

## UNTRADITIONAL PRODUCTS FROM ROUND BLACK EGGPLANTS

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### **Abstract**

Seven untraditional products from eggplant were processed into jam of round black eggplant, jam of round black eggplant and carrot, jam of round eggplant peel, compote of round black eggplant with lemon juice, compote of round black eggplant with lemon and orange juice, candy of round black eggplant sweetened with orange juice, and candy of saccharified eggplant.

All treatments were stored for 9 months at ambient temperature and showed non-sensitive changes of organoleptic qualities. The chemical analysis of the eggplant products revealed that the total solids ranged from 68.07 to 69.80%, 20.18 to 26.81% and from 90.03 to 92.64% for jam, compote and candy of round eggplant respectively. While total soluble solids portion ranged from 66.0 to 69.0%, 19.0 to 22.0%, and from 88.6 to 90.7%; total acidity ranged from 0.230 to 0.324, 0.103 to 2.0590% and from 0.009 to 1.020%, reducing sugars ranged from 12.56 to 17.10%, 10.0 to 68.35%, 6.29 to 16.43%; total sugars ranged from 67.06 to 72.60, 51.02 to 62.50 and from 71.0 to 82.89%; free amino acids ranged from 0.33 to 0.71%, 1.32 to 2.14 and from 0.19 to 1.07% and total phenols ranged from 0.22 to 0.89%, 0.90 to 1.53 and from 0.29 to 0.78% for jam, compote and candy of round black eggplant respectively.

From the organoleptic evaluation, it could be concluded that the best jam treatment was that of No. 2, which consisted of round black eggplant and carrot in spite of the acceptability of the other treatments (No. 1 and 3).

Results also showed that round eggplant plant compote had good acceptability for the samples No. 4 consisting of round black eggplant with lemon juice and sucrose and No. 5 consisting of round black eggplant with lemon juice, orange juice and sucrose.

With respect to the sweetened eggplant candy results revealed that the treatment No. 6 was better compared to No. 7, being related to the role of orange juice on enhancing the color, while the good quality of the other two treatments were similar.

## INTRODUCTION

The total production of round eggplants (Aubergine) in Egypt is very high reaching about 560000 tons (FAO, 1998). This vegetable crop is one of the most important popular food products consumed in the A.R.E., and is of relatively low price. round black eggplants are usually consumed locally (either fried or cooked).

Poly-phenol oxidase (PPO) plays an important role during the preparation of eggplant for cooking or processing. Therefore, studies have been carried out by *Nezam El-Din and Abd El-Hameed, (1991)* for preservation of eggplants and mentioned that this vegetable could be preserved by different ways such as drying after salting with NaCl as well as by drying after treatment with limon juice and other treatments.

Poly-phenol oxidase was studied by *Knapp, (1961)* who found that the optimum PH value suitable for oxidation of crude extract of eggplants was 6.6. Ortho-diphenols, were oxidized by eggplant poly-phenol oxidase and chlorogenic acid, was much faster oxidized than other substrates such as the catechol, caffeic acid and dopa but resorcinol was somewhat more effective as inhibitor than the chloride ions (*Knapp, 1965*).

Also, sodium chloride, and potassium meta-bisulfates were used as inhibitors for the poly phenol oxidase of pears and round black eggplants *Shouman et al.,( 1989 )* and *Nezam El-Din and Abd El-Hameed, (1991)*.

*Bajaj et al., (1981)* studied 18 varieties of eggplants and found that the dry matter varied from 6.32 to 8.32% and the P.P.O. activity from 2.12 to 45.5 unit/mg o-dihydroxy phenols/mg protein.

Aubergines were dried by heat from 45 to 90° C using different times and the air speed was 0.5 to 1.5 m/s (*Al-Khanashvili et al., 1982*).

Since round black eggplants production is high, so, it is very important to find new ways for using and processing this vegetable for exportation and/or local consumption.

## MATERIALS AND METHODS

### Materials:

Round eggplants variety obtained from local market were used for preparing the following products.

### I- Jam: was prepared from round black eggplants as follows :

- 1- Eggplants (1kg) were peeled, sliced then 1.25 kg of sucrose was added.
- 2- Eggplants (2kg), carrots (1kg) and 3kg of sucrose were added.
- 3- Peeled eggplants (100gm) were blended with 100 ml water and sucrose was added until the total soluble solids (TSS) of the new product reached to 69%,  
Citric acid (3gm/L) was added to all the previous treatments before cooking the jam.

