NEW UNTRADITIONAL DRIED SHEETS FROM PLUM AND APRICOT FRUITS

H.S. HAMED, HEMMAT I. MATTUK AND F.A. EL-ASHWAH

Food Technology Research Institute, Agricultural Research Centre. Giza, Egypt.

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Abstract

This study was conducted to assess the possibility of producing new untraditional dired fruit sheets prepared from mixtures of apricot and plum puree with or without the addition of binding agents such as carboxy methy cellulose (CMC), Locust bean gum (Vidogum (L 175) and Guar Gum (GH 200), and to compar these products with those produced from apricot and plum fruits separately. The effect of dehydration and cold storage at 4°C for six months, on those aforementioned dried sheets was studied. From this study, it could be concluded that from the point of view of chemical constituents and reconstitution percentage (R%), the dried ssheets prepared from the mixtures of apricot and plum puree (1:1/w/w) with the addition of binding agents (C.M.C, L175 and GH 200 separately) were the best products, respectivley. The effect of both the dehydration process and cold storage at 4°C for up to six months on their chemical composition, or on the changes occurred in their components were studied. The chemical analysis of the aforementioned dried sheets indicated that they contained moderate and balanced contents of acidity, ascorbic acid, non enzymatic browning color and sugars as well as they had high reconstitution percentage (R%) either after dehydration directly or after the cold storage at 4°C for up to six months.

INTRODUCTION

Apricot fruits are usually consumed either fresh or as processed products such as preserved single strength juice, concentrated juice, jams, dried sheets (Qumar El Din), and dried Meshmeshia etc. Since the apricot season in the A.R.E. is very short, it is our task to extend the apricot availability in the local market through processing and preservation technology. Plum is considered to be one of the most popular and tasty fruits for consumers in many countries.

The best varieties of plum are usually charcterized by having high content of sugars, being suitable to produce high quality processed products. Plum is also charcterized by its low conent of acidity while apricot fruits usually contain high total acidity with low sugar content compared to plum. On the other hand, the plum season in the A.R.E. is rather long, last more than three months in summer. In the mean time, it is well known that few attempts have been tried for processing plum fruits in Egypt and most of the produced plum quantities are consumed fresh.

The moisture content of the dried sheets plays an important role in their Keeping quality (Nezam El Din (1978) and Hamed (1980). On the other hand, Prain *et al.* (1969), and Voi *et al.* (1995) demonstrated that total acidity, total sugars content, moisture content and reconstitution ratio were the most important items affecting the quality factors of the final dried products.

Nezam El-Din (1978), and Hamed (1980), stated that natural pigments were injured by the drying processes, they also added that Millard browning reaction strictly occurred at elevated drying temperatures. Heikal *et al.* (1972) demonstrated that blanching at 185^{O}F for 5-6 minutes led to a high rehydration rate for the dehydrated product.

In Egypt three major apricot varieties are planted in 6956 feddans, the total annual production of apricot fruits in the year 1995 amounted to 44833 tons (Anonymous, 1996). These three varieties are El-Amar, Fayoumy and Hamawy varieties. As for plum, there are many varieties cultivated in Egypt such as Hollyoud, Golden Japanese, Methly, Climax, Beauty, and Santarosa, these aforementioned varieties are old and the new introduced varieties are Dorado, Aldorado, Kelzy, Merbosa and Larosa. All these varieties are planted in 8089 feddans which produced 53382 tons in (1995), Anonymus (1996). Therefore, and for all these mentioned aspects, it will be reasonable and desirable to asses the possibility of producing some untraditional dried products from different mixtures of plum and apricot fruits.

MATERIALS AND METHODS

A. Materials

Dehydration studies were carried out using apricot fruits of Balady variety obtaind from Fayoum governorate during (1995), while those of plum were purchased from a private orchard at kaluobia governorate during (1995) summer season. Apricot (Prunus armeniaca) and plum (Prunus domesicus, L). Fruits were washed, sorted, pitted without damaging pulp then steam blanched.

