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Influence of Storage Treatments on the Weight Loss and Quality of the Egyptian Garlic (*Allium sativum* L.) under Assiut Conditions

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Abstract:

The experiment was conducted during 2013/2014 and 2014/2015 successive storage seasons. A combination of two local cultivars of garlic namely, Assiut and El-Minia were arranged in a randomized complete block design (CRBD) with 4 replicates. This work aimed to study the effect of storage methods (packaging including storage in news paper and polyethylene bags, Basal stem removing, heat and Edible coating treatments (Agar, Agar+Gellan, Agar+Chitosan, Gellan and Chitosan) on some garlic physical and chemical properties. It could be concluded that garlic physical and chemical properties of stored garlic bulbs significantly influenced by the storage methods. Keeping it in Polyethylene bags gave the highest weight losses while wrapping in newspaper gave the minimum weight losses (%) and empty cloves (%). Protein and flavonoid significantly increased while carbohydrate (%) significantly decreased in comparison to fresh and control treatment as a results of storage treatments.

Keywords: *Polyethylene bags, garlic storage, garlic backing, hydrocolloid coatings, garlic bulb*

Introduction

Garlic (*Allium sativum* L.) belongs to family Alliacease. It is an important bulb crop which represents major ingredient of many food preparations after onion. Garlic is harvested in the Upper Egypt mid April and stored at room temperature to meet consumer demand. In order to keep the quality of garlic, people used to store garlic in different ways. The quality characteristics of garlic which complement the general criteria for U.S. Grade 1 were described by Cantwell (2003). Maintaining garlic in the state of dormancy for long time is considered the important way of the employed technology for storing.

Several treatments (storage system) were investigated to reduce garlic deteriorates after harvest. Moreover, several researchers investigated the effect of various packing types on garlic quality during storage. Bahnasawy and Dabee (2006) reveal that plastic packages recorded the lowest total weight losses (15.30%), while it was 16.96% for the clothe packages under the cold storage system. Conventional food packaging materials is usually effective in terms of backing materials but their non-biodegradability creates serious environmental problems, motivating researches on edible biopolymer films and coatings to at least partially replace synthetic polymers as food packaging materials to decrease respiration rates and moisture loss in fresh fruits and vegetables. Marita *et al.* (2003) concluded that hot water treatments may be useful to peeled garlic processors when raw product has undesirable internal sprout growth, but is otherwise of excellent quality.

Chitosan is a biopolymer, which is the second most abundant polysaccharide on nature after cellulose. It may be employed as packaging, particularly as edible films or coatings, enhancing shelf life of a diversity of food products (Henriette *et al*., 2010). Geraldine *et al*. (2008) found that coating of minimally processed garlic cloves with agar-agar based (1%) coatings incorporated with 0.2% chitosan and 0.2% acetic acid; the coating ensured lower color variation, moisture loss and respiration rate, prolonging shelf life. Nussinovitch and Hershko (1996) using hydrocolloid coatings of Alginate and gellan and carrageenan films extended the shelf-life of garlic. Gellan created stronger and more brittle coatings. Storage of garlic bulbs influences the chemical composition. There is a widespread need to find out a suitable storage method for storing garlic bulbs which can maintain the quality and reduce the losses for long time. Hence, this investigation conducted to find out the effect of different storage methods in reducing storage losses in garlic.

Materials and Methods

The experiment was conducted to assess the storability of garlic bulbs using different storage methods during 2013/2014 and 2014/2015 successive storage seasons. The storage study was conducted at the Vegetables Department, Faculty of Agriculture, Assiut, Egypt. Two local cultivars of garlic were collected directly from the farmers in different location (El-Mandra, Assiut, Egypt and Nazlet Mahmud, El-Minia, Egypt). Bulbs of cultivars of garlic namely, Assiut and El-Minia were procured after harvesting in the mid of April of each season. Garlic bulb roots were shorted to 4-6 cm long from the bulb basal stem and cured in natural condition. After the curing of the harvested garlic bulbs a suitable bulb was selected for the study. All chemical analysis were carried out at Food Science & Technology Department laboratories, Faculty of Agriculture, Assiut, Egypt.