### II- Compote: Two types of compote were prepared as follows:

- 4- Sliced, peeled round black eggplant (100gm per one slice) were cut into small bars then immersed in a solution containing 35% sugars and 10% lemon juice.
- 5- Sliced, peeled round eggplants (100gm per one slice) were cut into small bars then immersed in a solution containing sucrose 35%, orange juice 10% and lemon juice 10%.

The previously mentioned products of compote were sterilized at 100°C (boiling water) for 45 min in sealed tightly closed jars.

**III-Eggplant marshmallow (candy sweetened round eggplants):**

Two types of candy sweetened eggplant were produced as follows:

- 6-The bars of the sliced round black eggplants were immersed in orange juice containing sequential different concentrations of sucrose (50, 60, 70%), then removed, dried and covered by sugar powder.
- 7-The bars of the sliced round black eggplants were immersed in sequential different sugar concentrations (50, 60, 70%), removed and left to dry then covered by sucrose powder.

All previous treatments were stored for 9 months at ambient temperature.

**Methods:**

Moisture content, total acidity, ash, crude fiber, pH values, reducing and total sugars contents were determined according to the *A.O.A.C., (1990)*

Total phenols were determined by Folin-Denis method as reported by *Swain and Hillis, (1959)*.

Pectin content was measured as calcium pectate as described by *Lees, (1975)*.

Free amino acids FAA were determined according to *Kirk and Sawyer, (1991)*.

**Sensory evaluation:**

Data of sensory organoleptic evaluation accomplished by 10 panelists were subjected to analysis of variance using randomized block design (*Snedcor and Cochran, 1980*). The score for every attribute (colour, taste and flavour) were obtained using a scale from 1 to 10.

## RESULTS AND DISCUSSION

By analysis of processed round black eggplant (jam, compote and slices of sweetened round black eggplant), it was found that:

Total solids percentage of eggplant jam ranged from 68.07 to 69.50, from 20.18 to 26.81% of round eggplant compote (4 and 5 treatments) and from 90.03 to 92.64% of a sweetened round eggplant (6 and 7 treatments).

Total soluble solids (T.S.S.) of round eggplant jam (1, 2 and 3 treatments) ranged from 64 to 69% and the round eggplant compote (4 and 5 treatments) from 19 to 22%. It can also be observed that total soluble solids decreased gradually by storage which may be related to the effect of browning reaction on decreasing the reducing sugars and free amino acids contents (*Reynolds, 1965*).

Total acidity percentage of fresh eggplant and its peels were 2.45 and 2.07 respectively. The total acidity decreased in all treatments except that for treatment 4. These decrements could be as a result of the increase in total solids by the addition of sugars, but the increase of total acidity in treatment 4 would be due to the addition of Limon juice.

Total acidity in all treatments (Table 3) decreased by storage being resulted from the reaction between the organic acids and sugars to form sugar monoester (*Ingles and Reynolds, 1959*).

From Table (4) it could be observed that reducing sugars was increased clearly in treatment 4 as a result of the addition of acidic juice (lemon juice). Slight increase were observed in treatments 2, 3 and 6 which may be associated with the addition of acidic fruits. Treatment 3 (peels) had the lowest percentage of reducing sugars.

The changes of reducing sugars by storage may be resulted from the browning reaction between the reducing sugars and free amino acids (*Nezam El-Din, 1978*) as shown in treatments (1 and 6), but the increment of reducing sugars by storage may be resulted from the effect of acidic conditions on the hydrolysis of sucrose.

Total sugars in jams showed slight decrement by storage of treatments (1, 2 and 3), compote treatments (4 and 5) and candy sweetened round eggplant treatments (6 and 7). This decrease in total sugars may be related to the decrease in reducing

sugars which reacted with free amino acids as reported by (*Anet and Reynoldes, 1957*).

From Table (6) it could be observed that free amino acids of eggplant jam were very low compared to the fresh eggplant. These decrements may be resulted from the Maillard reaction (*Meyer, 1978*).

The high content of free amino acids (FAA) of compote treatments (2.14 and 2.03% of treatment 4 and 5 respectively) may be resulted from the effect of acidic condition on the hydrolysis of eggplant protein. The FAA of compote and sweetened round black eggplant treatments decreased by storage as a result of browning reaction.