Steam blanching was conducted using a special apparatus as shown in fig. (1) which was designed by El-Saidawy (1976) for two minutes. It was found that steam blanching for one minute was quite enough to inactivate or inhibit oxidizing enzymes activity as described by Erwin (1969). The blanched apricot and plum fruits were separately blended then screened to obtain their purees. The treatments carried out to prepare dehydrated fruit sheets were as follows:-

1. Hot puree of apricot and/or plum fruits were mixed by the ratio of (1:1 w/w) without any additives.

2. As the above mentioned treatment plus adding (CMC) (1g/liter) to the mixture, or adding L 175 (1g/liter) as treatment No. 3, or adding GH200 (1g/liter) as treatment No. 4.

5. Hot puree of apricot and plum fruits was mixed by the ratio of (2:1 w/w) respectively without additives.

6. Hot puree of plum fruits without any binding agent.

7. Hot puree of apricot fruits without any binding agent.

The total soluble solids (T.S.S.) content of each treatment was raised up to 15% by adding sugars. After dehydration all treatments were packed in cellophane, tighly closed then stored at 4^{o}C for six months. All the aforementioned treatments were separately poured on stainless steel trays, of an oven fitted with an electric fan at 65^{o}C for 8 hours. The dehydration process was continued until the moisture content ranged between 16 and 18%.

B. Methods:

Moisture content, total soluble solids, protein, total titratable acidity, reducing sugars, non reducing sugars, total sugars, ash, fat and color index were determined according to the methods described in the A.O.A.C. (1990). Ascorbic acid was determined using 2,6 dichlorophenol indophenol method as described by Pearson (1984).

Reconstitution percentage (R%) of the dried fruit products was determined as described by Neubert *et al.* (1968).

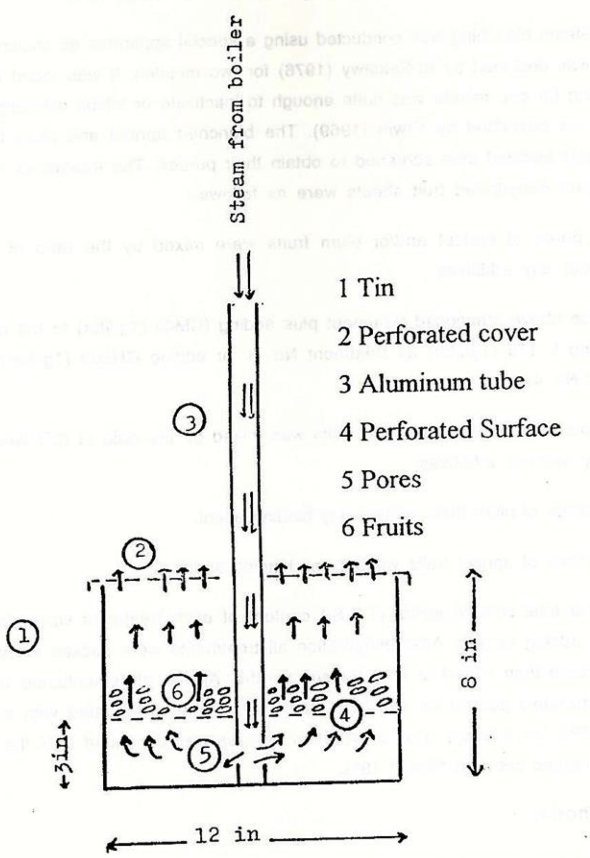

Fig. 1. Longitudinal section in the steam blanching apparatus designed for laboratory use.

The chemical analysis was performed for fresh fruits of apricot and plum separately, directly after dehydration and during storage at 4°C every 8 weeks for up to 24 weeks.

RESULTS AND DISCUSSION

1. Chemical composition of fresh apricot and plum fruits:

From the data shown in Table 1, it could be observed that total soluble solids content in plum pulp is higher than that of apricot pulp (11.86% and 12.94% respectively). From the same table, it could be concluded that sugars content was higher in plum pulp compared to that of apricot (78.6% and 57.16% respectively) calculated on dry weight basis.

Table 1. Chemical composition of fresh apricot and plum fruits.

Constituents	Apricot	Plum
Total soluble solids (T.S.S) (%)	11.86	12.94
Total Solids (T.S) (%)	14.66	14.07
Moisture content (%)	85.32	85.91
Total titratable acidity (*as citric acid g/100g)	11.92	3.66
Reducing sugars * (g/100g)	17.28	22.88
Non reducing sugars * (g/100g)	39.88	55.81
Total sugars * (g/100g)	57.16	78.69
Ascorbic acid * (g/100g)	96.71	79.97
Protein * (g/100g)	3.76	3.11
Fat * (g/100g)	1.71	0.72
Ash * (g/100g)	3.61	4.41

* Calculated on dry weight basis.

