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UTILIZATION OF SOME NATURAL PLANT SOURCES IN THE PRODUCTION OF SOME NEW SHEETS

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ABSTRACT

This study was carried out to produce new products (sheets)from some popular natural plant sources such as tamarind(*Tamarindus indcia L*,) carob pods (*Ceratonia Siliqua L*) and red roselle (*Hibiscus sabdariffa L*) as well as mixture of them. These sheets were prepared from tamarind, carob pods, mixes of tamarind and red Roselle (1:1 w/w) and mixes of tamarind, carob pods and red Roselle (4:1:1 w/w/w). Total soluble solids were increased to 18.0 % by sucrose. The dried sheets were evaluated chemically, physically and organoliptically at zero time, then after storage at room temperature for 4 and 8 months respectively. Data of pannel tests revealed that all reconstituted popular natural drinks of sheets showed a good score for color, taste, odour and palatability. It was also found through this study that storage at room temperature for 8 months had effects on the chemical and physical properties of all sheets

INTRODUCTION

Some natural plants used as popular drinks had good medical effects on some diseases. A part of these natural plants are famous such red roselle, tamarind and carob pod. The previous natural plants were studied by many researchers as shown in the following literature.

Red roselle (*Hibiscas sabdariffa* L) petals were boiled in water and used as drink in bilious to attack petals which contain gossypectin and glucoside hibiscin. The glucoside hibiscin have diuretic choleretic effect, as decreasing the viscosity of the blood, reducing blood pressure and stimulating intestinal peristalsis (Onyenekwe *et al*., 1994).

NMahadevan (2007) reported that the plants of Hibiscus sabdariffa contained protein, fats, carbohydrates, flavonoids, acids, minerals and vitamins. Several authors have confirmed that Hibiscus sabdariffa is a good source of dietary antioxidants, with its calyces containing amount of anthocyanins as high as 2.5 g/100g^{-1} DW (Aurelio, *et al*., 2008 ; Juliani, *et al.,* 2009).

Abdallah, *et al*., (2011) studied the chemical composition of dry red and white roselle calyces. They found that red and white karkade calyces contained 11 and 9.3% moisture, 0.16 and 0.12% fat, 13.2 and 12.0% fiber, 7.88 and 7.35% protein, 10.6 and 9.50% ash and 57.16 and 61.55% carbohydrates respectively. Red and white karkade calyces also contained 11 and 15.5 mg/100g of vitamin C, 60 and 50 mg/100g of calcium, 25 and 20 mg/100g of iron and 9 and 11 mg/100g total titrable acidity respectively.

Tamarindus Indical a native plant of tropical Africa was best known for its fruits, which contain about 30 percent, sticky, edible pulp. The acidic pulp as a common ingredient is culinary prepared as curries, chutneys,

sauces, ice cream and sherbet in countries where the tree grows naturally (Singh, *et al*., 2007).

Tamarind pulp had 28.20% moisture, 3.10% protein, 0.1% fat, 5.60% fibers, 67.4% carbohydrates, 30.41% invert sugars and 2.90% ash. Also, tamarind pulp contained 35 – 170, 54 – 110, 1.30 – 10.90, 24 and 375 mg/100g calcium, phosphorus, Iron, sodium and potassium respectively. Thiamine, riboflavin, niacin, ascorbic acid and tartaric acid contents were 0.16, 0.07, 0.6 -0.7, 0.7 – 3.0 and 8.0 – 23.80 mg/100g respectively (Singh, *et al*., 2007). The same researchers stated that tamarind juice concentration contained 30.0% moisture, 13.0% tartaric acid, 50% invert sugars and 2.0% proteins.

Abdel Moneim, *et al*., (2010) found that one kg of tamarind pulp contained 3.7% pectin, while the average chemical components of tamarind pulp were 5.44% protein, 2.44% ash, 18.20% moisture, 1.99% fat, 13.05% fibers and 55.0% carbohydrates. Tamarind pulp also contained amounts of minerals as follows 134, 74 and 88 mg / 100g for sodium ,potassium and calcium respectively.

Razali, *et al*., (2012) studied the effects of various solvents on the extraction of antioxidant phenolics from the leaves, seeds, veins and skins of tamarind indica. They found that phenolics content ranged from 3.17 to 309 mg of gallic acid equivalents/g.