Total phenols decreased in all treatments by processing and the lowest concentration was observed in jam and candy of round eggplant which had been thermally treated more than the round eggplant compote.

Ash content of jam and candy sweetened round eggplant were very low when compared to fresh and compote eggplant (Table 8).

From Table (8) it appears that all treatments of round eggplant contained lower percentage of fiber than the fresh and eggplant peels. This decrease may be related to the expand of round eggplant (fiber) to a big size or expansion and incorporateion with other foods, having high total soluble solids (sugars, fruits) measured on dry weight basis. The fiber of fresh round eggplant and its peels were 8.63 and 12.69% respectively. The apparent decrease of fiber content of different treatments may be resulted from the increasing of total solids by the sugar addition which led to a relative decrease in the percentage of fiber and ash.

By measuring the minerals of eggplant and its products it was found that fresh eggplant contained good concentration of sodium, potassium, iron, magnesium and zinc, while the peels contained high concentration of sodium, potassium, magnesium and zinc (Table 9).

Compote eggplant treatments (4 and 5) were relatively rich in potassium, magnesium and zinc but the other treatments contained low concentrations of all minerals with the exception of potassium content of eggplant jam (2 and 3)

Color measurement of eggplant and its products:

From Table (10) it could be conducted that the color (as optical density) increased gradually in all treatments except that of treatments 3 and 4. The lower gradual decrease of the color reading (O.D.) by storage of treatments 3 may be related to the degradation of peels anthocyanin (*Markakis, 1982*).

Also treatment 4 showed a decrease in the color index (O.D.) by storage which could be due to the effect of ascorbic acid of the added lemon juice on the inhibition of discoloration (*Meyer, 1978*).

#### **Organoleptic Evaluation:**

##### **1- Jam products:**

From Table (11) it could be observed that the best color of jam was that of the treatment 2 ( round eggplant and carrot) compared to the treatment 1 (round eggplant), but treatment 3 did not attain a good score for the color which may be resulted from the effect of browning reaction on anthocyanine discoloration (*Markakis, 1982*) and this unacceptable color could be concluded from Table 4.

Also treatment 2 and 1 had the maximum scores for taste, flavor and consistency but still the jam of round black eggplant peels was still acceptable.

##### **2- Compote products:**

Compote products consisted of eggplant and lemon (treatment 4) and eggplant with lemon and orange juice (treatment 5) gave nearly similar good scores for color, taste, flavor and consistency as found in Table 12.

##### **3- Candy sweetened round eggplant:**

Treatments 6 ( bars of round eggplant and orange juice) and 7 ( bars of round eggplant) show good scores for all parameters of candy sweetened round eggplant (color, taste, flavor and consistency) However, the color of treatment 6 is higher than that of treatment 7. The differences in the color would be attributed to the effect of orange juice and its content of carotenoid pigment and ascorbic acid on enhancing the color and preventing the discoloration (*Meyer, (1978)*).

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Table (1): The percentage of total solids of round eggplant and its products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam round black eggplant	1	69.50	69.04	68.70	68.52
Jam of round black eggplant & carrot	2	68.60	68.44	68.27	68.07
Jam of round black eggplant peel	3	69.80	69.3	68.80	68.51
Compote of round black eggplant with lemon juice	4	25.71	24.68	22.31	20.20
Compote of round black eggplant with lemon and orange juice	5	26.81	26.10	23.18	20.18
Candy sweetened round black eggplant with orange juice	6	90.09	90.29	90.16	90.03
Candy of sweetened round black eggplant	7	92.64	92.40	92.10	90.30

Total solids of round black eggplant (fresh) and its peels were 8.200 and 9.091% respectively.

Table (2): Total Soluble Solids% (TSS) of round black eggplant and its products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	68.0	67.1	66.3	66.0
	2	67.8	67.2	67.1	66.9
	3	69.0	68.2	67.0	66.0
Compote:	4	22.0	21.0	19.5	19.0
	5	22.0	21.5	21.0	20.0
Candy sweetened round black eggplant:	6	88.60	88.90	88.80	88.60
	7	90.70	90.70	90.40	88.60

Table (3): Total acidity percentage of round black eggplant jam.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	0.275	0.170	0.026	0.103
	2	0.324	0.124	0.028	0.161
	3	0.277	0.108	0.023	0.220
Compote:	4	2.590	2.000	0.150	1.640
	5	0.304	0.181	0.103	0.634
Candy sweetened round black eggplant:	6	1.020	1.000	0.940	0.890
	7	0.336	0.020	0.009	0.190

Total acidity determined as citric acid on dry weight basis.

