STUDIES ON THE STORAGE OF EGGPLANT SEEDS (*SOLANUM MELONGENA L.*)

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Abstract

Seeds of eggplant (*Solanum melongena* L.) were stored at room temperature (14.9-30.78°C) or cold storage (5°C) in three different package types i.e., cloth bags, aluminum foil bags (0.05 mm) and tin cans; for 24 months, starting from January 1994 till December 1995.

Results revealed that seeds stored at (5°C) retained their viability better than those stored at room temperature. Storing eggplant seeds in aluminum bags or tin cans gave similar results, in terms of seed index up to 24 months storage, Seeds germinarion percentages were 81.54%, 75.18% and 66.76%; just after seed extraction, 12 months and 24 months of storage periods; respectively. Successive reduction in germination percentages were slower, and tin cans were the best type, for seeds stored in cold storage (5°C) Averages germination rates were 3.62 and 5.02 days after seed extraction and 24 months of storage period, respectively. The slowest germination rate was observed for seeds packed in cloth bags and stored at room temperature.

Length of seedling declined with the expansion of storage period. Total protein content decreased at the range of 1.5% and 2.5% during seed storage for 24 months in cold storage and room temperature. Amino acid analysis of seeds stored, in tin cans, under room temperature showed high values than under cold storage (5°C).

Data indicated that eggplant seeds, with 6.6 percent moisture content, could be safely stored, in tin cans or aluminum foil bags (0.05 mm), for 24 months under cold storage (5°C) conditions.

INTRODUCTION

Eggplant (*Solanum melongena* L.) crop has a significant place among common

vegetable crops in Egypt. Many factors are known to affect longevity of eggplant seeds during storage period. Of the most important factors which affect seed longevity are seed moisture content and storage conditions. Type of seed packages and temperature during the storage period are very important in order to maintain high viability of stored seeds.

Storage of seeds was studied by many investigators. Rodrigo 1953 found that dry eggplant seeds in a sealed container in a laboratory showed a considerable loss of viability after 53 months. Crocker and Barton 1957 reported that the proteins of such seed and seed meals became less soluble and broke down, showing an increase in amino acids, during open and sealed storage's at 30° and 76°F for various periods. The change was more rapid in open than sealed storage, for meals than for intact seeds, and at 76°F than at 30°f . Bass *et al.*, 1961 reported that eggplant seeds, with 6 percent moisture content, were safely stored up to 3 years under sealed storage conditions. ABU - Shakra 1969 stored various vegetable seeds under natural environmental conditions. The germination capacity of all seeds decreased more rapidly after 3 years. The seeds of onion, beet, cabbage, cauliflower, turnip, sweet pepper, musk melon, squash, carrot, okra, lettuce, green snap bean, spinach and watermelon exhibited only 50 % germination or less. Ader 1978 stored lettuce and carrot pelleted seed at room temperature (18-22°C) or at 10°C, in paper bags, clear 0.05 mm polyethylene or in airtight glass jars. He observed no loss in germination capacity and a very little reduction in the percentage of seeds producting seedlings, when seeds of either species were stored at 10°C in airtight glass jars for up to 7 years. Selvaraj 1988 stored seeds of (*Solanum melongena* L.) for up to 24 months in different types of containers (i.e.; paper, aluminum foil and polyethylene) at ambient temperature. Seed germination and vigor index were generally acceptable up to 18 months, but declined rapidly thereafter, up to 18 months.

The aim of the present investigation was to study the changes of seed viability in eggplant seeds under different storage conditions to determine the best type for seed storage conditions at all times in the life of the seed.

MATERIALS AND METHODS

This study was carried out during the period, of 1994 to 1995. Recently produced eggplant seeds, with 6.6 percent moisture content, were packed in three different types of packages; i.e., cloth bags, tin cans and aluminum foil bags (0.05

mm). The containers were filled with 50 grams of seeds and were tightly closed. After seed packing, the packages were stored in an ordinary room and in a cold storage. The room temperature ranged from 14.9 to 30.38°C and the RH was 46.4-69.32%; during the storage period (Table, 1). The cold storage temperature was 5°C ±1 and the RH was 85%. The stored seeds were tested every 6 months for 2 years.

Table a. Monthly means of temperature degrees and relative of humidity percentage of room storage for 1994 and 1995.