Carob pods are rich in sugars 40 – 60%, low protein 2.7 – 3.5%, lipids 0.4-0.8% and high in phenolic compounds that accounted for nearly 20 mg/g on DW (Davies, *et al.,* 1970; Alumot, *et al.,* 1980 and Lambraki, *et al.,* 1996).

Youssef, *et al.,* (2009) found that proximate chemical composition of carob pods were 7.53% moisture, 5.42% protein, 54.36% total sugars, 2.72% ash, 1.94% lipids, 6.81% crude fiber, while minerals content as mg/100g were 15.88 Mg, 152.0 Na, 0.94 Zn, 1.66 Mn, 2.38 Fe, 488.6 Ca and 135.4 K, total phenolic compounds were 21.07 mg/100g and total antioxidant activity was 90.09%.

This study aims to investigate the possibility of producing new product with good ability in a drying form (sheets) from some natural plant sources such as tamarind, carob pods and Roselle and to evaluate the palatability of these products and also to study the effect of storage at room temperature for 8 months on these mentioned products.

MATERIALS AND METHODS

Materials and sample preparation:

Red roselle (*Hibiscus sabdariffa*) , carob pods (*Ceratonia siliqua L*) and tamarind (*Tamarindus indica L*) were obtained from local markets at Giza governorate.

Preparation of different sheets:

1-Tamarind sheets (T1) were prepared by extracting the cleaned pulp with boiling water (250 g /L water) for 5 min, blending, removing the taff fibers by screening. Sucrose was added until the T.S.S reached to 18 %.

2-Carob pods sheets (T2) were prepared by extracting 250g carob pods powder with 800 ml water, boiling for 5 min, blending, removing the taff fibers by screening. T.S.S of the aforementioned pulp was adjusted to 18 % by adding sucrose (Nezam Eldin, 1978).

3-*The mixed* sheets (T3) were composed of tamarind and red roselle .These sheets were prepared by mixing the pulp of tamarind and red roselle(1:1 v/v) after boiling for 5 min, blending, removing the taff fibers by screening, then the T.S.S was adjusted to 18 % by sugar addition.(Nezam Eldin,1978).

4-The mixed sheets (T4) were composed of tamarind, carob pods powder and red roselle, these sheets were prepared by mixing the pulp of tamarind, carob pods powder and red roselle(100 g : 25 g : 25 g) and boiling water was added (150 g/1200 ml water), blended , removing the taff fibers, then sucrose was added until the T.S.S reached 18 %.(Nezam Eldin,1978)

All the previous treatments were poured into stainless steel trays and dried in an oven at 60-65^{o}C till moisture content ranged between 16 – 18.5 %. The thickness of sheets were 0.3 – 0.4 mm after drying then packed in cellophane for storage at room temperature for 8 months.

Methods:

Moisture, total soluble solids (TSS%), crude fibers, ash and total acidity contents were measured according to A.O.A.C (2000). Reducing and total sugars were determined by arsinomolybedate and somogi cupper reagent as described by Somers (1952) and Nelson (1974).

Minerals Mg, Na, K, Mn, Fe, Ca and Zn were estimated according to Kasal, *et al*., (1997).

Total phenolic compounds were determined using Folin- denis reagent as described by Swain and Hillis, (1959). The concentration of flavoniods in methanol extract were measured spectrophotometrically at 440 nm (Zhisen,1999). Total color density (TCD) of all products (1 g) was extracted by 25 ml water, then filtered and the color value was measured at 420,520 and 700 nm (Somers, 1971, 1972).

$TCD = (Abs_{420} + Abs_{520}) – 2 (Abs_{700})$.

The pH value of all products was adjusted by pH meter as described by A.O.A.C (2000).

Sheet products can be reconstituted to natural drinks by adding water and sugars, then all the processed products were organoleptically tested for their color, taste, odor and palatability using a scale from 1 to 10 panelists according to Walter and Hoover (1986). The collected data were subjected to analysis of variance (completely randomized design) as described by Sendecor and Cochran (1980).

RESULTS AND DISCUSSION

Proximate physicochemical composition of raw tamarind, raw carob pods and red roselle flowers are represented in Table (1). Results showed that raw tamarind contained 18.10 %, 3.44, 11.30 %, 2.093, 2.44 %, 10.98 %, 43.93%, 77.32 mg /100g as gallic acid and 28.33 mg/100g as quercetin for

moisture content, pH value, total acidity, total color density, ash, crude fibers, total sugars, total phenols and total flavonoids respectively.

