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INFLUENCE OF PRE-TREATMENTS AND DEHYDRATION PROCESS ON CHLOROPHYLLS RETENTION OF PARSLEY, CORIANDER AND PEPPERMINT LEAVES

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Abstract

The suitability of producing some dehydrated leafy vegetables and some medicinal plants were assessed. Also, the influence of the dehydration process and storage at room temperature (25±5 °C) for up to three months on some chemical and physical properties of those dehydrated plants was determined. The obtained data reveal that parsley leaves were rich in ascorbic acid content (676.10 mg/100g).

Meanwhile, peppermint leaves were characterized for their high content of chlorophylls (2499.68mg/100g). It was also ascertained that ethanol was the most efficient solvent utilized for extraction of chlorophylls. It was also revealed that steeping in cold sodium hydroxide solution (0.2%) for one minute followed by steeping in sodium bicarbonate solution (0.3%) for 3 minutes was the best pretreatment for keeping the green brilliant color (chlorophylls). The obtained data also indicate that retained chlorophylls (as affected by dehydration) were 1167.03, 1254.96 and 1763.76 for parsley, coriander and peppermint respectively. On the other hand, the loss of ascorbic acid contents percentage was 60% in nearly all dehydrated plants. Finally, storage at room temperature for up to three months has no pronounced effect on chemical properties of dehydrated samples.

INTRODUCTION

Some leafy vegetables such as parsley (Petroselinum sativum), coriander (Coriandrum Sativum) as well as some medical plants such as peppermint (Mentha piperita) are considered to be among the most famous, important, common and popular plants in Egypt and allover the world. These aforementioned crops are commercially cultivated for their leaves widely consumed, their characteristic flavor, nutritive value and medical effects. A lot of investigators reported that Parsley, Coriander, and Peppermint are called green drugs, this may be attributed to their medical effects on minimizing and curing stomach and bladder pains, besides headache and toothache. (Holden, 1965 and Francis, 1987).

On the other hand Wu *et al.* (1992) demonstrated that Parsley is rich in its ascorbic acid content. Chlorophyll (the green pigment) is the predominant pigment existing in leaves of aforementioned crops (Steet and Tong 1996).

In Egypt, the total annual production of Parsley, Coriander and Peppermint amounted to 77831,1701 and 537 tons (as green leaves) produced from 4463,308 and 971 feddans respectively (anonymous, 1998).

Sun drying is one of the oldest and most important techniques utilized for preservation of different leafy vegetables and medical plants. It is well established by a lot of investigators that sun drying causes conversion of chlorophyll (the pigment responsible for the brilliant and preferable bright green color among consumers) to pheophytin responsible for the olive green color which is undesirable and unpalatable. Schwartz and Lorenzo (1990) reported that chlorophyll molecules are very unstable, consequently they are difficult to be retained during processing and storage. Hence, some attempts were performed investigating the possibility of maintaining chlorophylls to minimize the formation of pheophytin by controlling the pH value and minimizing heat exposure and / or by combining between high temperature short- time processing with pH adjustment (Clydesdale and Francis, 1968). Tan and Francis, (1962) and Clydesdale *et al.* (1970).

Foda and El-Waraki (1967) found that green beans blanched in sodium bicarbonate solution and then dehydrated contained more chlorophyll than green beans blanched in water or steam. On the other hand, Nezam El-Din and El- Feky (1991) reported that treating vegetables by dipping in magnesium carbonate solution led to maintain more quantities of chlorophylls and carotenoids after drying and after storage for three months.

Choi *et al.* (1991) reported that under acidic conditions (lower pH values, 1 to 4), the magnesium existing in the center of the porphyrin structure of chlorophylls (a) and (b) is replaced by hydrogen to form pheophytin, hence the color of chlorophylls (a) and (b) will change from bright green to olive green.

Steet and Tong (1996) reported that the most widely used and well established method of prevention of pheophytin formation is the addition of alkaline salts at all stages of processing. Halpin and Lee (1987) stated that addition of alkaline salts or raising the pH value to about (6) has been applied at one or more processing stages such as soaking, blanching and

This study aims to investigate the effect of some pretreatments and dehydration process on retention of bright green color (chlorophylls) as well as to investigate the effect of storage on appearance of dehydrated Parsley, Coriander and Peppermint.