On the other hand, titratable acidity in apricot pulp was about three folds of that in plum pulp (11.92% and 3.66% on dry weight basis, respectively). These results are in agreement with those reported by Ibrahim (1990) who demonstrated that apricot fruits were more acidic compared to plum ones while the highest content of sugars were found in plum fruits.

2. Effect of dehydration and storage on chemical and physical characteristics of dried fruit sheets:

From Table 2, it could be observed that the moisture content decreased from

85.32% and 85.91% (as described in Table 1) in fresh apricot and plum fruits to an extent which ranged between (14 and 18%) in the similar fruit dried sheets. From the same table, it could be noticed that the moisture content in all different treatments increased during storage at $4^{o}C$. this increment may be due to the absorption of the atmospheric moisture during storage and due to packing in cellophane.

Table 2. Effect of dehydration and cold storage (at $4^{o}C$) on moisture content of dried sheets.

Treatment*	Cold Storage at $4^{o}C$ (in weeks)			
	0	8	16	24
1	16.19	16.62	17.29	18.31
2	16.06	16.38	17.88	18.52
3	17.33	17.67	18.02	18.56
4	16.28	16.60	17.11	17.61
5	15.79	16.11	16.58	17.09
6	14.60	15.03	15.78	16.72
7	16.36	16.69	16.97	17.01

* 1. Mixed hot apricot and plum puree (1:1 w/w)
2. Mixed hot apricot and plum puree (1:1 w/w) containing carboxy methyl cellulose (CMC g/liter).
3. Mixed hot apricot and plum puree (1:1 w/w) containing (L 175, 1 g / liter).
4. Mixed hot apricot and plum (2:1 w/w).
5. Mixed hot pricot and plum (2:1 w/w).
6. Hot plum puree.
7. Hot apricot puree.

These results are in agreement with those found by Mohamed (1969) and Abd El-Salam (1991) during their studies on different dehydrated fruit products.

From Table 3, pronounced decrements could be observed in ascorbic acid content of all dried sheets, either during dehydration or throughout the storage period which lasted for 24 weeks. These decrements may be due to the oxidation of this vitamin into other forms such as dehydroascorbic acid 2.3 kitognolouic acid etc (Abd El-Salam, 1991).

From the same table, it could also be noticed that the aforementioned changes in ascorbic acid were the least in dried sheets produced from a mixture of apricot and plum (1:1 w/w) carboxy-containing (CMC) (1g/liter), followed by those prepared from the mixture of apricot and plum (1:1 w/w) with (L 175, 1g/liter), and finally those prepared from the same previous mixture with (GH200 (1g/liter). This means that the rate of ascorbic acid oxidation was decreased by the addition of binding agents, indicating that (CMC) had the best effect among all used binding agents. This effect may also be due to the properties of the binding agents which may act as a thin film coating the molecules and minute particles of the mixture of aprioct and plum. This coating will have a very improtant effect on the protection of different chemical components of that mixture against oxidation or it would serve as a barrier against oxidation. This conclusion is in agreement with Pakash *et al.* (1994) and Abdel-Salam (1991) who demonstrated that sulphuring, soaking in citric acid and the addition of binding agents had a great effect on the protection of ascorbic acid in dried products.

Table 3. Effect of dehydration and cold storage (at 4°C) on ascorbic acid content of dried sheets (mg/100 g dry weight basis).

Treatment*	Cold Storage at 4°C (in weeks)			
	0	8	16	24
1	105.25	71.57	55.82	42.86
2	152.17	121.73	92.31	81.41
3	142.18	118.68	83.61	72.40
4	136.83	109.83	78.66	68.06
5	132.15	102.16	69.46	45.58
6	65.28	52.22	31.38	21.06
7	59.25	47.40	30.81	18.25

* For treatment explaination, see table 2.

Concerning the effect of dehydration process on the total acidity of dried sheets (Table 4); it could be concluded that this component decreased as affected by all treatments. It is well known that most of organic acids are usually soluble in water. These acids may leach through blanching process, therefore it is expected that blanching will cause a decrease in total acidity (Mohamed, 1989).