Means 1994			Means 1995		
Month	Room temp. C	R.H. %	Month	Room temp. C	R.H. %
January	16.70	61.30	January	15.33	59.50
February	16.40	52.00	February	15.25	60.03
March	18.50	59.00	March	19.06	56.82
April	24.40	49.14	April	20.90	54.82
May	26.60	48.14	May	23.70	52.97
June	27.80	51.06	June	30.50	46.4
July	29.00	51.00	July	30.50	58.22
August	30.10	51.00	August	30.78	58.41
September	29.30	56.40	September	29.45	54.12
October	28.70	56.80	October	24.38	59.46
November	22.24	56.20	November	19.30	53.46
December	15.45	69.32	December	14.90	61.00

A factorial experiment which included 30 treatments, that were the combinations of 2 storage conditions, 3 packing types and 5 storage periods, was conducted using a split split plot system in a randomized complete block design with four replicates, using storage conditions as main plot, seed packing as sub-plots and storage period as sub-sub plots.

The following data were recorded:

1- Seed index as the weight of 1000 seeds.
2- Germination percentage, that was determined according to Bartlett (1937).
3- Germination rate, using the formulas of Clelad (1957).
4- Length of seedlings at 15 days after germination, was measuring the length of

each of hepocotyle and misocotyle (cm).

5- Total protein as well as amino acids contents of seeds were determined as follows:-

Total protein :

Eggplant seeds were grained in a ground mill. A sample of 0.3 grams was taken to determine the total nitrogen (N), using the semi-micro Kieldahl method as described by Miller and Hoghorn 1945 and Howk *et al.* 1947. The total protein was then calculated by multiplying the nitrogen percent by 6.25.

Quantitative determination of amino acids by amino acid analyzer:

It was only determined in seed samples of recently produced eggplant seeds, and seeds stored in tin cans at room temperature and cold storage 5°C for24 months.

Amino acids were transported in to micro reaction vials and derivatization procedure was carried out, according to Landault and Gulochen 1964, using N-butanol and triflouro-acetic anhydride. A varian Model 3700 GC equipped with FID, was used.

All obtained data were statistically analyzed, according to Snedecor and Cochran 1967.

RESULTS AND DISCUSSION

Seed index :

Seed index is expressed as weight of 1000 seeds. Table 1 shows that the storage of eggplant seeds in cold storage at (5°C) had significantly a greater seed index than seeds stored in room temperature. Seed index were 4.58 and 4.64 grams in storage at room temperature and cold storage (5°C), respectively. There was also insignificant effects among the different types of containers on seed index over, storing eggplant seeds in aluminum foil bags or in tin cans seemed to be better than in cloth bags .

The interactions among storage conditions, packing types and storage periods

had no appreciable effects on seed index. From Table 1 it is clear that seed index decreased with increasing storage period (seed index ranged from 4.75-4.50 grams). During the storage of eggplant seeds for 24 months, seed index started gradually to decline to reach 5.26% at the end of the storage periods. Insignificant interaction was found between storage conditions and packing types. However, a significant interaction was recorded between storage conditions and storage period (Table, 1). Storing eggplant seeds in cold storage (5°C) had significant effects on seed index. The longer was the storage period, the lower was the seed index obtained. At the end of the storage period seed index was 4.47 gm for seeds stored at room temperature and 4.54 gm for those stored in cold storage (5°C) (Table, 1).

Data in Table 1 also shows that the interaction between packing types and storage periods was insignificant. Storing eggplant seed in alluminum foil bags or in tin cans gave similar results in terms of seed index up to 24 months of storage.

Table 1. Effects of Storage conditions, Packing types and Storage period on seed index (gm) of eggplant seeds.

Storage condition	Storage at room temp.						Storage at 5°C.					
Storage period (month) Packing type	0	6	12	18	24	Mean	0	6	12	18	24	Mean
Cloth bags	4.75	4.58	4.53	4.50	4.43	4.56	4.75	4.56	4.65	4.55	4.48	4.62
Aluminum foil bags	4.75	4.63	4.55	4.53	4.50	4.59	4.75	4.75	4.65	4.55	4.48	4.64
Tin cans	4.75	4.58	4.58	4.55	4.48	4.59	4.75	4.59	4.66	4.58	4.55	4.59
Mean	4.75	4.59	4.55	4.53	4.47	4.58	4.75	4.58	4.66	4.57	4.54	4.64

Interaction effects between Storage periods x Packing types.