Table (1). Physicochemical properties of raw tamarind, raw carob pods and red roselle flowers (on dry weight basis).

Components	Raw tamarind	Raw carob pods	Red roselle
Moisture %	18.10	8.37	13.80
pH value	3.44	5.92	3.09
Total acidity(as citric acid)* %	11.30	0.803	16.33
Total color density*	2.093	0.702	5.06
Ash %*	2.44	2.79	8.90
Crude fibers %*	10.98	6.89	9.65
Total sugars %*	43.93	59.50	3.36
Total phenols (mg/100 g as gallic acid)*	77.32	36.69	15.73
Total flavonoids (mg/100g as quercetin)*	28.33	31.61	10.21
Mg (mg/100g *)	29.65	15.89	11.10
Na (mg/100g *)	80.80	151.99	65.98
K (mg/100g *)	462.306	135.4	4.23
Mn (mg/100g *)	2.590	1.69	0.20
Fe (mg/100g *)	10.98	2.39	11.50
Ca (mg/100g *)	60.03	499.80	241.36
Zn (mg/100g *)	0.363	0.903	0.990

*** on dry weight basis**

Raw carob pods contained 8.37% moisture, 6.11 pH value, 0.8 % total acidity, 0.702 total color density, 2.44 % ash, 10.98% crude fiber, 59.50 % total sugar, 36.69 mg/100g total phenols and 31.6 mg/100g total flavonoids.

On the other hand red roselle flowers contained 13.80 %, 3.09, 16.33%, 5.06, 8.90%, 9.65%, 3.36%, 15.73 mg/100g and 10.21 mg/100g for moisture content, pH value, total acidity, total color density, ash, crude fibers, total sugars, total phenols and total flavenoids respectively.

In the same Table (1),results reveald that raw tamarind, raw carob pods and red roselle flowers had different concentration of Mg, Na, K, Mn, Fe, Ca and Zn. Some changes were observed in physicochemical properties of all raw materials after processing and storage for 8 months at room temperature.

Data given in Table (2) showd that the chemical composition of tamarind sheet (T1), carob pods sheet (T2), mixture of tamarind and red roselle sheets (T3)and mixture of the tamarind ,red roselle and carob pods sheets (T4). From the obtained results it could be noticed that, the moisture content at zero time was 18.40%, 17.50%, 18.90% and 18.60% for T1, T2, T3 and T4 respectively.

Total soluble solids (TSS) were 78%, 79%, 76% and 78% for T1, T2, T3 and T4 respectively. On the other hand, total acidity has higher values for tamarind sheets T1 (0.60%) followed by mixture of tamarind and red roselle sheets T3 (0.36 %), and their mixes sheets T4 (0.27 %), while it was lower (0.03%) in carob pods sheets (T2) at zero time. These values of total acidity

for different investigated natural sheets are logic if compared to the pH value of those sheets, Table (2).

Table (2). Physicochemical properties of sheets manufactured from tamarind, carob pods and red roselle and its mixtures . (on dry weight basis).

Treatments / Properties	T1	T2	T3	T4
T.S.S. %	78	79	76	78
Moisture content %	18.40	17.50	18.90	18.6
pH value	3.26	5.98	3.31	3.43
Total acidity (as citric acid) %	0.60	0.03	0.36	0.28
Total Color Density	0.800	0.367	1.45	1.41
Ash content %	1.50	1.20	2.61	1.25
Crude fibers %	2.60	2.31	1.60	1.66
Reducing sugars %	24.53	48.0	59.00	59.50
Total sugars %	72.76	68.0	71.00	70.50
Total phenols mg/100g (as gallic acid)	76.63	35.16	35.33	33.25
Total flavonoids mg/100g (as quercetin)	27.48	30.0	23.71	30.71

T1: Tamarind sheets.
T2: Carob pods sheets.
T3: mixture of tamarind and red roselle sheets.
T4: Mixture of tamarind, red roselle and carob pods sheets.

