EVALUATION OF QUALITY ATTRIBUTES OF DEHYDRATED MINT LEAF UNDER DIFFERENT PACKAGING MATERIALS

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Abstract

Mint leaves are very popular in Mediterranean regions and represent a dominant part of the vegetation and they are mainly found only in summer.Drying is one of the traditional methods of preservation, which converts the vegetables into light weight, easily transportable and storable product. Advantage of this method is that the vegetable can be used throughout the year as it can be easily converted into fresh like form by rehydrating it. We want that Mint leaves are stored for whole year so dehydration were done . Dehydrated mint sample are packed in different packaging material such as LDPE, HDPE and Aluminum foil . Drying was completed under four different temperature, 40 C, 50 C, 60 C and Sundry. In Aluminum foil Moisture content and Ash content show best result under Sundry condition. The amount of β-carotene show best result in Aluminum foil under 40C temperature and lower in Sundry condition. Chlorophyll a, Chlorophyll b and Total Chlorophyll were found best in Aluminum foil packaging bag under Sundry condition . For Mint sample Aluminum foil packaging material are the best packaging material for long time preservation . 40 C and Sundry condition are the best for the drying of Mint because at this temperature the colour, flavor and nutritional quality of mint was maintained.

Introduction

All green leafy vegetables have occupied a unique place because of their colour, flavor and health benefits. They are rich source of β-carotene, ascorbic acid, iron, zinc, folate and dietary fiber **(Negi and Roy, 2000).** India, being bestowed with a variety of natural surroundings and varying climates and seasons has a number of edible green leafy vegetables some of which are locally grown and underutilized. In most of the underdeveloped countries, the majority of people are vegetarian and nonvegeterian items are beyond reach of poor people. Therefore, expansion of present agricultural practices into marginal lands can be expected to solve this chronic world food shortage. The nutrient content of few of the green leafy vegetables revealed that some of the greens contained comparatively higher amounts of crude protein **(Aletor *et al.*, 2002).**

Dehydration is simple and economical method of preservation. Processing by dehydration makes the green leafy vegetables light in weight, easily transportable and storable product. Dehydrated vegetables can be easily converted into fresh like form by rehydration and can be used throughout the year**.** Quality characteristics of dehydrated curry leaves and drumstick leaves were influenced by packaging materials and storage temperature **(Singh and Sagar, 2010**). During the drying process there is lot of losses takes place like nutritional, physical and chemical composition of leaves. When fenugreek leaves were dried by using solar, infra-red and tray drier there was a loss of color pigments **(Satwase *et al.* 2013)**.

The drying kinetics of mint leaves (*Mentha spicata* L.) in terms of moisture content, moisture ratio, drying time and rate, and effective moisture diffusivity was investigated **(Kadam *et al.* 2011).** The majority of research into herb dehydration examines the effect of convective drying on the ability of the dried material to retain its heat sensitive properties.