All storage treatments included the following main treatments:

1- Packaging treatments included storage in News Paper and polyethylene bags.

2- Basal stem removing.

3- Sprout control treatments: Cured garlic bulbs were submerged in circulating water at a temperature of 60 degrees Celsius for five minutes and left to draying in room temperature for 24 hour.

4- Edible coating treatments included Garlic bulbs were immersed in (Agar, Agar+Gellan, Agar+Chitosan, Gellan and Chitosan) solutions.

Edible Coating Solution preparation:

1-Agar Solution: Agar coating solutions (1 g/100mL) were prepared by dissolving Agar powder in distilled water. The solutions were equilibrated at 90°C and stirred vigorously with a magnetic stirrer bar for 30 min on a hotplate. The solutions were cooled to room temperature.

2- Gellan Solution: Gellan coating solutions (0.5 g/100mL) were prepared by slowly dissolving gellan powder in distilled water. The solutions were equilibrated at 70°C and stirred vigorously with a magnetic stirrer bar for 40 min on a hotplate. The solutions were cooled to room temperature.

3- Chitosan Solution: Chitosan solution made by dissolving 10 g chitosan powder into 1 liter distilled water containing 1% glacial acetic acid and stirred with a magnetic stirrer bar for 1 hr.

4- Agar + Chitosan Solution: Edible coating solutions were elaborated from a base solution of agar at 1% (w/v) and incorporated with 0.2% of chitosan which were prepared from (1% chitosan and 1% glacial acetic acid distilled water). The solution stirred until complete dissolution of the components.

5- Agar+ Gellan Solution: Edible coating solution prepared by dissolving mix of 2.5 g of gellan powder and 5 gm agar powder into 1 liter distilled water. The solutions were heated at 90°C and stirred with a magnetic stirrer bar for 30 min on a hotplate. The solution was cooled to room temperature.

The storage experiment was designed with 10 storage treatments and 2 cultivars in a randomized complete block design (CRBD) with 4 replicates. The treatments are presented as follows:

1. Control treatment (samples without storage treatment).
2. Cured garlic plant kept in Polyethylene bags.
3. Cured garlic plant wrapped up in News Paper.
4. Removing bulbs basal stem (RBS)
5. Bulbs were submerged in water bath at 60°C for 5 minutes (heat)
6. Bulbs were submerged in Agar Solution.
7. Bulbs were submerged in Agar+ Gellan Solution.
8. Bulbs were submerged in Agar+ Chitosan Solution.
9. Bulbs were submerged in Gellan Solution.
10. Bulbs were submerged in Chitosan Solution.

All treatments replicated four times (about 500 g each) and stored according each storage treatments. Garlic samples were taken randomly from different treatments every month for the determination of weight loss using the following formula:-

Weight loss (%) = Initial weight – Net weight at specific time/ Initial weight

At the end of storage period, cloves empty and bulb firmnesses (using pentameter) were determined. The samples were taken twice for chemical analysis once in the middle of the season and the other at the end of the storage season. Fresh garlic before storage and after curing was added to the analysis to compare it with storage treatments. Also, chemical analysis for composition of the garlic was carried out before storage period. Garlic cloves were dried in oven (50°C) and grind to a fine powder using grinder. According to AOAC (2000) methods, cured protein, ash and total carbohydrate Hedge and Hofreiter (1962) and flavonoid were determined according to Marinova *et al.* (2005).

Statistical analysis

All data were analyzed using the analysis of variance (ANOVA) and performed to compare mean values of different storage and control samples. The LSD test was applied to determinate differences among means at a

5% significance level. Gomez and Gomez (1984).

Results and Discussion

Results of this investigation focused firstly on the impact of several storage treatments on physical properties including the weight losses (%) of garlic plant, firmnesses and the empty cloves (%), secondly on the chemical composition of dried garlic bulbs stored for 11 months.