From the data given in Table 5, it could be clearly observed that the dehydration process had a clear effect on the sugars content. While an obvious decrease occurred in the non reducing sugars a simultaneous increase was observed in the reducing ones. This phenomenon could be explained by the fact that under acidic conditions and drying temperature, the non reducing sugars inverted to reducing ones (Hamed (1980) and Abd El-Salam (1991). This caused an accumulation of reducing sugars which could be observed immediately after dehydrtion in all treatments, meanwhile during storage of dried sheets at 4°C the reducing sugars began to decrease. This decrease indicates that the amount of inverted sugars would not be also enough to substitute all the losses in the reducing sugars content reacting in the browning system at the end of storage. These results could be proved by the pronounced decrease of the non reducing sugars encountered by an obvious decrease in the reducing and total sugars at these stages. These results coincide with the findings of (Bhatti *et al.* (1968), Hamed (1980) and Haredy (1992). From Table (5), it could be also concluded that dried sheets containing binding agents i.e. (CMC), L 175 and GH 200 had higher contents of reducing, non reducing and total sugars than those of dried sheets free from binding agents. This result is in agreement with Abd El-Salam (1991) and Pakash *et al* (1994). who demonstrated that the binding agents made thin films surrounding the minute particles of different chemical components causing protection to these compounds against any chemical reactions and minimizing to a great extent any loss which may happen due to these a forementioned reactions.

The non enzymatic browning color was expressed as absorbance and tabulated in Table 6. Generally, absorbance readings which represent the degree of darkening in the dried sheets were inversely proportional mainly to reducing and total sugars. From the data given in the above table it could be concluded that the absorbance readings of dried sheets containing, binding agents. i.e. (CMC), L 175, GH200 were less as affected by dehydration and storage conditions at 4^{o}C). compared to dried sheets free from those aforementioned binding agents. This may be due to the retarding or inhibition effect of binding-agents on non enzymatic browning.

These results are in agreement with those found by Abd El-Salam (1991) and Pakash *et al.* (1994).

The reconstitution percentage (R%) of the dried sheets was determined and illustrated in figures (2 and 3) against time of soaking in hours. The rehydration percent determination was continued in all different dried sheets up to six hours. From figures (2 and 3), it could be observed that nearly all different dried sheets had the ability to absorb water directly after dehydration and after storage at 4^{o}C for up to 24 weeks. This ability of absorbing water was found to increase until the fifth hour of soaking in water, then came to an end. From the same figures, it could be also noticed that these dried sheets after storage at 4^{o}C for 24 weeks (fig. 3) had reconstitution percentages (R%) higher by about (10-15%) compared to the dried sheets tested directly after dehydration (Fig. 2). These results are in agreement with Van-Arsedel (1964), Nezam El-Din (1978), Hamed (1980) and Hassan (1995). From the same figures, it could be also concluded that the dried sheets containing binding agents had higher reconstitution percentages (R %) compared to those of dried sheets not containing these agents.

This may be due to the high ability of binding agents in absorbing water as these agents are polysaccharides, these polysaccharides are lyophylic compounds which have the high ability of binding water, hence the rehydration percentage (R%) of dried sheets containing these agents will be higher (Glicksman (1969), Abd El-Salam (1991) and Pakash *et al* (1994).

Finally, it could be concluded that from the view point of chemical constituents and reconstitution percentage (R%), the dried sheets prepared from a mixture of hot puree apricot and plum (1:1 w/w) containing (CMC, g/Liter) as a binding agent was the best product concerning the effect of both dehydration process and storage at 4°C up to six months on its chemical components and/or on changes occurring in their components, followd by dried sheets produced from the same aforementioned mixture containing Locust bean gumvido gum (L 175) (g/Liter) as a binding agent, then those containing guar gum (GH 200).

Generally it is recommended to produce dried sheets from a mixture of both apricot and plum puree (1:1 w/w) with the addition of binding agents (1g/Liter). These sheets will acquire great preference among consumers due to their good chemical properities beside their high reconstitution percentage (R%) either directly after dehydration or after cold storage at 4°C for six months.

Table 4. Effect of dehydration and cold storage (at 4°C) on total titratable acid content of dried sheets (mg/100 g dry weight basis).