For a particular temperature, higher air humidity contributed to the degradation of the green color of the plants since drying times were prolonged. **Chou and Chua 2011** noted several advantages of hybrid microwave drying units over conventional units. Along with enhanced diffusion of heat and mass, microwave energy is reported to increase drying rates without increasing surface temperature, thereby increasing product quality. The effect of microwave heating on the extraction of volatiles from herbs and spices has been studied. The effect of microwave drying on the antioxidant activity of black pepper, oregano, basil and sage. They indicated that there was no statistical difference between the antioxidant activity of the fresh and the microwave dried samples. **Silva *et al.* 2009** evaluated drying kinetics of coriander (Coriandrum sativum) leaf and stem cinéticas de secado de hoja y tallo de cilantro (Coriandrum sativum). The fresh and dried samples were analyzed for chlorophyll and color changes during drying. It was found that microwave- dried samples had higher chlorophyll content and the green color was preserved better than for the air-dried and freeze-dried samples. Mint leaves (*Mentha spicata* L.) are a common name for members of the Labiate (Laminaceae Family). It is a large family of annual or perennial herbs and widely grown all over the world to reap its special herbal characteristics. They are herbaceous rhizome plants and emit quadrangular green or purple stalks. Several species are shrubby or climbing forms, but small trees rarely. Mint leaves are very popular in Mediterranean regions and represent a dominant part of the vegetation. Mint leaves are known for refreshing, antiseptic, antiasthmatic, simulative, diaphoretic, stomachic, and antispasmodic features. Mint leaves are used in both fresh and dried forms in different cuisines. Various authors **(Shaw *et al.* 2007)** have indicated the use of mint leaves in a variety of dishes such as vegetable curries, chutney, fruit salads, vegetable salads, salad dressings, soups, desserts, juices, sherbets etc. Mint is also very popular in India and mainly cultivated in southern parts of Himalayan range including Punjab, Himanchal Pradesh, Haryana, Bihar and Uttar pradesh. Mint (Mentha cordifolia Opiz ex Fresen) was one of the popular Thai kitchen herbs due to its unique aroma and benefits to human health such as helping to relieve from colds, flu, fever, motion sickness and poor digestion problems **(Therdthai and Zhou,2007)**. To preserve it, mint leaves were conventionally dried using either sun drying or hot air drying. Its color degrades significantly because of heating for long period. To decrease the drying time, air temperature should be increased. In addition, microwave drying may be applied. Microwave drying may be regarded as a rapid dehydration process. During the process, moisture content was reduced, as well as, loss factor of dried materials decreased. The local pressure and temperature could be increased and speed up the drying process (**Cheng *et al.* 2006**). Increasing microwave power also increased dehydration rate of carrot and mint. Mint (Mentha cordifolia Opiz ex Fresen) was one of the popular Thai kitchen herbs due to its unique aroma and benefits to human health such as helping to relieve from colds, flu, fever, motion sickness and poor digestion proble. Among the drying methods, the hot air drying is the most used method, but it can lead to thermal damage and can severely alter the volatile composition of herbs as well as the colour (**Antal *et al.*, 2011**). To preserve it, mint leaves were conventionally dried using either sun drying or hot air drying. Its color degrades significantly because of heating for long period.

Justification

The interest in studying the effects of blanching on dehydrated leafy vegetables has been of great importance as blanching is a process which extends the shelf life and stops the enzymatic activity. Blanching is a must for almost all vegetables to be frozen. It stops enzyme actions which can cause loss of flavor, color and texture. Blanching cleanses the surface of dirt and organisms, brightens the color and helps retard loss of vitamins. Dehydrated vegetables are simple to use and have longer shelf life. Mint leaves are not available throughout year so dehydrated leaves mint leaves are preferred. In addition to increasing variety in menu, reducing losses, labour and storage space. This research was also showing interest using different packaging to evaluate the shelf life of vegetables.

Objectives

In view of the above facts, thesis entitled "Evaluation of quality attributes of dehydrated mint leaves under different packaging

materials" was conducted with the following objectives:

1. To dehydrate the mint leaves at different temperature (40ºC,50ºC,60ºC and Sun Dry)
2. To determine the physico-chemical properties of samples for estimation of shelf life
3. To determine the nutritional and sensory quality of dried mint sample.

Materials and methods

Selection and Dehydration of Green Leafy Vegetables: Fresh and mature mint leaf were selected and procured from local market of Allahabad for daily experiment and brought to department of food process engineering, SHUATS Allahabad up, India to evaluation of quality attributes of dehydrated mint leaves under different packaging materials.Leaves were separated from petioles and washed with portable water to remove adhering dirt. The mint leaves were steam blanched for 90 sec and cooled immediately to room temperature by dipping in cool water. Blanched leaves were spread on trays in single layer and dried in a dehydrator at 40ºC, 50ºC, 60ºC and Sun Dry to a moisture content of 6-8% in the finished mint sample.

Packing and Storage: The dried mint leafy sample were ground to fine powder by using a mixer grinder and sieved through a 100 mesh size sieve and packed separately in 300 gauge Aluminum foil, 300 gauge high density polyethylene (HDPE) and Low density polyethylene (LDPE) bags and kept at ambient conditions (Temperature 28-36°C and RH 52-65%) for a period of 40 days for storage studies and product was drawn in 10 days interval for physicochemical analysis.

Physicochemical Analysis: Moisture content was determined by the method of AOAC [11].ASH content was estimated according to the method described by AOAC 1995.Beta Carotene Content was estimated by using Spectrophotometer. Chlorophyll was extracted in 80% acetone and the absorption at 663nm and 645nm were read using a spectrophotometer. The amount of chlorophyll is calculated using absorption coefficients (Witham, F.H.,). By this process to estimate the chlorophyll a, chlorophyll b and total chlorophyll.