1. Physical properties

1.1 Total weight loss (%)

Figure (1) and (2) show the total weight loss (%) of the garlic during storage as affected by different types of storage methods in two storage seasons. Concerning the effect of package type, the highest value of the total weight loss of the garlic (34.46% and 36.37%) for Assiut and El-Minia cultivars were recorded by the garlic bulbs stored in polyethylene bags in 1st season (2013 /2014). This may be explained under the bases that the condensation of moisture in this type of bags which encourage fungus spores germination, infection and further development during storage. El-Marzoky and Shaban (2013) reported that the highest significant losses were recorded in inoculated bulbs with *B. allii* and placed in non-perforated polyethylene bags (90.7%).

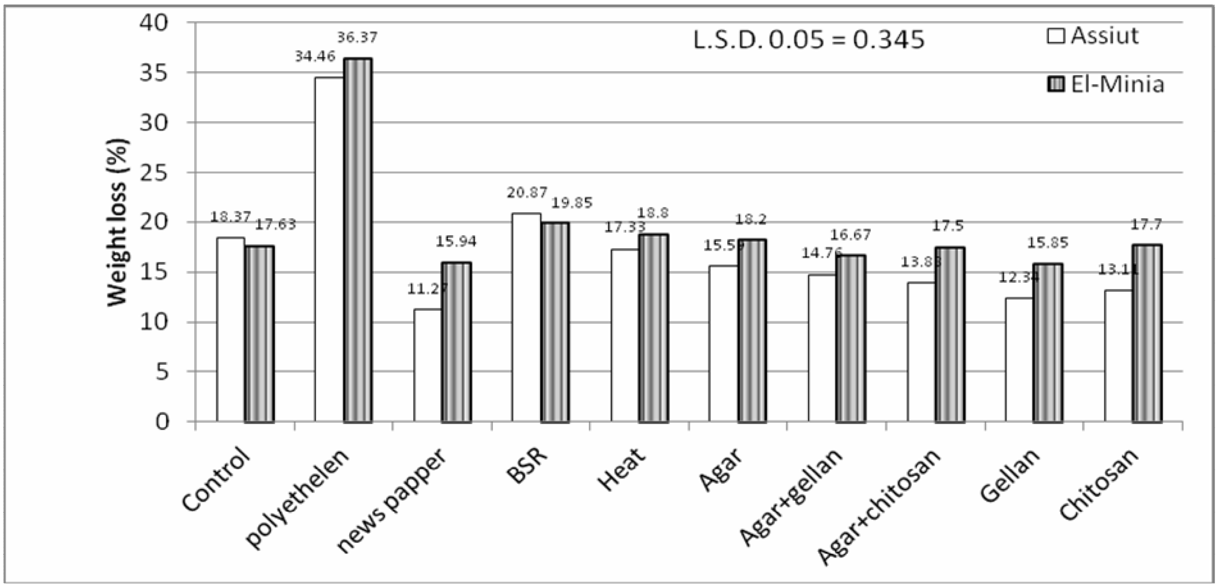

Fig.(1) Effect of storage treatments on weight losses (%) and cultivars in the 1st storage season (2013/2014).

The lowest weight loss values (11.27% and 15.94%) and (14.53 and 15.21%) were recorded for garlic cultivars (Assiut and El-Minia) stored in newspaper in both storage seasons, respectively. The statistical analysis showed highly significant differences in the total weight losses due to the different treatment of storage. The lowest value of weight losses of cured garlic plant wrapped up in newspaper may be due to the regulation of oxygen transport, carbon dioxide, moisture and, also, reduces the loss of flavor and aroma (Miller and Krochta, 1997).

In relation to the treatment of basal stem removing and sprout control treatments T4(BSR) and T5 (heat), the highest losses (20.87 and 19.85%) for Assiut and El-Minia cultivars were recorded by the garlic bulbs stored at BSR treatment (T4), while it was 17.33 and 18.8% when stored at (T5), in the 1st storage season. The statistical analysis showed highly significant differences between both T4 and T5. Weight losses in Assiut cv. under heat storage treatment was significantly decreased by 5.44% compared to the control. Figure (1) shows clearly that result of weight losses of Assiut cultivar. In the 1st storage season was significantly decreased comparing with El-Minia cv. under all coating treatments, while this trend (difference between two cv.) was insignificantly in the 2nd storage season. Heat treatments has beneficial effects that may be occur through changes in physiological processes (Lurie S. 1998), or by killing of critical insect contaminations, and by controlling the onset of fungal decay (Schirra *et al*., 2000).