Treatment*	Cold Storage at 4°C (in weeks)			
	0	8	16	24
1	14.81	14.51	13.85	12.74
2	14.95	14.65	14.35	13.63
3	14.90	14.60	13.87	13.59
4	14.88	14.58	13.81	13.42
5	18.89	17.94	16.51	14.85
6	3.52	3.44	3.27	2.94
7	10.23	10.01	9.78	9.66

* For explaination, see table 2.

Table 5. Effect of dehydration and cold storage (at $4^{o}C$) on reducing, non reducing Sugars of dried sheets (g/100 g dry weight basis).

Treatment*	Reducing sugars %					Non reducing sugars %			
	0	8	16	24	0	8	16	24	0
1	20.12	18.68	16.31	14.23	38.27	36.74	34.12	33.18	58.39
2	26.11	25.78	23.16	21.88	41.18	39.12	36.77	35.31	67.29
3	24.32	23.09	21.11	19.81	39.18	37.22	35.36	33.59	63.50
4	23.51	21.21	19.18	17.32	38.92	36.97	35.12	32.92	62.43
5	28.91	26.01	20.10	16.71	42.18	38.80	34.19	31.77	71.09
6	23.88	16.09	13.11	10.52	46.81	41.46	33.17	30.18	70.69
7	18.28	13.82	9.53	8.51	36.81	34.18	32.19	30.32	55.09

* For explaination, see table 2.

Table 6. Effect of dehydration and cold storage (at $4^{o}C$) on non enzymatic browning of dried sheets expressed as absorbance at 420 nm.

Treatment*	Cold Storage at $4^{o}C$ (in weeks)			
	0	8	16	24
1	0.402	0.575	0.685	0.745
2	0.104	0.184	0.208	0.288
3	0.165	0.215	0.295	0.310
4	0.175	0.205	0.300	0.325
5	0.295	0.395	0.485	0.595
6	0.365	0.445	0.510	0.635
7	0.310	0.585	0.615	0.785

* For explaination, see table 2.

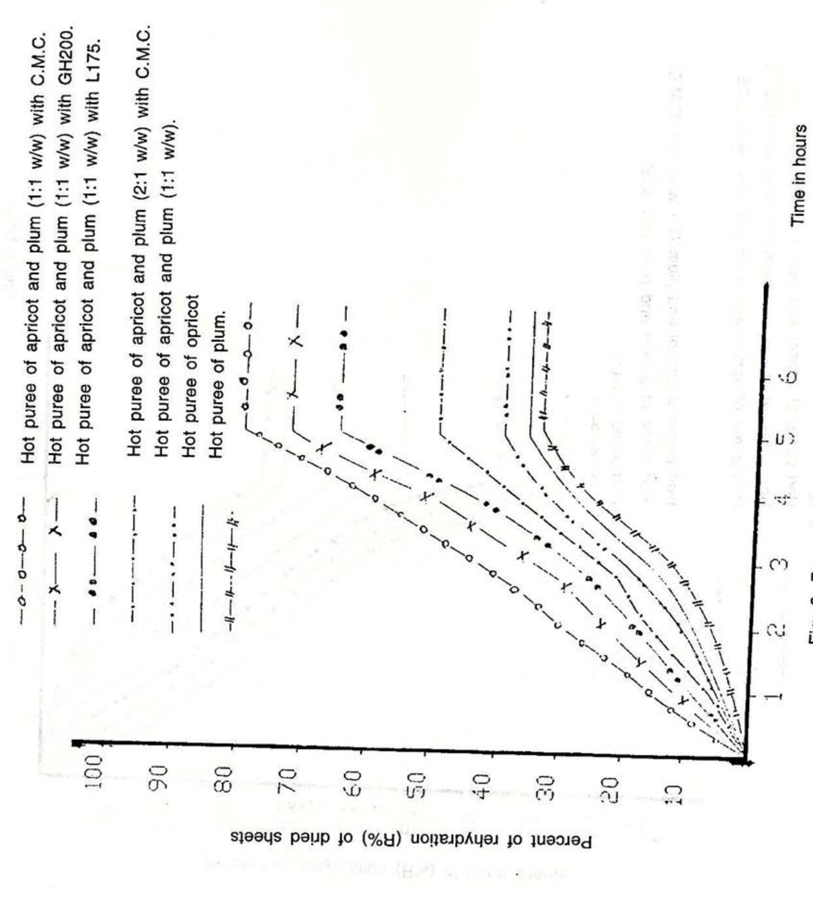

Fig. 2. Percent of rehydraation (R%) of dried sheets directly after dehydration.