Statistical Analysis: All measurements were performed in triplicate for each sample. Data were analyzed using three way ANOVA and statistical software. Differences were considered significant at $p < 0.05$.

Results and discussion

Physico-Chemical analysis of fresh Mint

On the basis of physical-chemical analysis of mint, we determined the Moisture content, Ash content, β- carotene and chlorophyll (Chl.a, Chl.b, Total chl.) of fresh mint.

Table 4.1 Quality analysis of fresh Mint leaves.

Quality analysis	Reading
Moisture content	**79.6%**
Ash content	**3.78%**
β-carotene	**6.92 mg/100gm**
Chlorophyll a	**0.614 mg/gm**
Chlorophyll b	**0.182 mg/gm**
Total Chl.	**0.796 mg/gm**

Determination of Moisture Content

The present study was conducted to determine the moisture content of mint at different temperature 40ºC, 50ºC, 60ºC and Sun dry under different packaging material such as LDPE, HDPE and aluminum foil. In LDPE packaging material the variation in moisture content was found 6.51 % at zero day and 7.78 % at 40 days in Sun dry condition. In HDPE packaging material, the variation in Moisture content was found 6.51 % at zero day and 7.64 % at 40 days in Sun dry condition. In Aluminum foil the variation in moisture content was found 6.51 % at zero days and 7.61 % at 40 days in sun dry condition. At 60ºC moisture content was found 6.51 % in LDPE packaging material at zero days and 7.94 % at 40 days. At 60ºC moisture content found 6.51 % in HDPE

packaging material at zero days and 7.91 % moisture content found at 40 days. In Aluminum foil 6.51 % moisture content found at zero days at 60ºC temperature and 7.91 % moisture content found at 40 day.The data so obtained analysed by using three way ANOVA and found significant at 5% level.

Table: Variation of moisture content under different packaging material with respect to time and temperature.

Temperature	Packaging materials	No. of days				
		0	10	20	30	40
40C	LDPE	6.51	6.61	6.79	7.52	7.79
	HPDE	6.51	6.59	6.72	7.47	7.68
	Aluminum	6.51	6.55	6.68	7.41	7.62
50 C	LDPE	6.51	6.64	6.82	7.72	7.88
	HPDE	6.51	6.6	6.78	7.69	7.78
	Aluminum	6.51	6.56	6.73	7.63	7.72
60C	LDPE	6.51	6.69	6.8	7.74	7.94
	HPDE	6.51	6.63	6.79	7.7	7.91
	Aluminum	6.51	6.59	6.73	7.61	7.91
SUN DRY	LDPE	6.51	6.6	6.72	7.52	7.78
	HPDE	6.51	6.59	6.69	7.49	7.64
	Aluminum	6.51	6.54	6.63	7.42	7.61

	Result	S. Ed. (±)	C.D. at 5%
Due to days	S	0.01	0.02
Due to Temp	NS	0.05	0.03
Due to Packing	S	0.01	0.02

