

Role of pomegranate peel extract and calcium treatments on the storage ability of broad beans (*Vicia faba* L.)

Abstract

After harvesting the crop of broad beans grown in one of the orchards in Al-Harthah region, Basrah, Iraq for the agricultural season 2023-2024, the pods were separated to obtain the seeds by removing the pod, then the seeds were divided into three parts. A part of the seeds was treated by dipping in pomegranate peel extract at a concentration of 3 ml l⁻¹ for 5 minutes. The second part of seeds was dipped in calcium at a concentration of 2 ml l⁻¹ for 5 minutes. The last part was dipped in distilled water only for 5 minutes. After the seeds dried, they were packed in perforated polyethylene bags (8 holes of 5 mm diameter) with an amount of 1 kg per bag and stored at a temperature of 4 °C for two weeks. The experiment was carried out as factorial experiment consisting of two factors, using Complete Randomize Design (CRD) with 3 replicates. The results showed that 2 ml l⁻¹ calcium treatment was the best in reducing the weight loss of seeds and recording the highest percentage of total soluble solids and protein, while the treatment of pomegranate peel extract was superior to the rest treatments in recording the highest vitamin C. The results also showed that the two mentioned treatments did not record any significant decay after two weeks of storage compared to the control treatment. The weight loss of seeds, the percentage of decay, and the total soluble solids increased with increasing storage period, while the protein percentage and vitamin C concentration decrease with increasing storage period.

Keywords: bean seeds, pomegranate peel extract, calcium, weight loss, vitamin C

I. INTRODUCTION

Vicia faba L. is one of the important winter vegetable crops belonging to the fabaceae family, which is grown for its pods or fresh or dry seeds. It is considered the fourth most important leguminous crop in the world, as it occupies an important place among food security crops in a number of countries. This importance comes as a result of a high protein content of seeds, estimated at 8.4 gm per 100 gm of seeds (Winch, 2006). In addition to being a source of energy and containing a good percentage of crude fiber ranging between 5-8.5%, this has made the crop one of the most important low-cost food sources, especially in poor people, as an alternative to expensive animal proteins. The importance of

Comment [Ma1]: 1. This manuscript needs English grammar revision.
2. The manuscript needs Abbreviations.
3. Some methods need references.
4. Delete the older references than 2010, and cite to newer.
5. The results need to more scientific statistical analysis.
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Comment [Ma2]: The abstract didn't describe the manuscript well. So, please, rewrite this section with the main points of the manuscript; background and aim, methods, results, discussion, and conclusion without writing these topics.

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Comment [Ma4]: In a few words, write a paragraph about by-products and the possibility of utilization in many products. Please, read and cite to this manuscript "(El-Hadary et al., 2022)" El-Hadary, A.R.E., Sulieman, A.M., & El-Shorbagy, G.A. (2022). Comparative the antioxidants characteristics of orange and potato peels extract under differences in pressure and conventional extractions. Carpathian Journal of Food Science and Technology, 14(1): 162-177. <https://doi.org/10.34302/crpfst/2022.14.1.13>

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beans is also due to their ability to improve soil properties through their contribution to fixing atmospheric nitrogen through the root nodule bacteria *Rhizobium leguminosarum* (Igwil, 1982).

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The modern trend in agriculture is to move away from the use of chemical fertilizers, chemical growth regulators, and pesticides due to their toxic effect on human and animal life. Therefore, researchers in agriculture have turned to finding safer materials, such as the use of plant and herbal extracts (Taainet al., 2017; Taain and Salman, 2018). Polyphenols constitute the most part of components of pomegranate peels, which include flavonoids (flavonols, flavanols, and anthocyanins), condensed tannins, proanthocyanidins, and biodegradable tannins, ellagitannins, and gallotannins (Dahhamet al., 2010). Calcium salts are used to increase the hardness of fruits and to treat many physiological disorders to fruits and resistance to damage, because calcium is involved in the construction of the middle lamina of the cell wall and plays an important role in activating many enzymes, and therefore treatment with calcium salts plays a major role, especially in the postharvest physiology of fruits (Taain and Hamza, 2019). The present study aims to improve the storage ability of beans after treating them before storage with pomegranate peel extract and calcium.

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II. MATERIALS AND METHODS

After harvesting the crop of beans grown in one of the orchards in the Hartha region for the agricultural season 2023-2024, the pods were separated to obtain the seeds by removing the pod, then the seeds were divided into three parts. A part of the seeds was treated by dipping them in pomegranate peel extract at a concentration of 3 mL⁻¹ for 5 minutes. The second part of seeds was dipped in calcium at a concentration of 2 mL⁻¹ for 5 minutes. The last part was dipped in distilled water only for 5 minutes. After these seeds dried, they were packed in perforated polyethylene bags with an amount of 1 kg per bag and stored at a temperature of 4 °C for two weeks. Tests were conducted on these seeds before storage and during the storage period as the decay and weight loss of seeds were calculated as percentages, Vitamin C (mg / 100 g) determined according to A.O.A.C. (1992). Total soluble solids determined by using hand refractometer and the results were corrected to 20 °C.