Storage period (month) Packing type	0	6	12	18	24	Mean
Cloth bags	4.75	4.62	4.59	4.52	4.46	4.59
Aluminum foil bags	4.75	4.65	4.56	4.56	4.53	4.62
Tin cans	4.75	4.63	4.62	4.57	4.53	4.62
Mean	4.75	4.63	4.61	4.55	4.50	

L.S.D. 5% for :
1- Storage condition (Sc) 0.02
2- Storage period (Sp) 0.04
3- Sc X Sp 0.05

Concerning the effect of storage condition, packing type and storage periods it appeared that there were successive reductions in seed index values with increasing the storage period from the time of extraction up to 24 months. Such results might be due to the physiological changes occurring in the seeds during storage, such as respiration which caused a grading reduction in stored foods inside the seed .

Seed germination :

As shown in Table 2, it is evident that seed germination percentage was significantly higher at cold storage (5°C) compared with that at room temperature.

Table 2. Effects of Storage conditions, Packing type and Storage period on germination percentage of eggplant seed.

Storage condition	Storage at room temp.						Storage at 5°C.					
Storage period (month) Packing type	0	6	12	18	24	Mean	0	6	12	18	24	Mean
Cloth bags	81.54	74.76	74.13	70.19	62.56	62.64	81.54	75.92	74.76	74.13	66.69	73.62
Aluminum foil bags	81.54	75.26	74.29	73.13	63.20	73.48	81.54	77.75	75.83	74.45	71.75	74.87
Tin cans	81.54	77.84	74.85	73.63	63.48	74.46	81.54	81.54	76.93	74.79	78.83	75.89
Mean	81.54	75.95	74.42	72.32	63.08	73.46	81.54	78.40	75.84	74.46	70.42	76.13

Interaction effects between Storage periods x Packing types.

Storage period (month) Packing type	0	6	12	18	24	Mean
Cloth bags	81.54	75.34	74.44	72.16	61.63	73.62
Aluminum foil bags	81.54	76.50	75.06	73.79	67.48	74.87
Tin cans	81.54	79.69	75.89	74.21	68.16	75.89
Mean	81.54	77.18	75.13	73.39	66.76	

L.S.D. 5% for :
1- Storage condition (Sc) 0.21
3-Sc XSp 3.29
2- Storage period (Sp) 2.33

In general, packages types had little effect on germination percentage. Storing eggplant seeds either in cloth and alluminum foil bags or in tin cans at room temperature and cold storage (5°C) did not influence seed germination. Howerver, storing eggplant seeds at room temperature and cold storage (5°C) for longer periods resulted in a Significant reduction in seed viability. The obtained seed germination percentages were 81.54%, 75.13% and 66.75% at the time of seed extraction from

fruits, 12 months and 24 months of storage period, respectively (Table, 2). Insignificant interaction was found between storage packages and storage conditions. However, a significant interaction was recorded between storage conditions and storage periods (Table, 2). Germination percentages for seeds stored at 5°C were always higher than those of seeds stored at room temperature. The interaction between storage condition and storage periods showed insignificant effects on germination percentage. Such result indicated that the reduction in seed viability was always slower at low temperatures than that at relatively high ones and that tin cans were the best container type for seed storage. Similar results were reported by Rodrigo. 1953, ABU-Shakra 1969, Ader (1978) and Selvarj {1988).

Germination rate :

Storing eggplant seeds had appreciable effects on germination rate, whether the storage was in an ordinary room or in cold storage (5°C) conditions (Table, 3). The results showed also some significant differences in germination rate among the different types of containers. Using tin cans for storing eggplant seeds seemed to be best backage relative to the other packing types.

Table 3. Effects of Storage conditions, Packing types and Storage period on germination rate (day) of eggplant seeds.

Storage condition	Storage at room temp.						Storage at 5°C.					
Storage period (month) Packing type	0	6	12	18	24	Mean	0	6	12	18	24	Mean
Cloth bags	3.62	3.82	4.87	6.47	6.67	5.09	3.62	3.85	4.02	4.50	4.87	4.17
Aluminum foil bags	3.62	3.75	4.42	5.37	5.62	4.56	3.62	3.77	3.87	4.05	4.35	3.93
Tin cans	3.62	3.72	3.87	4.10	4.45	3.95	3.62	3.65	3.67	3.80	4.17	3.78
Mean	3.62	3.76	4.39	5.31	5.58	4.53	3.62	3.76	3.58	4.12	4.46	3.96

Interaction effects between Storage periods x Packing types.