From the same Table (2), it could be noticed that ash contents of T1, T2, T3 and T4 were 1.59%, 1.44%, 2.16% and 1.25% respectively at zero time. Crude fibers of tamarind sheets and carob pods sheets were higher than the sheets (T3 and T4) .The reducing sugars of T1, T2, T3 and T4 were 24.53%, 48.0%, 59% and 59.50% while total sugars content were 72.76%, 68.0%, 71.0% and 70.50% for the same sheets respectively at zero time.

From the same Table (2) it could be noticed that total phenolic compounds of tamarind sheet(T1)(76.63mg/100g as Gallic acid) were higher than the other sheets(T2,T3 andT4),while total flavonoids were 27.48, 30.0, 23.71 and 30.71 mg/100g as quercetin for T1, T2, T3 and T4 respectively at zero time.

The chemical properties of all sheets products are mentioned in Table (2). It could be noticed that the pH values were 3.26 of (T1), 5.98 of (T2), 3.31 of (T3) and 3.43 of T4 respectively.

The total color density (TCD) measurements revealed that T3 and T4 show a higher color density when compared to T1 and T2. This could be related to anthocyanine pigments of red roselle (Abdallah, *et al*., 2011).

Effect of storage period on the chemical properties of tamarind sheets (T1), carob pods sheet (T2); mixes of tamarind and Roselle sheets (T3), and their mixes sheets (T4) at room temperature for 8 month and being shown in Table (3). It was noticed that the moisture content had slightly decreased during storage after 4 months and decreased slightly during storage at room temperature for 8 months which could be related to the

decrease in some soluble components (sugars, phenolics and flavonoids). These results agree with those obtained by Sedki, (1978), Nezam Eldin and Azza Abd El Hameed, (2001).

Table (3). Physicochemical properties of sheets manufactured from tamarind, carob pods and red roselle and its mixtures . (on dry weight basis).

Treatments / Storage (months)		T.S.S. %	Moisture content %	pH value	Total acidity (citric acid) %	Total color density	Ash content %	Crude fiber %	Reducing sugars %	Total sugars %	Total* phenols	Total** flavonoids
T1	Zero	78	18.40	3.26	0.60	0.80	1.50	2.60	24.53	72.76	76.63	27.48
	4	77	18.10	3.58	0.35	0.27	1.56	2.64	22.20	71.79	26.86	23.00
	8	70	16.70	2.49	0.59	1.05	1.53	2.15	21.15	55.86	6.64	4.75
T2	Zero	79	17.50	5.98	0.03	0.361	1.20	2.31	48.0	68.0	35.16	30.00
	4	74	17.30	5.93	0.03	0.12	1.36	2.44	39.14	64.75	31.44	29.50
	8	71	13.60	5.77	0.05	0.57	1.30	2.42	34.03	63.04	5.21	3.47
T3	Zero	76	18.90	3.31	0.36	1.45	2.16	1.60	59.0	71.0	35.33	23.71
	4	75.8	18.60	3.06	0.37	1.09	2.13	1.60	57.99	70.90	29.48	20.50
	8	74	17.89	3.57	0.31	0.78	2.20	1.70	23.87	61.76	6.17	4.87
T4	Zero	78	18.60	3.43	0.28	1.41	1.25	1.66	59.50	70.50	33.25	30.71
	4	76	18.30	3.15	0.30	0.75	1.25	1.66	59.97	69.11	30.33	26.50
	8	74	17.47	3.62	0.22	0.74	1.13	1.89	21.20	66.89	3.15	3.03

***mg/100g as gallic acid.**
****mg/100g as quercetin**
T1: Tamarind sheets.
T2: Carob pods sheets.
T2 : Mixture of tamarind and red roselle sheets
T4: Mixture of tamarind, red roselle and carob pods sheets.

Total acidity of (T1) decreased after 4 months then increased after 8 months. The changes of acidity were a summation of basic organic compounds produced by Maillard reaction (Reynolds, 1965). On the other hand, total acidity of (T2) and (T3) increased after 4 and 8 months while (T4) increased after 4 months then decreased after 8 month. This increase may be related to the changes of protopectin into pectic acids (Michael Eskin, 1990).

Table (3) shows that reducing and total sugars decreased gradually throughout storage periods of 8 months. This decrease may be attributed to the non enzymatic browning reaction (Nezam El Din, 1978). Also, previous reaction may be accelerated by heat of processing and storage (Hamed, 1980 and Aguilera, *et al*., 1987).