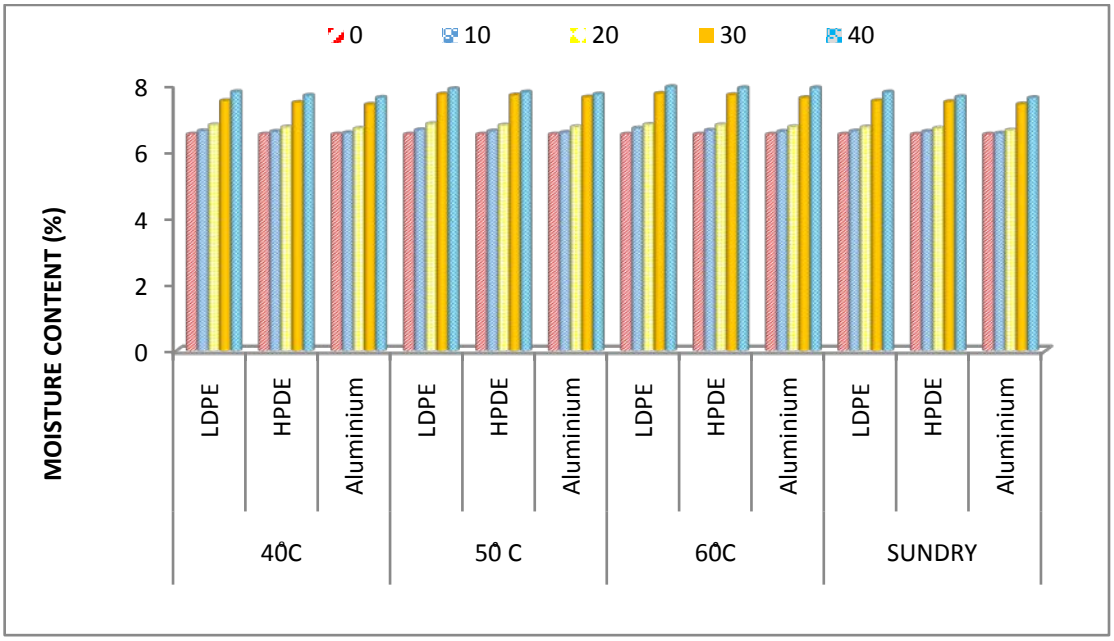

Fig. 4.1 Variation in Moisture Content of dehydrated Mint sample

The variation in the Moisture content may be due to the separately opening of the packaging material. Similar results were obtained in the studies conducted by **Singh and Sagar (2010)** whose work on quality characteristics of dehydrated leaves vegetables influent by packaging material and storage temperature and **Seevaratnam *et al.* (2012)** whose work on effect of packaging materials on retention of Quality Characteristics of Selected Dehydrated Green Leafy Vegetables During Storage.

Determination of Ash Content (%)

In LDPE packaging material, the variation in Ash content was found 3.16 % in Sun dry condition at 10 days and 2.80 % at 40 days. In HDPE packaging material, the variation in Ash content was found 3.24 % at 10 days and 2.94 % at 40 days in sun dry condition. In Aluminum foil, the variation in Ash content was found 3.27 % at 10 days and 2.96 % at 40 days in sun dry condition. At 60ºC Ash content was found 3.11 %, 3.16 % and 3.20 % in LDPE, HDPE and Aluminum foil at 10 days. At 40 days the Ash content was found 2.87 %, 2.91 % and 2.90 % in LDPE, HDPE and Aluminum foil at 60ºC. The data so obtained were analysed by using three way ANOVA and found significant at 5% level

Table: Determination of Ash content of dehydrated Mint sample at different interval of time under different packaging material

Temperature	Packaging materials	No. of days			
		10	20	30	40
40C	LDPE	3.16	3.11	3.06	2.8
	HPDE	3.22	3.2	3.11	2.93
	Aluminum	3.27	3.21	3.13	2.96
50 C	LDPE	3.12	3.01	3.02	2.87
	HPDE	3.18	3.14	3.1	2.9
	Aluminum	3.2	3.17	3.11	2.9
60C	LDPE	3.11	3.01	3.02	2.87
	HPDE	3.16	3.12	3.1	2.91
	Aluminum	3.2	3.17	3.1	2.9
SUN DRY	LDPE	3.16	3.12	3.06	2.8
	HPDE	3.24	3.2	3.11	2.94
	Aluminum	3.27	3.2	3.13	2.96

	Result	S. Ed. (±)	C.D. at 5%
Due to days	S	0.00	0.01
Due to Temp	S	0.01	0.02
Due to Packing	S	0.00	0.01