Storage period (month) Packing type	0	6	12	18	24	Mean
Cloth bags	3.62	3.84	4.45	5.49	5.77	4.63
Aluminum foil bags	3.62	3.76	4.15	4.71	4.99	4.25
Tin cans	3.62	3.69	3.77	3.95	4.31	3.87
Mean	3.62	3.76	4.12	3.95	5.02	

L.S.D. 5% for :

1- Storage condition (Sc)	0.18	4- Sc X Pt	0.37	6- Pt X Sp	0.40
2- Packing type (Pt)	0.26	5- Sc X Sp	0.33	7- Sc X Pt X Sp	0.57
3- Storage period (Sp)	2.33				

The interaction between storage conditions, packing types and storage periods reflected some significant effects on germination rate. Data in Table 3, clearly, indicated that the highest germination rate was recorded soon after seed extraction from fruits. This result indicated that the required time for germination prolonged as the storage period increased. Germination rate, was 3.62 after seed extraction 5.02 days after a storage period of 24 months. Data in Table 3 showed that the interaction between storage conditions and package types was significant. Germination rates for seeds obtained from different storage containers and stored at room temperature were always higher than those for seed observed for seeds packed in cloth bags and stored at room temperature, whereas the lowest germination rate was obtained from seeds packed in tin cans and stored at cold temperatures (5oC).

The interaction between storage conditions and storage periods was only clear after 6 months of storage. It showed insignificant effects on germination rate, whereas the lowest germination rate was obtained from seeds stored for 24 months at cold temperature (5°C). The interacttion among packages and storage periods was significant in terms of its effect on germination rate. although the germination rate of seeds obtained from different types of packages was not affected considerably after 6 months of storage, such germination rate was considerably affected after twelve months of storage in cloth and alluminum foil bags. Germination rate of seeds stored in tin cans was significantly lower than that for seeds stored in cloth and alluminum foil bags (Table, 3). Longer storage periods resulted in relatively more days required for germination.

Seedling length :

It is clear from Table 4, that seedling length decreased gradually with the expansion of storage periods of the seeds storage. The highest seedling length was recorded for seeds stored in cold storage (5°C). The lowest seedling length was observed for seeds packed in colth bags under room temperature. Moreover, significant interaction effects were recorded among storage conditions, packages and storage periods; on seedling length. The longer was the storage period the lower was the obtained seedling length. Seedling length declined from 11.30% after 6 months, to 23.26%, 31.38%, and 43.00% after 12 months, 18 months and 24 months of storage periods; respectively.

A significant interaction was noticed between storage conditions and storage packages (Table, 4). Storing eggplant seeds at room temperature or in cold storage (5°C) gave similar results in terms of seedling length up to 12 months and 18 mo-

nths of storage periods; whereas at 24 months, cold storage proved to be the best condition for seedling. Data in Table 4 showed also that the interaction between storage packages x storage periods was also significant. Storing eggplant seeds in tin cans gave always higher seedling length, all over the period of storage, than those of the other used backages. These results are partially in line with those reported by Ader, 1978.

Table 4. Effects of Storage conditions, Packing type and Storage period on seedling length (cm) of eggplant seed.

Storage condition	Storage at room temp.						Storage at 5°C.					
Storage period (month) Packing type	0	6	12	18	24	Mean	0	6	12	18	24	Mean
Cloth bags	13.80	10.70	9.83	8.13	5.45	9.58	13.80	12.95	9.68	9.48	7.45	10.69
Aluminum foil bags	13.80	11.50	10.73	9.83	8.28	10.83	13.80	13.28	10.83	9.73	8.63	11.25
Tin cans	13.80	11.70	10.98	9.83	8.62	10.99	13.80	13.28	11.48	9.83	8.70	11.42
Mean	13.80	11.30	10.51	9.26	7.46	10.48	13.80	13.17	10.66	9.68	8.26	11.11

Interaction effects between Storage periods x Packing types.

Storage period (month) Packing type	0	6	12	18	24	Mean
Cloth bags	13.80	11.82	9.75	8.80	6.45	10.12
Aluminum foil bags	13.80	12.39	10.78	9.78	8.45	11.04
Tin cans	13.80	12.49	11.23	9.83	8.65	11.21
Mean	13.80	12.24	10.59	9.47	7.86	

L.S.D. 5% for :

1- Storage condition (Sc)	0.29	4- Sc X Pt	0.65	6- Pt X Sp	0.68
2- Packing type (Pt)	0.09	5- Sc X Sp	0.56	7- Sc X Pt X Sp	0.24
3- Storage period (Sp)	0.39				

Protein content :

Proteins are the main form of nitrogen storage in seeds. The data of Table 5 showed that total protein content decreased in the range of 1.5% and 2.5% during seed storage, for 24 months, cold storage or at room temperature, respectively. Similar results were found by Crocker and Barton 1957.