From the sameTable (3), it is evident that the total free phenolic compounds and total flavonoids content were very high in all treatments of sheets after processing (at zero time), on the other hand storage of all treatments of sheets for 4 months at room temperature showed a gradual decrease in total phenolic compounds and flavonoids. In addition a high decrease was observed in total phenolic compounds and flavonoids of all sheets treatments after storage for 8 months at room temperature. This

decrease may be related to the oxidation of phenolic compounds (Khames, 2004).

Chemical characteristics of prepared natural sheets processed from tamarind, carob pads, mixture of tamarind and red roselle, and their mixes were tested during storage for 8 months at room temperature. The pH value and total color density were measured after 4 and 8 months. Results are tabulated in Table (3). The pH value of (T1) increased after 4 months which may be related to formation of basic compounds resulting from browning reaction (Hodge, 1953). A low decrease was observed after 4 months for T2, T3 and T4. Then after 8 months a slight decrease was observed of T1 and T2 while T3 and T4 were increased.

From the same Table (3) it could be conducted that the total color density (TCD) decreased gradually in all sheets after 4 months at room temperature. This decrease of total color density would be related to the effect of heating on the degradation of natural pigments (Nezam El Din, 1996c). Increasing the time of storage for 8 months at room temperature led to increase the total color density of tamarind sheets (T1) and carob pods sheets (T2) which may be due to the non enzymatic browning reaction (Nezam El Din and Azza, 2003).

By measuring the minerals content of all sheets at zero time, it could be noticed that all the sheets contained good concentration of magnesium, sodium, potassium, manganese, iron, calcium and zinc. Results in Table (4) illustrated that minerals had slightly decreased during storage at room temperature for 4 and 8 months.

Table (4). Mineral contents of different sheet products (mg/100g on dry weight basis).

Treatments / Storage (months)		Mg	Na	K	Mn	Fe	Ca	Zn
T1	Zero	5.618	133.727	16.732	0.286	10.344	55.60	0.359
	4	5.450	133.527	16.032	0.265	10.044	55.29	0.352
	8	5.440	133.501	15.132	0.223	10.010	55.011	0.350
T2	Zero	4.388	125.222	18.842	0.126	2.818	557.834	0.306
	4	4.178	120.001	18.141	0.112	2.810	552.981	0.302
	8	4.165	119.119	18.043	0.111	2.789	552.881	0.301
T3	Zero	4.073	122.990	11.715	0.215	8.766	623.058	0.940
	4	4.012	120.001	10.315	0.210	8.511	620.805	0.912
	8	4.001	119.129	10.139	0.200	8.210	616.552	0.202
T4	Zero	4.231	124.106	15.279	0.171	5.792	590.446	0.200
	4	4.095	122.010	14.228	0.161	5.660	586.893	0.196
	8	4.083	120.139	14.091	0.156	5.499	584.716	0.195

T1: Tamarind sheets.
T2: Carob pods sheets.
T3: mixture of tamarind and red roselle sheets.
T4: Mixture of tamarind, red roselle and carob pods sheets.

The organolepitc evaluation of reconstituted natural drinks of all sheets were done at zero time and during storage for 4 and 8 months at room temperature. Data were statistically analyzed. The obtained results are

shown in Table (5) for color, taste, odor and palatability. It could be clearly observed that there were no significant differences in sensory attributes at zero time and during storage of all reconstituted sheet drinks at room temperature. Also, it could be noticed that there were no important differences in sensory evaluation between all drinks produced from all the sheet products. This indicates that the processing of those natural drinks from all sheets were perfect either on the zero time or during storage at room temperature.

Table (5) Organoleptic evaluation of reconstituted natural drinks prepared from sheet products.