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The experiment was carried out as factorial experiment consisting of two factors, using Complete Randomize Design (CRD) with 3 replicates. The mean differences were compared using the least significant difference (L.S.D) test at the probability level of 0.05 (Al-Rawi and Khalfallah, 1980).

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El-Hadary A.R.E., Sulieman A.M., & El-Shorbagy G.A. (2023). Comparative effects of hibiscus leaves and potato peel extracts on characteristics of fermented orange juice. Journal of Food Quality and Hazards Control. 10: 39-50.
<https://doi.org/10.18502/jfqhc.10.1.11988>

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I. RESULTS AND DISCUSSIONS

1. Weight loss (%)

Table 1 showed the effect of treatment with pomegranate peel extract, calcium, storage period, and their interaction on the weight loss (%) of broad bean seeds stored at 4 °C. It is noted from the table 1, that the treatment with 2 mL⁻¹ calcium is superior to the rest treatments in reducing the weight loss of seeds stored at 4 °C that recorded 0.68%, followed by the treatment with pomegranate peel extract at the concentration of 3 mL⁻¹, which recorded 0.89%. The highest

percentage of weight loss was in the control treatment (distilled water only), which gave 2.23% after two weeks of storage.

The water content of fruits is one of the most important factors affecting the fruit quality during storage because the loss of water leads to reduce the turgor pressure of fruit tissues and wilting of fruits. Weight loss of fruits takes place as a result of the loss of stored food caused by vital processes especially respiration rate or as a result of the loss of water content due to an evaporation of water or both (Dessouki *et al.*, 2001). Results are in constant with Taain *et al.* (2017) as reported that the loss of weight of tomato fruits hybrid Wegdan increased with the increment of storage period and the percentage of weight loss decreased in fruits treated with calcium chloride as compared to untreated fruits.

Table 1. Effect of treatment with pomegranate peel extract, calcium, storage period, and their interaction on weight loss (%) of bean seeds stored at 4 °C.

Treatments	Storage period (week)		Average treatments
	1	2	
Pomegranate peel extract (3ml l ⁻¹)	9856	1822	9889
Calcium (2ml/l ⁻¹)	9823	1812	9868
Control	1833	3812	2823
Average storage period	9871	1882	
RLSD 0.05			
Treatment 9822	Storage period 9878	Treatment × Storage period 1893	

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2. Decay (%)

Table 2 showed the effect of treatment with pomegranate peel extract and calcium, storage period, and the interaction between them on decay (%) of broad bean seeds stored at 4 °C. It is noted from the table that the treatment with pomegranate peel extract 3 ml l⁻¹ and the treatment with calcium 2 ml l⁻¹ were superior to the control treatment due to the two treatments did not record any significant decay after two weeks of storage compared to the control treatment, which recorded 1.21% at the end of the storage period. It is also noted from the same table, the significance of the interaction between the treatments and the storage period in affecting the decay percentage, as it is noted that the highest percentage of decay was in fruits of the control treatment after two weeks of storage, which was 1.63%. During handling and storage, fruits expose to damage that can take some forms depending on the reason. It may be the result of mechanical injuries resulting from the pressure of fruits each other inside the package or the damage caused by pathogens infections like bacteria, fungi and yeasts (Dementeva and Vegonski, 1988; Desouki *et al.*, 1998). Results are in agreement with Fadala *et al.* (2023) as reported that decay percentage decreased when pepper fruits treated with calcium salts and stored for two weeks at 10 °C.

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Table(2):Effectoftreatmentwithpomegranatepeelextract,calcium,storageperiod,andtheir interaction on decay (%) of bean seeds stored at 4 °C.

Treatments	Storageperiod(week)		Average treatments
	1	2	
Pomegranatepeel extract(3ml l ⁻¹)	9	9	0
Calcium(2ml l ⁻¹)	9	9	9
Control	9878	1863	1821
Averagestorageperiod	9878	1863	
RLSD0.05			
Treatment 9876	Storageperiod 9822	Treatment×Storageperiod 9888	

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3. Totalsolublesolids

It is clear from table 3 that treatment of broad bean seeds with calcium ata concentration of2 ml l⁻¹ achieved the highest percentage of total soluble solids, reaching 8.75%, with a significant difference from the rest treatments, followed by treatment with 3 ml l⁻¹ pomegranate peel extract, while the lowest percentage of total soluble solids was in the control treatment, which recorded 7.1%. It is noted from the table that total soluble solids increased as the storage period continued, reaching 8.3% after two weeks of storage.