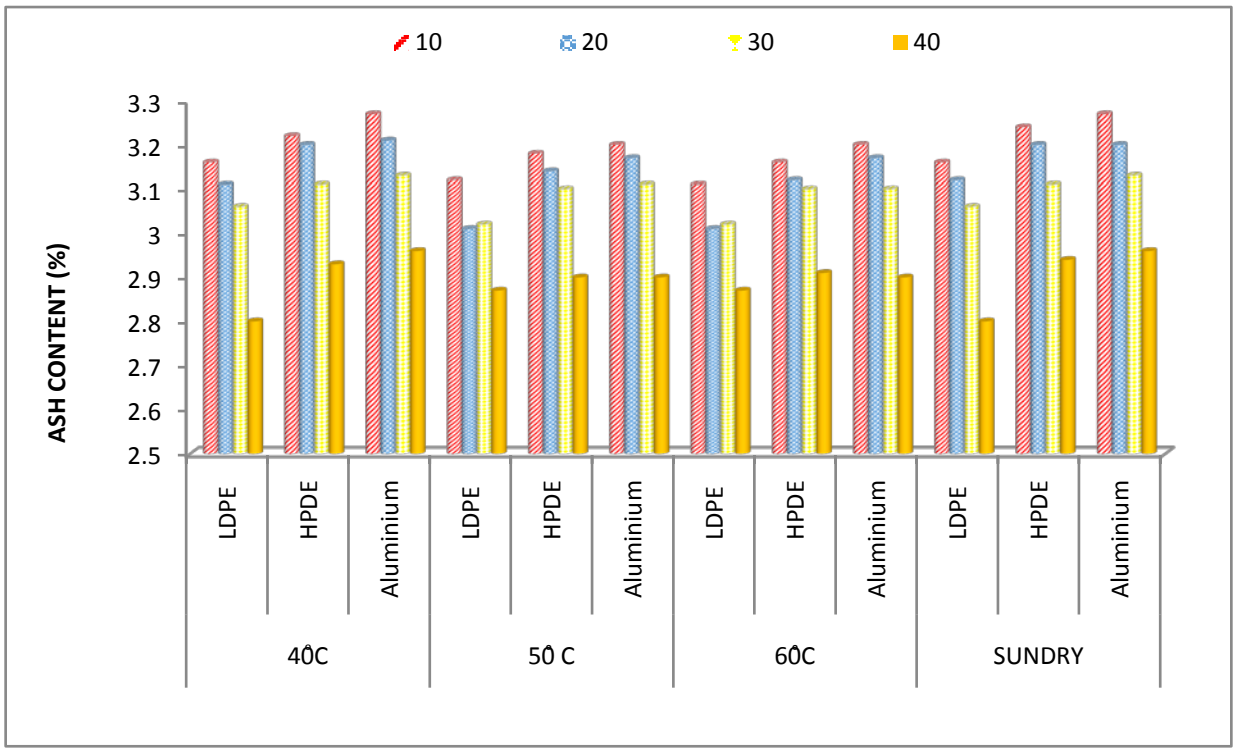

Fig. Variation in Ash content of dehydrated Mint sample

The variation in the Ash content may be due to the separately opening of the packaging material. Approximate results were obtained in the studies conducted by **Sulieman *et al.* (2011)** whose work was on phytochemical analysis of local spearmint leaves and detection of the antimicrobial activity of its oil and **Saeed *et al.* (2014)** whose work was on compositional profiling of Mentha piperita.

Determination of Beta carotene (mg/100gm)

At 40ºC the amount of β-carotene is 5.74 mg/100gm, 5.80 mg/100gm and 5.84 mg/100gm in LDPE, HDPE and Aluminum foil at 10 days and 5.30 mg/100gm, 5.42 mg/100gm and 5.47 mg/100gm in LDPE, HDPE and Aluminum foil at 40 days.

The data so obtained analysed by using three way ANOVA and found significant at 5% level.

Table: Determination of β- carotene of dehydrated Mint sample at different interval of time under different packaging materials.

Temperature	Packaging materials	No. of days			
		10	20	30	40
40̊C	LDPE	5.74	5.42	5.3	5.3
	HPDE	5.8	5.57	5.48	5.42
	Aluminum	5.84	5.6	5.51	5.47
50̊ C	LDPE	5.7	5.31	5.1	5.02
	HPDE	5.76	5.4	5.24	5.12
	Aluminum	5.79	5.43	5.28	5.17
60̊C	LDPE	4.16	3.82	3.67	3.4
	HPDE	4.2	4	3.8	3.57
	Aluminum	4.22	4	3.82	3.6

	LDPE	2.62	2.5	2.36	2.17
	HPDE	2.68	2.58	2.45	2.24
SUN DRY	Aluminum	2.73	2.6	2.48	2.27

	Result	S. Ed. (±)	C.D. at 5%
Due to days	NS	0.027	0.013
Due to Temp	S	0.031	0.062
Due to Packing	S	0.013	0.027