Table (4): Reducing sugar percentage of round black eggplant products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	17.10	16.81	16.49	12.56
	2	13.18	14.90	16.49	19.59
	3	12.79	12.95	13.15	13.91
Compote:	4	10.00	12.10	42.72	68.35
	5	11.03	11.03	11.03	12.77
Candy sweetened round black eggplant:	6	16.34	12.90	8.41	8.29
	7	6.29	9.03	10.20	11.05

The percentage of reducing sugars determined on dry weight basis  
 Fresh round black eggplant and its peels contained 13.4 and 1.2% of reducing sugars respectively.

Table (5): The percentage of total sugars of round eggplant and its products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	67.20	72.07	72.60	69.70
	2	70.49	70.48	69.30	68.80
	3	69.98	68.21	67.73	67.06
Compote:	4	62.50	54.33	54.30	51.1
	5	60.82	51.37	51.02	47.2
Candy sweetened round black eggplant:	6	82.89	75.62	75.60	71.3
	7	80.93	74.32	74.30	71.0

The percentage of total sugars determined on dry weight basis

Total sugar percentage of fresh round eggplant and its peels were 11.71 and 38.5% respectively.

Table (6): The percentage of free amino acids of round black eggplant and its products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	0.33	0.34	0.35	0.49
	2	0.38	0.43	0.61	0.53
	3	0.69	0.71	0.67	0.45
Compote:	4	2.14	2.10	2.00	1.89
	5	2.03	1.72	1.32	1.43
Candy sweetened round black eggplant:	6	1.07	0.61	0.35	0.19
	7	0.64	0.50	0.42	0.36

The free amino acids determined on dry weight basis

The free amino acid percentage of fresh round black eggplant and its peels were 1.67 and 1.655% respectively.

Table (7): The percentage of total free phenols of round black eggplant and its products.

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	0.22	0.33	0.43	0.83
	2	0.33	0.41	0.48	0.86
	3	0.53	0.40	0.41	0.89
Compote:	4	1.53	1.21	1.07	1.00
	5	1.35	1.15	0.90	1.00
Candy sweetened round black eggplant:	6	0.29	0.31	0.34	0.69
	7	0.45	0.36	0.31	0.78

The free phenols determined on dry weight basis

Total phenols of fresh round eggplant and its peels were 1.62 and 1.74% respectively.

Table (8): Ash and fiber contents of round black eggplant and its products.

Products	Treatment No.	Ash content %	Fiber content %
Jam:	1	0.73	0.28
	2	0.93	0.13
	3	1.01	0.51
Compote:	4	2.67	0.52
	5	1.64	0.78
Candy sweetened round eggplant:	6	0.35	0.31
	7	0.65	0.36
Fresh round black eggplant Peels of round black eggplant		9.04	8.63
		11.00	12.69

All constituents determined on dry weight basis.

Table (9): Minerals content of round black eggplant and it products (mg/100gm).

Products	Treatment No.	Na	K	I	Mg	Zn
Jam:	1	11.50	54.60	0.100	5.81	0.031
	2	11.21	75.40	0.120	5.69	0.020
	3	18.30	77.07	0.230	5.32	0.060
Compote:	4	18.61	139.85	0.230	11.91	0.060
	5	31.61	110.03	0.260	12.80	0.150
Candy sweetened round black eggplant:	6	4.86	22.94	0.210	3.64	0.017
	7	7.35	52.28	0.113	3.67	0.018
Fresh round black eggplant		40.04	72.14	0.450	23.55	0.046
Peels of round black eggplant		63.15	132.24	0.130	53.68	0.170

Minerals determined on dry weight basis.

Table (10): Color measurement of round black eggplant and its products (optical densities at 420nm).

Products	Treatments No.	Storage period			
		Zero time	3 months	6 months	9 months
Jam:	1	0.042	0.049	0.056	0.060
	2	0.091	0.091	0.091	0.091
	3	0.144	0.140	0.127	0.116
Compote:	4	0.152	0.135	0.101	0.095
	5	0.105	0.112	0.124	0.133
Candy sweetened round black eggplant:	6	0.085	0.097	0.1070	0.188
	7	0.056	0.073	0.0912	0.110

The optical density was measured at 420nm of fresh round eggplant and peels were 0.436 and 0.721 respectively.