In edible coating treatment gellan coating (T9) in the 1st storage season (2013/2014) gave minimum weight losses in garlic bulbs of Assiut cv. (12.34%) and (15.85%) for El-Minia cv.

The obtained results in the 2nd storage season (2013/2014) emphases the results in the 1st storage season. The lowest values (14.53 and 15.21%) were recorded for garlic cultivars Assiut and El-Minia stored in newspaper in 2nd season, respectively. Figure (2) show that T2 gave the highest value and T3 gave the minimum value. All storage treatments take the same trend as demonstrated in the 1st season.

Moreover, the second storage season in Figure (2) shows the minimum weight losses value of Assiut cv. (15.26%) due to gellan coating garlic bulbs stored treatment in (T9), while it was 15.99% for El-Minia cv. by gellan coating garlic bulbs stored treatment in (T9). The weight losses due to coating of garlic bulbs may be due to the reduction in clove respiration and Water vapor transmission; coating ensured lower color variation, moisture loss and respiration rate, prolonging shelf life. In this context as reported by Geraldine *et al.* (2008) significant reduction ($p < 0.05$) in clove respiration. Water vapor transmission was lower for the films added with chitosan due to coating garlic bulbs with agar-agar based (1%) incorporated with 0.2% chitosan and 0.2% acetic acid. Henriette *et al.* (2010) reported that Chitosan forms clean, tough and flexible films with good oxygen barrier, which may be employed as packaging, particularly as edible films or coatings, enhancing shelf life of a diversity of food products.

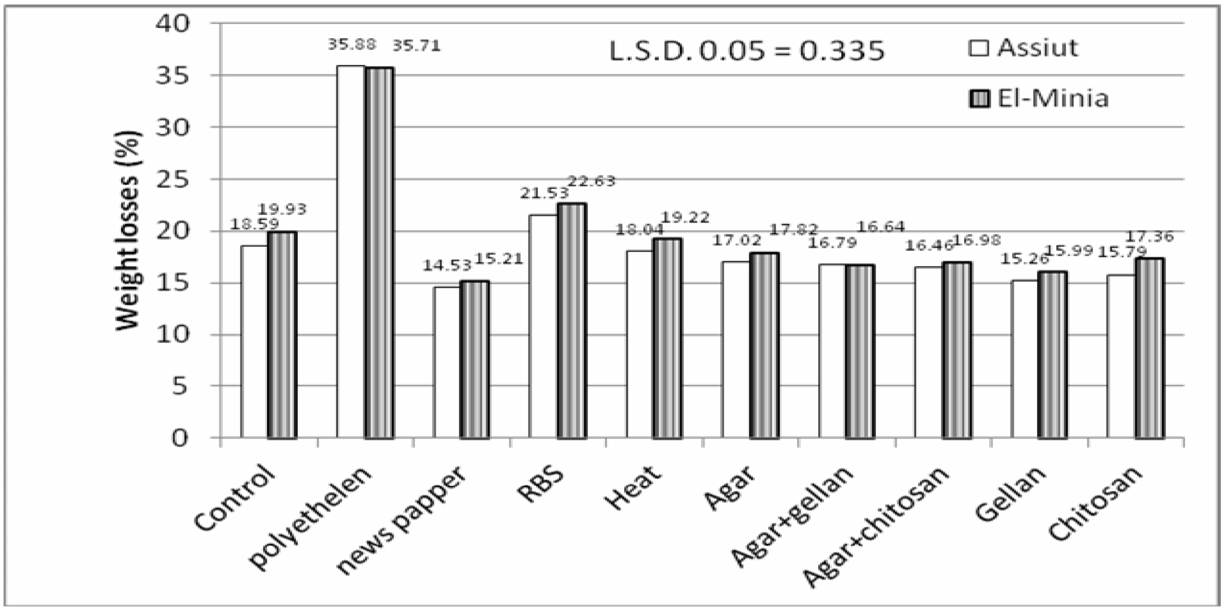

Fig.(2) Effect of storage treatments on weight losses% and cultivars in the 2nd storage season (2014/2015).