Sensory properties	Storage period (months)	T1	T2	T3	T4	LSD at 0.05 level
Color	Zero	7.60^{Aa}	7.75^{A}	7.70^{Aa}	7.55^{Aa}	0.83^{ns}
	4	8.00^{Aa}	7.90^{Aa}	7.80^{Aa}	7.50^{Aa}	0.73^{ns}
	8	7.70^{Aa}	7.70^{Aa}	7.45^{Aa}	7.55^{Aa}	0.81^{ns}
LSD at 0.05 level		0.79^{ns}	0.83^{ns}	0.81^{ns}	0.72^{ns}	
Taste	Zero	7.80^{Aa}	7.65^{Aa}	8.20^{Aa}	8.05^{Aa}	0.94^{ns}
	4	8.15^{Aa}	7.95^{Aa}	7.70^{Aa}	7.55^{Aa}	0.79^{ns}
	8	7.85^{Aa}	8.05^{Aa}	8.05^{Aa}	7.65^{Aa}	0.77^{ns}
LSD at 0.05 level		0.65^{ns}	0.95^{ns}	0.94^{ns}	0.78^{ns}	
Odor	Zero	7.70^{Aa}	7.60^{Aa}	7.55^{Aa}	7.30^{Aa}	0.85^{ns}
	4	7.75^{Aa}	7.90^{Aa}	7.40^{Aa}	7.40^{Aa}	0.77^{ns}
	8	7.55^{Aa}	7.80^{Aa}	7.35^{Aa}	7.40^{Aa}	0.71^{ns}
LSD at 0.05 level		0.82^{ns}	0.81^{ns}	0.94^{ns}	0.98^{ns}	
Overall acceptability	Zero	8.05^{Aa}	7.65^{Aa}	8.20^{Aa}	7.95^{Aa}	0.81^{ns}
	4	7.70^{Aa}	7.85^{Aa}	7.30^{Aa}	7.09^{Aa}	0.97^{ns}
	8	7.80^{Aa}	7.65^{Aa}	7.39^{Aa}	7.30^{Aa}	$0.0.75^{ns}$
LSD at 0.05 level		0.57^{ns}	0.61^{ns}	0.96^{ns}	0.91^{ns}	

mean values in the same column (as a capital letter) or row (as a small letter) with the same letter are not significant different at 0.05 level
ns = not significant
T1: Tamarind sheets.
T2: Carob pods sheets.
T3: mixture of tamarind and red roselle sheets.
T4: Mixture of tamarind, red roselle and carob pods sheets.

Table (6) shows the yield and cost of tamarind, carob pods, mixes of tamarind and red roselle sheets and its mixed sheets. It was found that (T2) had a lower yield of sheets (350 g) and a lower cost (4.50 pound), while (T3) and (T4) had an equal yield of sheets (500 g). While the cost were 4.60 and 4.65 pounds respectively. Meanwhile the yield of (T1) was 400 g of sheet. This treatment had a higher cost (5.25 pound) when compared with the others.

Table (6). The yield and costing of tamarind sheet, carob pods sheet and its Mixtures

S. No.	Name of the item	Yield / gm	Cost / pound
T1	• Tamarind (250g) extracted with boiling water (1 liter water). • Sugar**s**	400	4.00 1.25
	Cost of production		5.25
T2	Carob pods (250g) extracted with boiling water (1 liter water). • Sugars	350	3.00 1.25
	Cost of production		4.50
T3	• Mixing extract of tamarind and red roselle (1:1 v/v) • Sugars	500	1.60 1.50 1.50
	Cost of production		4.60
T4	Tamarind (100g) + red roselle (25 g) + carob pods (25g) extracted with boiling water (1200 ml water). • Sugars	500	160 0.75 0.30 2.00
	Cost of production		4.65

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الإستفادة من بعض المصادر النباتية فى انتاج لفائف جديدة

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أجريت هذه الدراسة بغرض انتاج منتجات جديدة من بعض المصادر النباتية الشائعة فى صورة لفائف من التمر هندى و الخروب و خليط من التمر هندى والكركديه الاحمر(١: ١ وزن / وزن) وخليط من التمر هندى والخروب و الكركديه الاحمر(٤ : ١ : ١ وزن / وزن). تم رفع المواد الصلبة الذائبة الى ١٨% بواسطة السكروز وقيمت اللفائف المجففة من ناحية التركيب الكيميائى والطبيعى والتقييم الحسى بعد الإنتاج مباشرة ثم بعد التخزين على درجة حرارة الغرفة ولمدة ٤ و٨ شهور. لقد ثبت من خلال النتائج التحصل عليها من التقييم الحسى أن جميع المشروبات الطبيعية الشعبية المسترجعة من اللفائف حصلت على قيم جيدة من ناحية اللون و الطعم و الرائحة ومدى القابلية لدى المحكمين. ثبت أيضا أن تخزين اللفائف على درجة حرارة الغرفة أحدث بعض التأثير على الخصائص الطبيعية والكيماوية لتلك اللفائف.

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