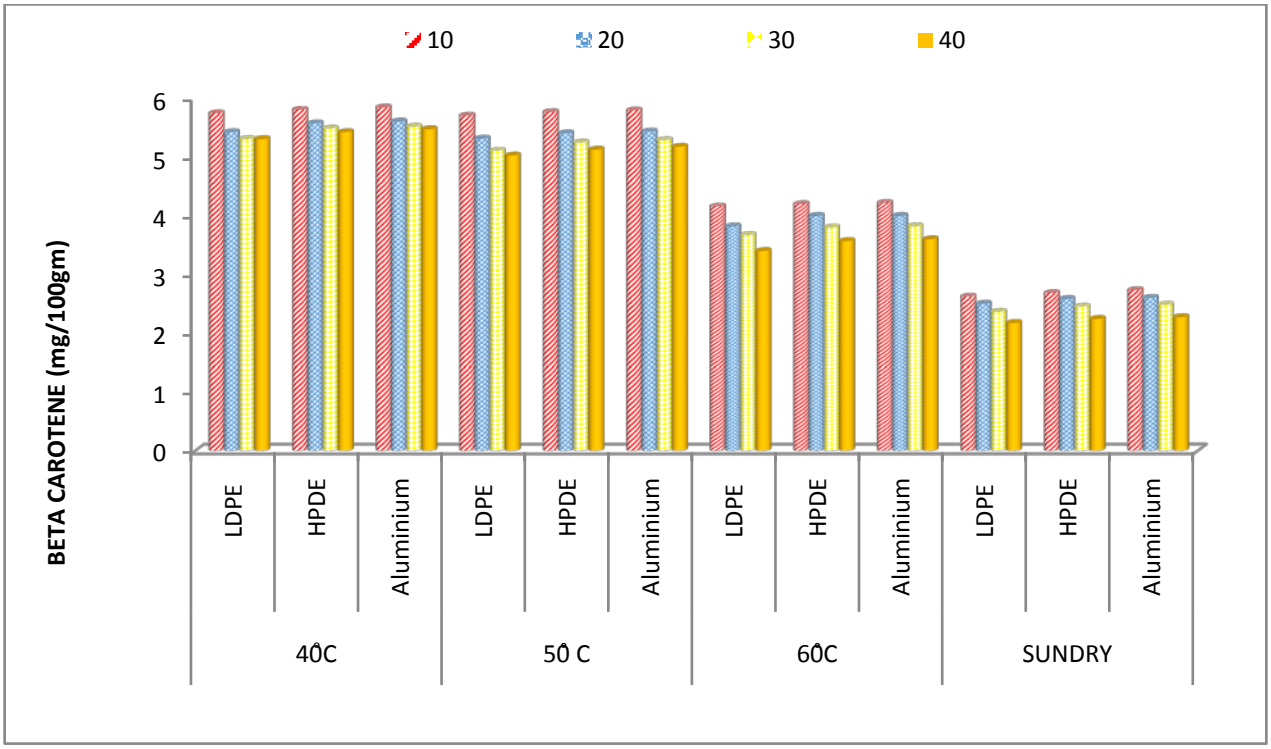

Fig. Variation in β-carotene of dehydrated Mint sample

The variation in the Moisture content may be due to the separately opening of the packaging material. The similar result were obtained by **Vyankatrao (2014)** whose work was on effect of drying methods on nutritional value of some vegetables.

Determination of Chlorophyll a (mg/gm)

On the 10th day of storage, Chlorophyll A value was found to be higher in LDPE, HDPE, Aluminum foil 0.406 mg/gm, 0.459 mg/gm, 0.487 mg/gm at Sun dry condition and 0.284 mg/gm, 0286 mg/gm and 0.301 mg/gm found in LDPE, HDPE and Aluminum foil at 40 days on same temperature. On the 10 day Chlorophyll a value found lower in LDPE , HDPE and Aluminum foil, 0.372 mg/gm, 0.391 mg/gm and 0.40 mg/gm at 60˚C at 60 ℃ and 0.184 mg/gm, 0.20 mg/gm and 0.201 mg/gm found in LDPE, HDPE and Aluminum foil at 40 days on same temperature .

The data so obtained analysed by using three way ANOVA and found significant at 5% level.

Table: Determination of Chl.a of dehydrated Mint sample at different interval of time under different packaging materials.

Temperature	**Packaging materials**	**No. of days**			
		10	20	30	40
	LDPE	0.389	0.4	0.316	0.201
40℃	HPDE	0.434	0.416	0.337	0.26

	Aluminum	0.468	0.42	0.34	0.3
	LDPE	0.312	0.291	0.271	0.206
	HPDE	0.376	0.306	0.286	0.222
50 C	Aluminum	0.41	0.32	0.3	0.261
	LDPE	0.372	0.3	0.28	0.184
	HPDE	0.391	0.321	0.286	0.2
60C	Aluminum	0.4	0.371	0.301	0.201
	LDPE	0.406	0.36	0.307	0.284
	HPDE	0.459	0.382	0.326	0.286
SUN DRY	Aluminum	0.487	0.417	0.361	0.301