Generally, minimum weight losses in garlic bulbs due to storage methods was obtaiend in warapping in news paper as one of packing types and in gellan coating as on of edible coatin treatments.

1.2. Empty cloves % and firmness

Concerning the effect of storage treatments on empty cloves, Table (1) clearly shows that T4 gave the highest value of empty cloves (34.9% and 43.5%) while, T3 gave the minimum values (18.0 and 22.7%) in the 1st and 2nd season compared to the control T1, respectively. These results could be attributed to number of factors namely decay, injuries, pests, weight loss and sprout Bahnasawy and Dabee (2006).

Polyethylene packing storage treatment in (T2) as well as, hot water dips (T5) had no effect on firmness as reported by Cantwell *et al.* (2003). In addition, El-Minia cv. surpassed Assiut cv. in empty cloves. Interaction effects reveal that El-Minia cv. treated with T4 gave the highest empty cloves. While Assiut cv. treated with T3 gave the minimum values of empty cloves. Edible coatings have the potential to reduce moisture loss and firmness loss reported by Li and Barth (1998).

Table 1. Effect of storage treatments on empty cloves and firmness of Assiut and El-Minia cultivars in two storage seasons.

Tre.	Empty cloves %						Firmnesses					
	1st season			2 nd season			1st season			2 nd season		
	V_1	V_2	M.	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M.
T1	18.5	34.2	26.4	32.7	37.0	34.8	3.27	2.16	2.72	3.90	3.66	3.78
T2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
T3	10.9	25.2	18.0	16.7	28.8	22.7	3.28	2.68	2.98	4.00	4.61	4.30
T4	30.1	39.8	34.9	42.8	44.1	43.5	1.92	2.05	1.99	2.75	3.05	2.90
T5	18.4	33.5	25.9	29.4	36.2	32.8	3.19	2.83	3.01	3.62	4.66	4.14
T6	18.2	28.6	23.4	28.8	35.0	31.9	3.82	2.87	3.34	4.50	4.69	4.59
T7	16.1	25.9	21.0	27.2	30.2	28.7	4.00	3.62	3.81	4.62	5.27	4.95
T8	12.7	26.5	19.6	21.4	32.1	26.7	3.71	3.38	3.55	4.25	5.26	4.75
T9	11.5	25.6	18.6	19.5	28.9	24.2	3.42	3.16	3.29	4.07	4.77	4.42
T10	12.6	28.3	20.4	21.1	32.8	27.0	2.59	2.61	2.60	3.08	4.52	3.80
Mean	14.9	26.8		23.9	30.5		2.92	2.54		3.48	4.05	

Tre. = Storage treatment V_1 =Assuit V_2 =El-Minia M =Mean

F-test (Cv.)	**	**	**	**
L.S.D. 0.05 B (Tre.) =	0.727	1.68	0.46	0.37
L.S.D. 0.05 AB (Tre.) =	1.02	2.37	0.65	n.s

Results in Table (1) show that firmnesses were affected by storage treatments. Mean value of all treatments significantly increased firmnesses compared to the control except T2. The highest value was obtained as a result of T7 storage treatment. While, T4 gave the minimum value of garlic firmnesses compared to the control.

In conclusion, the results of the physical properties under the study revealed the responses of garlic to storage methods throughout the storage period was significantly different ($p<0.05$) for Assiut and El-Minia cultivars. This responsibility could be as result of genetic quality of this particular cultivar of the garlic cultivars.

2. Chemical properties

Table 2. Effect of storage treatments on ash percent of Assiut and El-Minia cultivars in two storage seasons.