MATERIAIS AND METHODS

Materials:

Fresh Parsley (Petroselinum sativum), Coriander (Coriandrum sativum) and Peppermint (Mentha piperita) were obtained from a private farm in Sharqiya Governorate, Egypt. The whole plants of each crop were washed, yellow leaves were removed, divided into eight parts and treated as follows:

1. Leaves of the first part were steeped in tap water for 3 minutes as a control.
2. Leaves of the second part were dipped in hot water at (95°C) for 10 sec.
3. Leaves of the third part were steeped in sodium bicarbonate solution (0.3%) for 3 minutes.
4. Leaves of the fourth part were steeped in citric acid phosphate buffer solution for 3 minutes.
5. Leaves of the fifth part were dipped in hot (95°C) sodium hydroxide solution (0.2%) for 10 sec.,then rinsed with tap water to remove the effect of alkalinity
6. Leaves of the sixth part were steeped in cold sodium hydroxide solution (0.2%) for one minute,rinsed with tap water to remove the effect of alkalinity .
7. Leaves of seventh part were steeped in cold sodium hydroxide (0.2%) for one minute, rinsed with tap water to remove the effect of alkalinity and steeped in sodium bicarbonate solution (0.3%) for 3 minutes.
8. Leaves of eighth part were steeped in cold sodium hydroxide (0.2%) for one minute, rinsed with tap water and steeped in citric acid phosphate buffer solution for 3 minutes.

All treatments were dehydrated by oven at 50°C till moisture content ranging between 5 to 6%. The dehydrated samples were packed in polyethylene bags and stored at room temperature (25±5°C). Samples were analyzed directly after drying and during storage every month up to three months.

2. Analytical Methods :

Moisture content, chlorophyll (a), chlorophyll (b) and phieoptiylin contents were determined according to A.O.A.C. methods (1990). Ascorbic acid was determined us-

ing 2, 6 dichlorophenol indophenol as described by pearson (1984).

Color measurement:

An ultraviolet spectrophotometer (Unicam SP1800) was used for the measurement of the color intensity at different wavelengths between 600 and 700 nm using ethanol as a blank. Dehydration ratio and dehydration yield were calculated from the equations reported by Van-Arsdel (1973).

RESULTS AND DISCUSSION

1. Chemical and physical properties of fresh leaves:

From data in Table 1, it could be observed that fresh peppermint plants had the highest percentage of leaves (59.90%) compared to stems (40,10%), so the ratio of leaves to stems was 1.5:1. Meanwhile, Parsley had lower color intensity (0.384 as O.D at 665 nm) than Coriander (0.456) and Peppermint (0.695).

Regarding chemical composition, it could be noticed that Parsley was the highest in ascorbic acid content (676. 10mg/l00g) on dry weight basis comparing to others. Moisture contents were (82.81%, 85.10% and 81.67%) in Parsley, Coriander and Peppermint. These results agree with those reported by Enayat *et al.* (1989), Yossef (1994) and Steet and Tong (1996).

2. Efficiency of extraction of chlorophylls:

From Table 2 and fig. 1, it could be clearly observed that, ethanol was the most efficient solvent utilized for extraction of chlorophylls from Parsley, Coriander and Peppermint followed by acetone and hexane (Sallam 1977).

3. Spectrophotometric analysis:

Natural green pigments isolated from Parsley, Coriander and peppermint were analysed by spectrophotometric analysis using measuring absorbances at different wavelengths ranging between 600 and 700 nm. The absorbances are illustrated in Fig. 2.

From figure 2, it could be observed that there are two peaks for absorptions of natural green pigments isolated from parsley, coriander and peppermint were recorded at 645 and 665 nm., indicating that the separated pigments were chlorophylls (a) and (b).These results were in agreement with Holden (1963), Francis (1987) and Schwartz

Table 1. Chemical and physical properties of fresh Parsley, Coriander and Peppermint leaves. (on dry weight basis)

Constituents	Parsley	Coriander	Peppermint
Physical properties:-			
- Percentage o leaves	42.91	43.18	59.90
- Color intensity (O.D at 665 nm)	0.384	0.456	0.695
Chemical composition:-			
- Moisture content (%)	82.81	85.10	81.67
- Total solids (%)	17.19	14.90	18.33
Chlorophyll (a) (mg/100g)	1298.30	1312.33	1768.42
Chlorophyll (b) (mg/100g)	356.33	466.75	731.26
Total chlorophylls (mg/100g)	1654.63	1779.08	2499.68
Pheophytin (mg/100g)	9.48	7.53	8.37
Ascorbic acid (mg/100g)	676.10	286.99	142.03

Table 2. Efficiency of extraction of chlorophylls in Parsley, Coriander and Peppermint.