	Result	S. Ed. (±)	C.D. at 5%
Due to days	NS	0.008	0.004
Due to Temp	S	0.009	0.018
Due to Packing	S	0.004	0.008

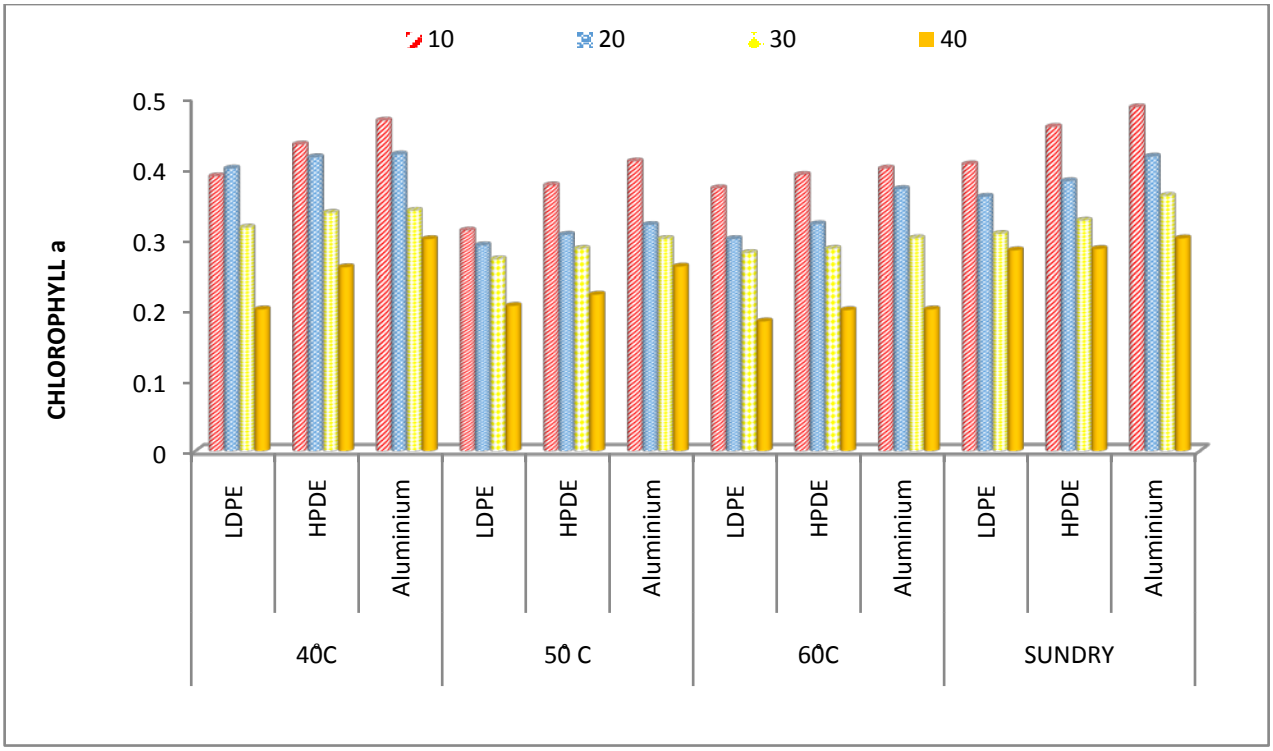

Fig. Variation in Chl.a of dehydrated Mint sample

On critical evaluation of the result during storage it was found that the Chlorophyll a content decreased with increase in storage period and temperature as in Fig 4.5. The similar result were obtained by **Straumite *et al.* (2015)** whose work was on pigment is mint leaves and stems and **Rudra *et al.* (2007)** whose work was on enthalpy entropy compensation during thermal degradation of chlorophyll in mint and coriander puree.

Determination of Chlorophyll b (mg/gm)

On the 10th day of storage, Chlorophyll b value was found to be higher in LDPE, HDPE, Aluminum foil 0.038 mg/gm, 0.062 mg/gm,

0.094 mg/gm at Sun dry condition. During the 40thdays of storage the value of Chl. b was lower in LDPE, HDPE, Aluminum foil 0.011 mg/gm, 0.01 mg/gm, 0.015 mg/gm at 60˚C. The data so obtained analysed by using three way ANOVA and found significant at 5% level.

Table: Determination of Chl.b of dehydrated Mint sample at different interval of time under different packaging materials.