Table (11): Organoleptic evaluation of round black eggplant jam(on a scale from 1 to 10):

Sample	Color	Taste	Flavor	Consistency
1	7.50	8.30	8.12	8.50
2	8.87	8.80	8.50	8.50
3	5.90	6.80	6.50	7.25
L.S.D. 5%	1.32	1.171	0.773	0.959

Table (12): Organoleptic evaluation of round black eggplant compote (on a scale from 1 to 10):

Sample	Color	Taste	Flavor	Consistency
4	7.4	7.9	7.7	7.3
5	7.5	7.0	7.0	7.4
L.S.D. 5%	NS	NS	NS	NS

Table (13): Organoleptic evaluation of round black eggplant Candy (on a scale from 1 to 10):

Sample	Color	Taste	Flavor	Consistency
6	8.60	8.30	7.60	7.00
7	7.50	8.25	7.50	7.80
L.S.D. 5%	0.568	NS	NS	NS

## منتجات غير تقليدية من الباننجان

عزة كمال الدين عبد الحميد

مركز البحوث الزراعية - معهد بحوث تكنولوجيا الأغذية - مصر - جيزة

تم إعداد ٧ منتجات غير تقليدية من الباننجان الرومي مربي الباننجان ، مربي الباننجان بالجزر، مربي قشر الباننجان، كمبوت الباننجان مع عصير الليمون، كمبوت الباننجان بعصير الليمون والبرتقال، حلوى سكرية من الباننجان المضاف إليه عصير البرتقال وحلوى سكرية من الباننجان قسط خزنت جميع المعاملات لمدة ٩ شهور ولم يلاحظ أى تغيرات ملموسة على قابليتها للمستهلك. أظهرت التحاليل الكيماوية لمنتجات الباننجان الآتى تراوحت المواد الصلبة من ٦٨,٧ إلى ٦٩,٨٠ % ٢٠,١٨٢ إلى ٢٦,٨١%، و ٩٠,٠٣ إلى ٩٢,٦٤ % لكل من المربي، الكمبوت وحلوى الباننجان السكرية على التوالي كذلك تراوحت المواد الصلبة الذاتية من ٦ إلى ١٩,٠٦٩% إلى ٢٢ %، و ٨٨,٦ إلى ٩٠,٧ % على التوالي. وتراوحت النسبة المئوية الحموضة الكلية من ٠,٢٣٠ إلى ٠,٣٢٤، و ٠,١٠٣ إلى ٢,٥٩٠ ومن ٠,٠٠٩ إلى ١,٠٢٠ على التوالي فى حين تراوح السكر المختزل من ١٢,٥٦ إلى ١٧,١٠، ١٠ إلى ٦٨,٣٥ ومن ٦,٦٩ إلى ١٦,٤٣ وأظهرت نتائج السكر الكلى أن نسبته تراوحت من ٦٧,٠٦ إلى ٧٢,٦٠، ٥١,٠٢ إلى ٦٢,٥ ومن ٧١ إلى ٨٢,٨٩ على التوالي فى حين تراوحت الأحماض الأمينية الحرة من ٠,٣٣ إلى ١,٣٢، ٠,٧١ إلى ٢,١٤ ومن ٠,١٩ إلى ١,٠٧ % كما وجد أن الفينولات الكلية تراوحت من ٠,٢٢ إلى ٠,٨٩، ٠,٩٠ إلى ١,٥٣ ومن ٠,٢٩ إلى ٠,٧٨ % لكل من المربي والكمبوت والحلوى السكرية للباننجان على التوالي. أظهر التقييم الحسى للعينات أن أفضل معاملة للمربي كانت رقم ٢ والتي أحتوت على الباننجان والجزر وذلك من ناحية القابلية. بالرغم من تقبل المعاملات الأخرى (رقم ١,٣) كذلك ظهر أن أفضل قابلية للكمبوت كان للعينتين التي تتكون إحداهما من الباننجان وعصير الليمون والسكر والأخرى تتكون من الباننجان وعصير الليمون والبرتقال والسكر. أما من حيث منتجات حلوى الباننجان فقد اتضح أن العينة التي أحتوت باننجان وعصير برتقال أظهرت أفضل لون أما باقى القياسات فكانت ممتازة لكل العينات من حلوى الباننجان.