Organic	Parsley			Coriander			Peppermint		
Solvent	*Chl.a	**Chl.b	***Total. Chl.	Chl.a	Chl.b	Total Chl.	Chl.a	Chl.b	Total Chl.
Acetone	1137.70	307.18	1444.88	1232.85	357.52	1590.37	1642.73	492.75	2135.17
Ethanol	1298.30	356.33	1654.63	1312.33	466.75	1779.08	1768.42	731.26	2499.68
Hexan	879.37	263.81	1143.18	947.50	293.73	1241.23	1029.32	298.50	1327.82

* Chl.a = chlorophyll a

** Chl.b = chlorophyll b

*** Total chl. = total chlorophyll

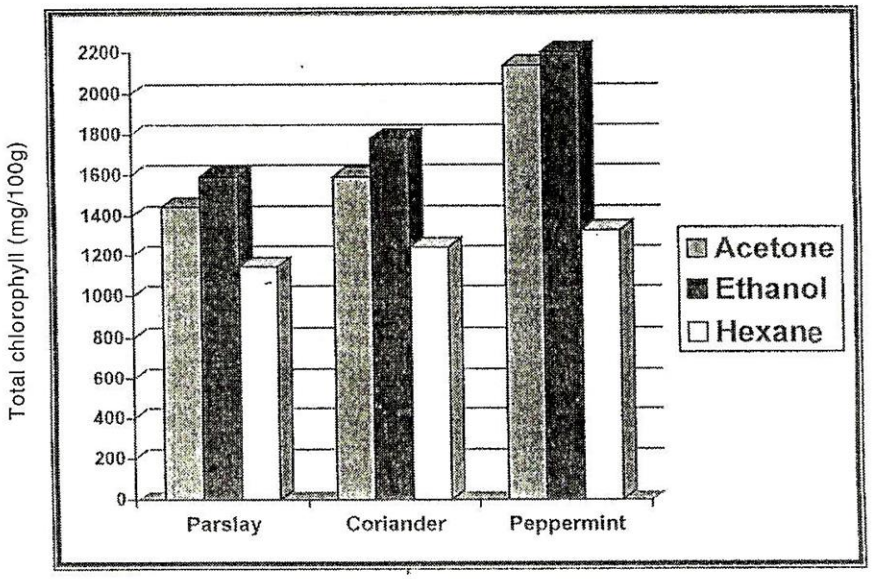

Fig. 1. Efficiency of extraction of chlorophylls in Parsley, Coriander and Peppermint

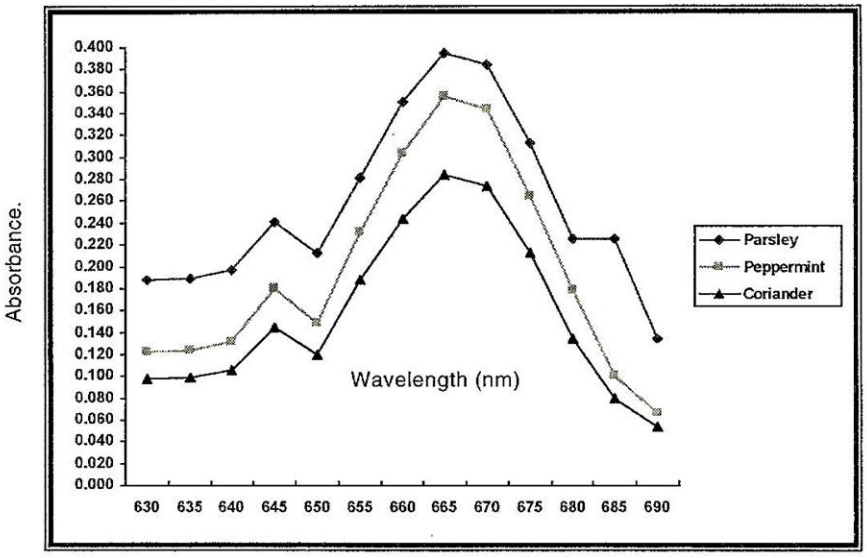

Fig. 2. Qualitative spectra of natural green pigment isolated from Parsley, Coriander and Peppermint

and Lorenzo (1990) who demonstrated that chlorophyll (a) gave its maximum absorption at 663 nm while chlorophyll (b) gave its maximum absorption at 645 nm.