Amino acids :

The amino acid composition of eggplant seeds, obtained from fresh extrated

Table 5. Protein content of fresh and stored eggplant seed in tin cans.

Storage condition	Fresh seeds	seed storage at (5C) for (24 months)	seed storage at room temp. for (24 months)
Protein content %	19.4	19.1	18.9

seeds, is shown in Table, 6. The contents of the different amino acids in eggplant seeds in the decreasing order: glutamic > arginine > aspartic > leucine > phenyl alanine > valine > glysine and alanine > lysine > iso leucine > serine > cysteine > threonine > histidine > tyrosine. The amino acid analysis of eggplant seed during storage period showed a variable progressive increase whereas, remarkable decrease was noted for arginine. The results showed the proline and methionine were absent. After 24 months of storage, amino acid analysis of seeds stored in tin cans under room temperature gave relatively higher values than at cold storage (5^{o}C). Similar concolusions were reported byCrocker and Barton 1957, and Farag *et al.* 1982, who found that the amino acids composition slightly increased in stored pepper seeds.

Table 6. Amino acids composition of fresh and stored eggplant seed in tin cans.

Storage condition Amino acid %	Fresh seeds	seed storage at (5C) for (24 months)	seed storage at room temp. for (24 months)
Aspartic acid	1.49	1.51	1.57
Threonine	0.47	0.49	0.53
Serine	0.59	0.62	0.69
Glutamic acid	3.78	3.78	3.79
Proline	-	-	-
Glysine	0.82	0.88	1.03
Alanine	0.82	0.86	0.94
Cysteine	0.56	0.57	0.61
Valine	0.86	0.90	0.99
Methionine	-	-	-
Iso leucine	0.70	0.72	0.76
Leucine	1.12	1.15	1.25
Tyrosine	0.23	0.24	0.34
Phenyl alanine	0.91	0.92	0.99
Histidine	0.39	0.39	0.41
Lysine	0.73	0.75	0.82
Arginine	1.90	1.87	1.79

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دراسات على تخزين بذور الباذنجان

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حفظت بذور الباذنجان لمدة سنتين من يناير ١٩٩٤ الى ديسمبر ١٩٩٥ فى ثلاث أنواع من العبوات المصنوعه من (القماش – رقائق الالومنيوم (٠,٠ مم) – علب الصفيح).

ووضعت العبوات المعباه بالبذور تحت ظروف التخزين فى الغرفة العادية (تراوحت درجة الحرارة بين ٩,١٤ – ٣٠,٧٨م°) وفى الثلاجة (تحت درجة حرارة ٥م°).

وقد أوضحت النتائج ما يلى :

١ – احتفظت بذور الباذنجان بحيويتها بالتخزين تحت درجة حرارة ٥م° عن المخزنه فى درجة حرارة الغرفة العادية.

٢ – لم يتأثر وزن ١٠٠٠ بذرة بالتخزين فى عبوات مصنوعة من الصفيح أو الالومنيوم خلال فترة التخزين.

٣ – انخفضت نسبة الانبات خلال فترة التخزين وكانت ٨١,٥٤ ٪ – ٧٥,١٨٪ – ٦٦,٧٦٪ فى البذور المستخرجه حديثا والبذور المخزنة لمدة ١٢ شهرا والمخزنة لمدة ٢٤ شهرا على التوالى.

٤ – كانت أعلى نسبة انبات متحصل عليها أثناء التخزين فى البذور المحفوظة فى العلب الصفيح.

٥ – زادت عدد الايام اللازمه للانبات (سرعة الانبات) من ٣,١٢ يوما فى البذور المستخرجة حديثا الى ٥,٠٢ يوما فى البذور المخزنة لمدة ٢٤ شهرا.

٦ – انخفض طول البادرات خلال فترات التخزين.

٧ – انخفض محتوى البروتين الكلى فى البذور بنسبة ١,٥٪ تحت ظروف التخزين المبرد ونسبة ٢,٥٪ تحت ظروف الغرفة العادية.

٨ – ارتفعت نسبة الاحماض الامينية فى البذور المخزنة على درجة حرارة الغرفة عن المخزنة على درجة حرارة ٥م°.

أوضحت هذه الدراسة أن أنسب ظروف لحفظ حيوية بذور الباذنجان المحتوية على ٦,٦ ٪ رطوبة هى حفظها فى علب مصنوعة من الصفيح أو الالومنيوم وتخزينها فى مخازن درجة حرارتها ٥ درجه مؤيه .