	0.32	0.30	0.32
Mean	2.64	2.57	2.49		0.30	0.27	0.25	

(T_0): control. (T_1):cellophane paper. (T_2):news paper. (T_3):kraft paper. (T_4):foil paper. (T_5):butter paper (St.$_1$): five days. (St.$_2$): twenty days. (St.$_3$): sixty days

Regarding the effect of storage periods on total sugars. Among the storage periods, the short one (5 days at cold storage) occupied the first order, as it gave greater amount of sugars than the other storage periods (20 and 60 days). The content of sugars in *Zanthoxylum beecheyanum* at the different durations of storage were 3.64, 3.55 and 3.47 % in parallel with 3.61, 3.53 and3.45 % in the first and second season, respectively. Besides, the contents of sugars in *Ficus benjamina* showed the same pattern and produced 2.68, 2.62 and 2.53% in the first season and 2.64, 2.57 and 2.49% in the second one for 5, 20 and 60 days cold storage, respectively. The interaction between packaging materials and storage periods showed the arrangement of the best treatments were butter paper,

kraft paper, news paper, foil paper and cellophane paper and the least one was cut branches with no packaging of cut *Zanthoxylum*, while the arrangement of the best treatments in cut ficus were foil paper, butter paper, news paper, kraft paper and cellophane paper and the control in last order in this concern. It has been established thatshort duration of storage for improved the content of sugars as compared with long durations. The results agree with Amin [53] on some cut foliage.

Total Phenols: According to the data presented in Tables (9 and 10), it showed that, the great effect of packaging materials on total phenols of cut branches had been clear. The results showed that the percentage of total phenols content were positively progressive as a result of using different wrapping materials. The considerable percentages of total phenols from cut branches of *Zanthoxylum* that warped by butter paper and had pronounced 0.42 and 0.40 % with great difference from the control which gave 0.23 and 0.22% in the first and second season, respectively. The obtained results from Table (10) pointed out that cut branches of ficusthat warped by foil paper gave 0.35 and 0.34 %compared to control 0.19 and 0.18% from phenols content in both seasons, respectively.

Regarding the effect of storage periods on total phenols content in cut branches, it could be concluded that the highest content obtained by storing cut branches for five days which led to increasing vase life after take out of storage and held in vase solution which cleared the positive effect of suitable period for storage. As, Shahri *et al.* [54] found that, cold storage treatment before transferring to holding solution maintaining soluble proteins and phenols of *Ranunculus asiaticus* cut spikes.

Generally the interaction between the treatments exhibited a pronounced improving effect of the various packaging materials on increasing total phenols content of cut branches.

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