Effect of pretreatments on chlorophylls contents in investigated crops :

Date concerning the effect of different pretreatments performed before dehydration on chlorophyll contents of tested samples are recorded in table 3 and illustrated in Fig. 3. It could be concluded that steeping of leaves of tested samples (Parsley, Coriander and Peppermint) in cold sodium hydroxide solution (0.2%) for one minute followed by steeping in sodium bicarbonate (0.3%) for three minutes were the best pretreatments for keeping and maintaining chlorophyll contents, indicating that this treatment was very successful compared with others in minimizing the loss in chlorophyll contents (16% loss). It could be also observed from the same table and figure that steeping in cold sodium hydroxide solution (0.2%) for one minute then buffer solution (citric acid phosphate buffer) for three minutes minimized chlorophyll loss (24%loss). Meanwhile, steeping in sodium hydroxide solution whether hot or cold was the least effective treatment in keeping chlorophylls. However, Steet and Tong (1996) reported that the most widely well-established method used for maintaining chlorophyll as well as preventing pheophytin formation is the addition of alkaline salts or buffer solution to adjust the pH value over (6). Hence steeping in sodium hydroxide solution then buffer solution were successful and applicable (pH over 6) for maintaining chlorophyll contents in tested samples. On the other hand steeping in sodium hydroxide solution wether hot or cold raised the pH value above (9) which was not suitable for keeping chlorophyll. (Hatpin and lee 1987).

Effect of dehydration on the physical and chemical properties:

The data in table 4 show that the chemical composition was greatly affected by dehydration process. The moisture contents were 5.94, 6.01 and 5.87% for parsley, coriander and peppermint after 9,10 and 8 hrs respectively. From Table 4, it could be clearly noticed that peppermint gave dehydration ratio (1:5.14) followed by parsley (1:5.5) and finally coriander (1:6.31). It was also observed that parsley contained the highest content of ascorbic acid (270.44 mg /100 g on dry weight basis), but, peppermint was the lowest 80.69 mg/l00g.

Regarding the influence of dehydration process on chlorophyll and pheophytin contents, it could be noticed that peppermint had the highest content of total chlorophylls (1763.60 mg/l00g) followed by coriander (1254.96mg/100g) and finally par-

Table 3. Effect of pretreatments on chlorophylls of Parsley, Coriander and Peppermint. dehydration.

(mg/100g on dry weight basis)

Pretreatments before dehydration	Parsley			Coriander			Peppermint		
	Chl.(a)	Chl.(b)	Chl (a)	Chl (b)	Total chlo	Chl (a)	Chl (b)	Total chl	Total chl
1	444.282	248.194	1124.854	374.951	992.776	800.586	266.862	1067.448	1499.806
2	868.680	289.560	1312.332	437.444	1158.241	934.017	311.334	1245.356	1749.776
3	930.725	310.247	1406.070	468.690	1240.972	1007.324	333.577	1334.310	1874.760
4	893.499	297.834	1349.826	449.942	1191.333	960.702	320.235	1280.937	1799.769
5	459.159	153.054	693.660	231.221	612.213	493.695	164.564	658.259	924.881
6	707.354	235.785	1068.612	346.205	943.139	760.557	253.518	1014.075	1424.817
7	1042.417	347.472	1574.798	524.932	1389.890	1120.821	373.606	1494.427	2099.731
8	943.140	314.380	1424.817	474.939	1257.520	1014.075	338.025	1352.100	1899.750

1 = Steeping in tap water for 3 minutes (control). Then dehydration.

2 = Dipping in hot water for 10 Sec. Then dehydration.

3 = Steeping in sodium bicarbonate solution (0.3%) for 3 minutes then dehydration.

4 = Steeping in Citric acid phosphate buffer solution for 3 minutes then dehydration.

5 = Dipping in hot (95°C) Sodium hydroxide solution (0.2%) for 10 Sec. Then dehydration.

6 = Steeping in cold sodium hydroxide solution (0.2%) for one minute then dehydration.

7 = Steeping in cold sodium hydroxide solution (0.2%) for one min, washing with for water, steeping in soduiom bicarbonate solution (0.3%) for 3 minutes and dehydration.