Tre.	1st season						2nd season					
	Mid			End			Mid			End		
	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M
Fresh	3.14	3.73	3.43	3.14	3.73	3.43	3.78	3.94	3.86	3.78	3.94	3.86
T1	4.58	5.52	5.05	5.92	6.11	6.01	6.04	5.60	5.82	7.45	6.41	6.93
T2	4.40	6.20	5.30	0.00	0.00	0.00	3.97	6.82	5.40	0.00	0.00	0.00
T3	4.43	5.39	4.91	5.15	5.97	5.56	4.13	5.38	4.75	6.87	6.34	6.60
T4	4.70	5.60	5.15	5.19	6.28	5.73	4.47	5.72	5.09	7.12	6.48	6.80
T5	4.92	6.12	5.52	5.52	7.56	6.54	5.57	6.30	5.93	7.16	7.41	7.28
T6	4.79	5.89	5.34	5.31	6.50	5.91	4.65	6.01	5.33	7.14	6.80	6.97
T7	4.88	5.85	5.36	5.45	6.29	5.87	4.83	5.76	5.29	7.15	6.53	6.84
T8	4.08	6.08	5.08	4.65	6.76	5.70	3.83	6.28	5.06	6.49	6.97	6.73
T9	4.677	4.197	4.43	5.17	5.51	5.34	4.24	4.33	4.29	7.05	6.30	6.68
T10	4.32	5.51	4.92	4.70	6.27	5.48	3.85	5.72	4.78	6.86	6.44	6.65
Mean	4.44	5.46		4.56	5.54		4.49	5.62		6.10	5.78	

Tre. = Storage treatment V_1 =Assuit V_2 =El-Minia M =Mean

F-test (Cv.)	**	**	**	**
L.S.D. 0.05 B (Tre) =	0.219	0.208	0.166	0.164
L.S.D. 0.05 AB (Tre.) =	0.310	0.295	0.235	0.232

2.1. Ash %

Table (2) shows the effect of storage treatments on the chemical composition of Assiut and El-Minia cultivars of garlic after storage including Ash (%). Concerning the effect of cultivars on the Ash (%), results reveal that the mean value of Ash percent of El-Minia cv. surpassed Assiut Cv. This is true under 1st, 2nd season. The mean values of Ash percent due to storage treatments increased with increasing storage period. T2 proved that polyethylene packing could not continue until the 2nd season. This is true each storage season. These results may be attributed to increasing the depletion process during the storage period of garlic plant as reported by Nasrin *et al.* (2008).

In addition to that, T6 gave the highest mean value of Ash% in each season and year. In the same time, the highest mean values of Ash% as a result of storage treatment (T6) were significantly increased compared to the fresh and even the control in each season. The increase were 61.8, 91.2 and 55.3 and 92.1% for Assiut and El-Minia cultivars over fresh treatments in the 1st season, while the increase were (7.8, 8.3%) and (1.7, 5.8 %) for both cultivars over the control treatment respectively.

Interaction effects of variety and treatments on Ash% reveal that the highest Ash% value (6.2%) was obtained due to T2 for El-Minia cv. (Table 2) 7.5 % due to T6 for El-Minia cv. 6.8% due to T2 for El-Minia and 7.4% due to T1 for Assiut in the middle and end of the 1st and 2nd season respectively. Similar results were reported by (Sipahioglu and Barringer 2003).

2.2 Protein percent

The results revealed that the mean value of protein % was affected by all storage treatments except T2 in the end season of both storage seasons. (Table 3). Meanwhile, all mean values of protein significantly increased in comparison to fresh treatment and even control treatment in each season. This increase could be apparent due to the high percentage of moisture loss during storage (Maalekuu *et al*. 2004). Results of the interaction effects of cv. and storage treatment show that the highest value was obtained due to Assiut cv. under the storage treatment T7.

Table 3. Effect of storage treatments on Protein percent of Assiut and El- Minia cultivars in two storage seasons.

Tre.	1st season						2nd season					
	Mid			End			Mid			End		
	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M
Fresh	18.4	20.6	19.5	18.4	20.6	19.5	20.3	21.5	20.9	20.3	21.5	20.9
T1	20.3	23.2	21.7	29.5	35.9	32.7	22.3	24.2	23.3	30.0	38.6	34.3
T2	28.3	25.4	26.8	0.00	0.00	0.00	30.2	26.8	28.5	0.00	0.00	0.00
T3	24.9	25.2	25.0	32.5	37.8	35.1	26.8	26.7	26.8	33.3	39.5	36.4
T4	25.8	22.5	24.1	36.5	34.6	35.5	28.0	23.2	25.6	37.1	35.1	36.1
T5	25.3	27.3	26.3	33.3	38.2	35.8	27.0	28.8	27.9	34.0	39.5	36.8
T6	25.6	22.8	24.2	35.1	35.4	35.2	27.4	23.5	25.4	36.0	36.4	36.2
T7	28.4	22.1	25.2	39.5	34.1	36.8	30.5	23.1	26.8	40.3	29.5	34.9
T8	25.8	28.1	27.0	36.3	39.3	37.8	27.5	28.9	28.2	37.1	41.5	39.3
T9	27.9	24.4	26.2	38.7	37.1	37.9	29.1	25.2	27.2	39.7	39.3	39.5
T10	25.9	22.6	24.2	38.6	34.7	36.6	29.1	23.4	26.3	39.1	35.5	37.3
Mean	25.19	24.06		30.80	31.64		27.17	25.08		31.5	32.4	