Regarding the effect of the interaction between treatments and storage period, the highest percentageof total soluble solids was in the calcium treatment after two weeks of storage, while the lowest percentage of total soluble solids was in the control treatment after a week of storage.

The accumulation of total soluble solids with the increment of storage periods may be due to the decrease of water content of seeds with the increment of storage periods , led to increment the total soluble solids (Burton, 1982).

The application of post-harvest calcium preserved the dry matter content, as well as the role of calcium in reducing the breakdown of pectic soluble materials, which are a part of the total soluble solids and increases the firmness of cell walls because it is included in the synthesis of calcium pectate(Taain, 2005, Fadalaet al.,2021).

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Table3.Effectoftreatmentwithpomegranatepeelextract, calcium,storageperiod,andtheir interaction on total soluble solids of bean seeds stored at 4 °C.

Treatments	Storageperiod(week)		Average treatments
	1	2	
Pomegranatepeelextract(3ml l ⁻¹)	788	882	8
Calcium(2ml l ⁻¹)	885	9	8875
Control	685	787	781
Averagestorageperiod	786	883	

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RLSD0.05		
Treatment	Storage period	Treatment×Storageperiod
9822	9872	1897

4. Protein (%)

The results of table 4 indicated that the treatments differed significantly in affecting the percentage of protein in the seeds. The 2 ml l⁻¹ calcium treatment excelled in recording the highest percentage of protein, amounting to 26.19%, followed by the treatment with pomegranate peel extract, while the lowest percentage of protein was in the control treatment, which was recorded 21.78%. It is noted from the table that the percentage of protein decreased relatively as the storage period increased until reached 24.03% after two weeks of storage. As for the effect of the interaction between the treatments and the storage period, was significant, as it is noted that the highest percentage of protein was in the 2 ml l⁻¹ calcium treatment after a week of storage, which amounted to 26.35%, while the lowest percentage of protein was in the control treatment after two weeks of storage, which amounted to 21.42%. The results of present study are in the same line with Fadala (2022) as reported that there was no significant difference between the fruits of pepper sprayed with pomegranate peel extract and those treated with calcium, and both of them outperformed compared to control.

The reason for reducing the percentage of protein with the continuation of storage period maybe due to the biological processes that occur within the cells, which lead to the decomposition of protein (Taainet *al.*, 2014).

Table 4. Effect of treatment with pomegranate peel extract, calcium, storage period, and their interaction on protein (%) of bean seeds stored at 4 °C.

Treatments	Storage period (week)		Average treatments
	1	2	
Pomegranate peel extract (3ml l ⁻¹)	25817	24866	24892
Calcium (2ml/l ⁻¹)	26835	26892	26819
Control	22814	21842	21878
Average storage period	24855	24893	
RLSD0.05			
Treatment	Storage period	Treatment×Storageperiod	
1825	9842	3815	

5. vitamin C (mg 100g⁻¹)

The results of table 5 showed that the treatment with 3 ml l⁻¹ pomegranate peel extract was superior in recording the highest concentration of vitamin C, which reached 16.55 mg 100g⁻¹, followed by the treatment with 2 ml l⁻¹ calcium. The lowest concentration of vitamin C was in the control treatment, which recorded 11.61 mg 100g⁻¹. It is noted from the same table that the concentration of vitamin C decreased with increasing storage period until reached 12.70 mg 100g⁻¹ after two weeks of storage. As for the effect of the interaction between the treatments and the storage period, it was significant, as the highest concentration of vitamin C was in the treatment with 3 ml l⁻¹ pomegranate peel extract after a week of storage, which amounted to 17.77 mg 100g⁻¹, while the lowest concentration of vitamin C was in the control treatment after two weeks of storage, which amounted to 9.55 mg 100g⁻¹.

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The reason for decreasing a vitamin C with the continuation of storage period may be due to the increment of the activity of ascorbase and oxidase with the continuation of storage period and the exposure to light which caused the oxidation of vitamin C to dehydro ascorbic acid (Taainet *al.*, 2014).

Table 5. Effect of treatment with pomegranate peel extract, calcium, storage period, and their interaction on Vitamin C ($\text{mg } 100\text{g}^{-1}$) of bean seeds stored at 4 °C.

Treatments	Storage period (week)		Average treatments
	1	2	
Pomegranate peel extract (3ml l^{-1})	17877	15832	16855
Calcium (2ml l^{-1})	15812	13822	14817
Control	13866	9855	11861
Average storage period	15852	12879	
RLSD 0.05			
Treatment 1898	Storage period 1853	Treatment $\times$ Storage period 5813	

Comment [Ma22]: Apply SD and ANOVA one-way between results.

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Comment [Ma23]: Design the reference according to the journal's guidelines, delete older references than 2010, and add DOI to all references.

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