8 = Steeping in cold sodium hydroxide (0.2%) for one minute, washing with tap water, steeping in citric acid phosphate buffer solution for 3 minutes and dehydration.

Table 4. physical and chemical properties of dehydrated Parsley, Coriander and Peppermint.

Constituents	Dehydrated Parsley	Dehydrated Coriander	Dehydrated Peppermint
Physical properties:-			
Time of dehydration (hr)	9	10	8
Dehydration ratio	1:5.47	1:6.31	1:5.14
Dehydration yield (%)	18.74	15.90	20.12
Color intensity (O.D at 665nm)	0.515	0.525	0.533
Chemical Components:			
- Moisture content (%)	5.94	6.01	5.87
Ascorbic acid (mg/100g)	270.44	114.79	80.69
Chlorophyll (a) (mg/100g)	875.07	941.22	1322.82
Chlorophyll (b) (mg/100g)	291.96	313.74	440.94
Total chlorophyll (mg/100g)	1167.03	1254.96	1763.76
Total pheophytin (mg/100g)	276.68	201.75	182.10

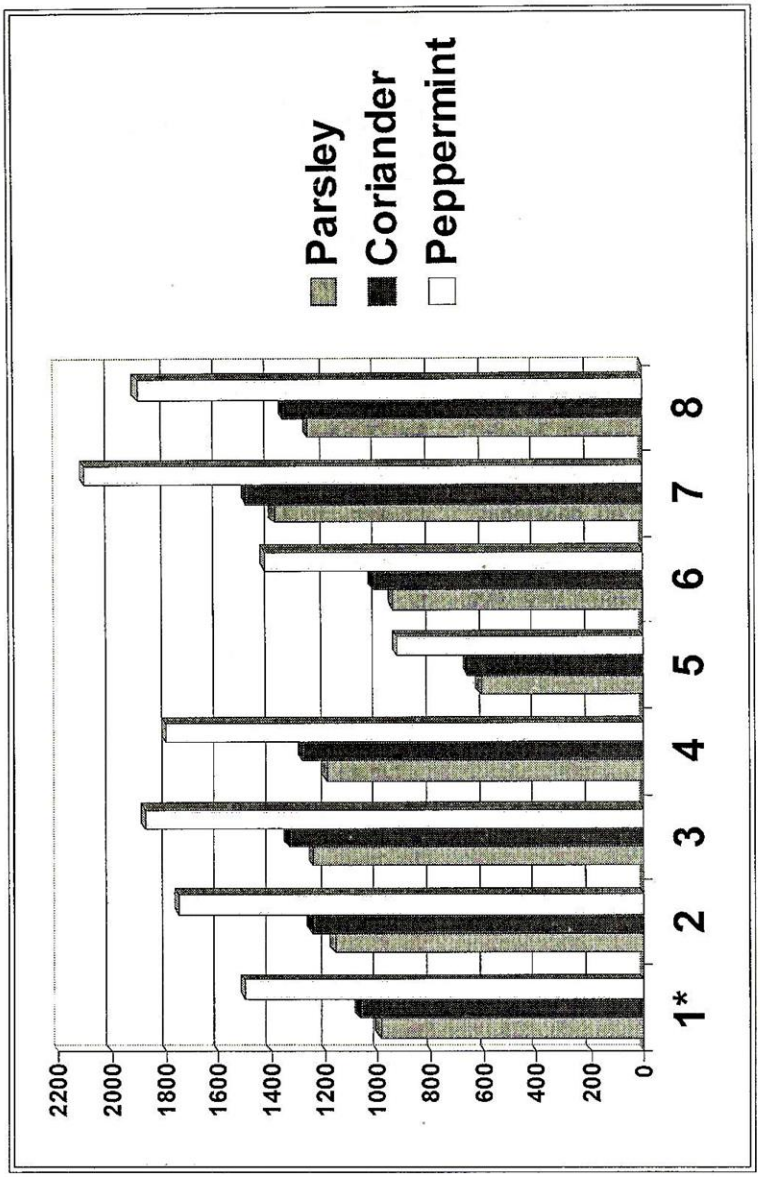

Fig. 3. Effect of pre-treatment on chlorophyll of Parsley, Coriander and Peppermint

sley (1167.03mg l00g). Meanwhile, parsley had the highest content of pheophytin (276.68mg / 100g.). This may be attributed to high content of chorophylls in peppermint, hence the retention of chlorophylls would be better in the dehydrated peppermint compared to other dehydrated samples containing less amounts of chlorophylls. These results were confirmed with Foda and El-Waraki (1967), Enayat *et al.*, (1989) and Nezam El-Din and El-Feky (1991).