Tre. = Storage treatment V_1 =Assuit V_2 =El-Minia M =Mean

F-test (Cv.)	**	**	**	**
L.S.D. 0.05 B (Tre.) =	0.226	0.272	0.154	0.235
L.S.D. 0.05 AB (Tre.)	0.319	0.385	0.218	0.332

2.3. Flavonoid (mg catechin/100g)

The results in Table (4) revealed that the mean value of flavonoid was significantly affected by all storage treatments except T2 (polyethylene treatment) in the end season of both storage seasons. Meanwhile, all mean values of flavonoid significantly increased compared to fresh treatment. In comparison to control treatment, the highest and minimum mean value of flavonoid % in 1st and 2nd seasons (6.1 and 4.3%) for mid season, (9.3 and 6.7) for end season of 1st storage season and (6.6 and 4.6%) for mid season and 10.2 and 6.9%) for end of the 2nd season. These results confirmed by Ver'ssimo *et al.,* (2010) who reported that antioxidant activity and total phenolic contents increased over the storage time.

Table 4. Effect of storage treatments on flavonoid (mg catechin /100g) of Assiut and El-Minia cultivars in two storage seasons.

Tre.	1st season						2nd season					
	Mid			End			Mid			End		
	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M
Fresh	4.24	4.10	4.17	4.24	4.10	4.17	3.99	4.71	4.35	3.99	4.71	4.35
T1	4.90	6.80	5.85	7.57	8.37	7.97	5.23	7.57	6.40	7.47	11.66	9.56
T2	4.52	4.15	4.33	0.00	0.00	0.00	4.09	5.15	4.62	0.00	0.00	0.00
T3	5.90	4.76	5.33	11.94	6.44	9.19	6.22	5.57	5.89	10.1	7.06	8.59
T4	5.89	6.31	6.10	10.65	8.10	9.38	6.02	7.18	6.60	9.85	10.20	10.02
T5	4.66	4.75	4.71	7.54	6.23	6.89	4.52	5.18	4.85	6.99	6.97	6.98
T6	5.28	6.18	5.73	8.37	8.04	8.20	5.71	7.13	6.42	8.52	9.40	8.96
T7	5.46	5.50	5.48	10.13	7.90	9.01	5.90	6.52	6.21	9.47	8.94	9.20
T8	5.14	4.82	4.98	7.90	6.54	7.22	5.28	5.63	5.45	7.56	7.47	7.52
T9	5.23	5.62	5.43	8.11	7.98	8.04	5.28	6.77	6.02	8.32	9.01	8.67
T10	4.66	5.33	4.99	6.89	6.66	6.78	4.47	5.83	5.15	5.61	8.723	7.168
Mean	5.08	5.30		7.57	6.40		5.15	6.11		7.08	7.65	

Tre. = Storage treatment V_1 =Assuit V_2 =El-Minia M =Mean

	1st season Mid	1st season End	2nd season Mid	2nd season End
F-test (Cv.)	**	**	**	**
L.S.D. 0.05 B (Tre.):=	0.218	0.520	0.285	0.364
L.S.D. 0.05 AB (Tre.):=	0.309	0.735	0.403	0.515

2.4. Carbohydrate percent

The results in Table (5) revealed that the mean value of carbohydrate % was affected by all storage treatments except T2 in the end season of both storage seasons. Meanwhile, all mean values of carbohydrate% significantly decreased in comparison to fresh treatment and even control treatment in each season. Carbohydrate decreases during storage due to conversion of starch to sugar and respiratory losses and sprouting reported by Sahore *et al.* (2007).