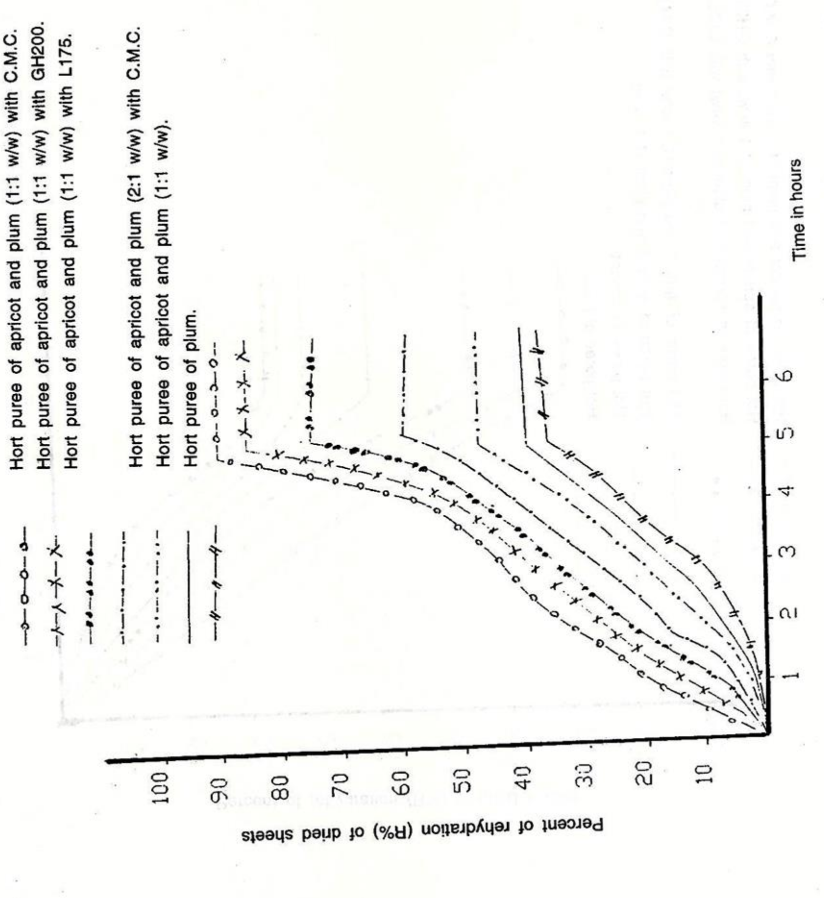

Fig. 3. Percent of rehydration (R%) of dried sheets after 24 weeks of storage at (4°C).

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لفائف مجففه غير تقليديه من ثمار البرقوق والمشمش

حامد سعيد حامد، همت إبراهيم معتوق، فؤاد أمين الاشوح

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

أجريت هذه الدراسة لتحديد مدي امكانية إنتاج لفائف مجففة من مخاليط البرقوق والمشمش وقد اضيفت الي بعض هذه المخاليط قبل التجفيف مواد رابطة مثل كربوكسي ميثيل سليلوز، صمغ الجوار، وصمغ الخروب كل علي حده بمعدل واحد جرام لكل لتر مخلوط من المشمش والبرقوق (بنسبه ١:١ وزن/وزن). وقد تمت المقارنة مع اللفائف المصنعة من مخاليط المشمش والبرقوق (١:١ وزن/وزن)، (١:٢ وزن/وزن) بدون اضافة مواد رابطه اليها وقد دلت النتائج المتحصل عليها من هذه الدراسة ان اللفائف المجففه والمصنعه من مخاليط المشمش والبرقوق بنسبة (١:١ وزن / وزن) والمضاف اليها كربوكسي ميثيل سليلوز، صمغ الجوار، صمغ الخروب كانت أفضل المنتجات المجففه علي التوالي سواء من حيث تركيبها الكيمائي الذي لم يتأثر بشده سواء بالتجفيف او التخزين علي درجة حرارة ٤ م لمدة ٦ شهور كما كانت نسب التشرب بالماء لهذه المنتجات افضل بكثير من المنتجات الأخري سواء بعد التجفيف مباشرة او بعد التخزين لمدة ٦ شهور علي درجة حرارة ٤ م.