Effect of storage on chemical constituents of dehydrated Parsley, Coriander and Peppermint:

Chlorophylls, ascorbic acid, pheophytin and moisture contents were determined periodically every month up to three months at room temperature (25 ± 5°C). The results in table 5 show that the total chlorophylls and ascorbic acid contents were affected by storage. There were pronounced losses in total chlorophylls and ascorbic acid contents, and the losses increased by increasing time of storage. This may be due to conversion of chlorophylls to other compounds. The same trend was observed for ascorbic acid. The retention percentages were 90, 91.5 and 93% receptively. On the other hand, the moisture content and pheophytin increased continuously as the time of storage increased due to the absorption of water from the atmosphere.

On conclusion, steeping of leafy vegetables and medical plants in cold sodium hydroxide solution (0.2%) for one minute followed by steeping in sodium bicarbonate solution (0.3%) was the best pre-treatment compared with other pre-treatments in maintaining and keeping chlorophylls of dehydrated leafy vegetables and medical plants.

Table 5. Effect of storage at room temperature (25+S°C) on chemical constituents of dehydrated Parsley, Coriander and Peppermint. (on dry weight basis)

Major Constituents	Storage period (Months)								
	Parsley			Coriander			Peppermint		
	0	1	3	0	1	3	0	1	3
Moisture content (%)	5.94	5.98	6.30	6.01	6.22	6.50	5.87	6.08	6.40
Ascorbic acid (mg/100g)	270.44	251.83	243.69	114.79	108.50	105.03	80.69	78.50	75.04
Chlorophyll (a) (mg/100g)	875.07	836.17	853.19	941.22	925.10	922.40	1322.82	1307.90	1302.98
Chlorophyll (b) (mg/100g)	291.96	289.33	284.66	313.74	6.50	307.45	440.94	437.60	434.32
Total chlorophylls (mg/100g)	1167.03	1152.50	1137.85	1254.96	1231.60	1229.85	1763.76	1745.50	1737.30
Pheophytin (mg/100g)	276.68	280.30	283.59	201.75	203.50	205.79	182.10	183.50	184.83

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تأثير المعاملات الأولية والتجفيف علي الكلوروفيل فى البقدونس والكزبرة والنعناع

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اجري هذا البحث بغرض دراسة مدي إمكانية إنتاج منتجات مجففه لبعض الخضروات الورقية مثل البقدونس والكزبرة وبعض النباتات الطبية مثل النعناع . كذلك لدراسة تأثير المعاملات الأولية وعملية التجفيف والتخزين على درجة حرارة الغرفة (٢٥ ± ٥,٠م) لمدة ٣شهور على محتوى الكلوروفيل لهذه النباتات المجففة .

وقد دلت النتائج المتحصل عليها أن أوراق البقدونس كانت عالية المحتوى من فيتامين ج (٦٧٦,١ مليجرام / ١٠٠ جرام) . كما أثبتت النتائج أن " كحول الإيثايل " كان اكفأ المذيبات التي استخدمت في استخلاص الكلوروفيل . أما عن المعاملات الأولية فقد ثبت أن النقع فى محلول هيدروكسيد الصوديوم (٠,٢٪) لمدة دقيقة ثم الغسيل بماء جارى يليه النقع في محلول بيكربونات الصوديوم (٠,٣٪) لمدة ثلاث دقائق كان أفضل المعاملات للمحافظة على اللون الأخضر الزاهي للمنتجات المجففة.

أما عن تأثير عملية التجفيف فقد وجد أن محتوى الكلوروفيل المتبقي بعد عملية التجفيف كان في أوراق النعناع (١٧٦٣,٧٦ مليجرام / ١٠٠ جرام) أما أوراق البقدونس المجففة فقد احتوت على أعلى محتوى من حمض الاسكوربيك (٢٧٠,٤٤ مليجرام / ١٠٠ جرام)

وجدير بالذكر أن التخزين على درجة حرارة الغرفة (٢٥ ± ٥,٠م) لمدة٣ شهور لم يكن له تأثير ملحوظ على الخصائص الكيمائية للمنتجات المجففة.