Results of the interaction effects of cv. and storage treatment show that the highest values was obtained from fresh treatment due to El-Minia cv. compared to all storage treatments under the study.

Table 5. Effect of storage treatments on carbohydrate percent of Assiut and El-Minia cultivars in two storage seasons.

Tre.	1st season						2nd season					
	Mid			End			Mid			End		
	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M	V_1	V_2	M
Fresh	34.9	37.4	36.1	34.9	37.4	36.1	36.0	38.2	37.1	36.0	38.2	37.1
T1	23.9	31.2	27.5	19.7	25.4	22.6	31.5	31.9	31.7	22.7	28.3	25.5
T2	25.3	31.2	28.3	0.00	0.01	0.00	31.7	32.2	32.0	0.00	0.00	0.00
T3	30.7	33.0	31.8	25.6	27.8	26.7	34.1	34.2	34.1	25.8	30.3	28.0
T4	25.9	31.9	28.9	20.6	27.7	24.2	32.5	33.2	32.9	23.0	28.8	25.9
T5	27.4	32.5	30.0	21.6	27.8	24.7	32.5	33.5	33.0	23.3	29.3	26.3
T6	28.3	31.8	30.1	22.2	26.4	24.3	33.0	32.6	٣٢.٨	24.9	28.8	26.9
T7	33.1	28.1	30.6	26.7	22.5	24.6	35.2	31.8	٣٣.٥	25.8	23.7	24.8
T8	29.7	34.3	32.0	22.3	29.4	25.9	33.2	35.3	34.2	25.0	31.8	28.4
T9	33.6	33.6	33.6	28.9	27.9	28.4	35.1	34.4	34.8	29.3	31.6	30.5
T10	27.6	31.8	29.7	21.9	26.0	24.0	32.9	32.4	32.6	24.9	28.5	26.7
Mean	29.1	32.4		22.2	25.3		33.4	33.6	23.7	27.2		

Tre. =Storage treatment V_1 =Assuit V_2 =El-Minia M =Mean

F-test (Cv.)	**	**	n.s	**
L.S.D. 0.05 B (Tre.):=	0.299	0.557	0.522	0.392
L.S.D. 0.05 AB (Tre.):=	0.423	0.787	0.738	0.554

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تاثير ظروف التخزين على فقد الوزن والجوده للثوم المصرى تحت ظروف أسيوط

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الملخص

أجريت هذه التجربه فى قسم الخضر وقسم علوم تكنولوجيا الأغذيه بكلية الزراعه – جامعة أسيوط خلال فترتى التخزين ٢٠١٤/٢٠١٣ و ٢٠١٥/٢٠١٤ ، تم توفير صنفين من الأصناف المحليه من الثوم وهما صنفى أسيوط والمنيا و تم وضع معاملات التخزين فى تصميم قطاعات كاملة العشوائيه (CRBD) مع أربع مكررات.

يهدف هذا البحث إلى دراسة تأثير أساليب التخزين (يشمل التخزين التعبئه والتغليف فى ورق الجرائد وأكياس البولى إيثلين، وازالة الساق القرصيه والمعامله الحراريه والتغطيه بمواد (أجار، جيلان، شيتوسان، أجار وشيتوسان ،أجار وجيلان) على بعض الخواص الفيزيائيه والكميائيه.

أوضحت النتائج أن الخصائص الفيزيائيه والكميائيه لنباتات الثوم المخزنه تأثرت بشكل كبير بطرق التخزين المختلفه ، حيث أظهرت النتائج أن طريقة التخزين فى أكياس البولى اثلين أعطت أعلى نسبة فقد فى الوزن ، بينما أعطت طريقة التخزين بلف نباتات الثوم بورق الجرائد أقل نسبة فقد فى الوزن.

أظهر التحليل الكيميائى أرتفاع نسبة البروتين ، الفلاوفونيد بشكل ملحوظ فى حين أن الكربوهيدرات انخفضت بشكل كبير مقارنه بالعينات الطازجه والكنترول وذلك نتيجة لمعاملات التخزين.