Temperature	Packaging materials	No. of days			
		10	20	30	40
40C	LDPE	0.014	0.021	0.016	0.02
	HPDE	0.047	0.041	0.02	0.06
	Aluminum	0.081	0.061	0.032	0.018
50 C	LDPE	0.044	0.02	0.014	0.011
	HPDE	0.06	0.031	0.021	0.012
	Aluminum	0.067	0.042	0.026	0.015
60C	LDPE	0.021	0.02	0.09	0.011
	HPDE	0.047	0.026	0.016	0.01
	Aluminum	0.051	0.031	0.02	0.015
SUN DRY	LDPE	0.038	0.041	0.019	0.02
	HPDE	0.062	0.062	0.027	0.06
	Aluminum	0.094	0.071	0.046	0.029

	Result	S. Ed. (±)	C.D. at 5%
Due to days	S	0.004	0.007
Due to Temp	NS	0.008	0.016
Due to Packing	S	0.004	0.007

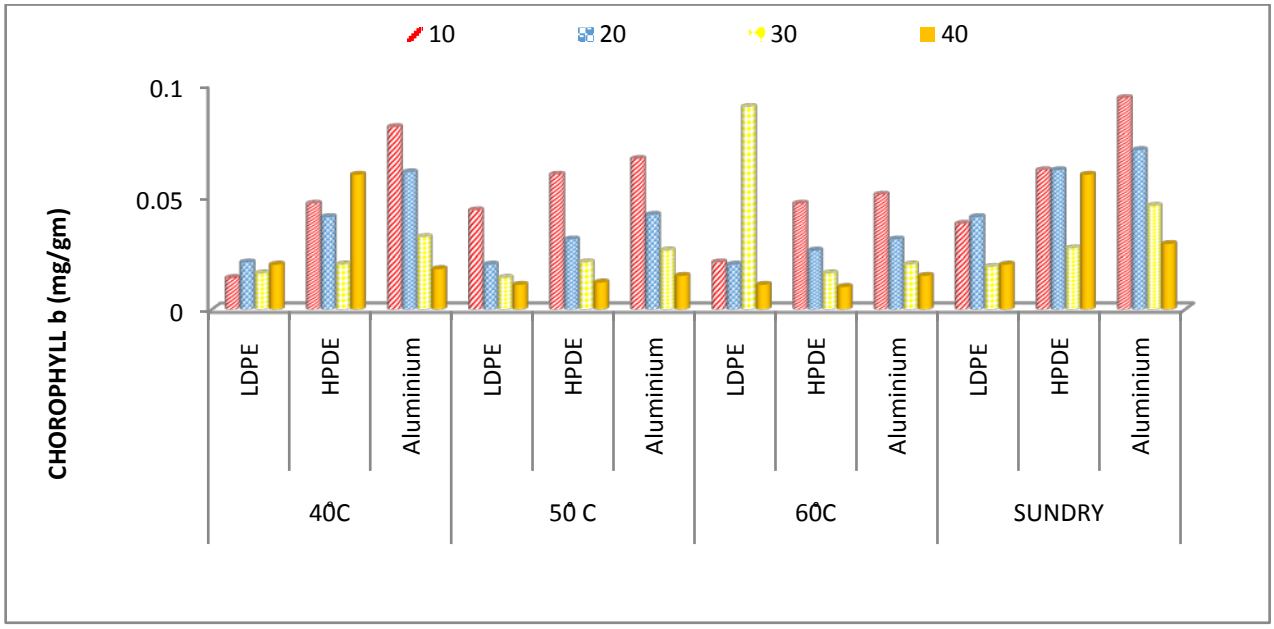

Fig. Variation in Chl.b of dehydrated Mint sample

On critical evaluation of the result during storage it was found that the Chlorophyll b content decreased with increase in storage period and temperature as in Fig 4.6. The variation in the Chl. b may be due to the separately opening of the packaging material. The similar study show by **Grzeszczuk and Jadczak (2009)** whose work was on estimation of biological value of some species of mint and Kizhedath and **Sulieman (2011)** whose work was on estimation of chlorophyll content in common household medicinal leaves and their utilization to avail health benefits of chlorophyll.

Determination of total Chlorophyll (mg/gm)

On the 10^{th} day of storage, Total chl. value was found to be higher in LDPE, HDPE, Aluminum foil 0.444 mg/gm, 0.521 mg/gm and 0.581 mg/gm at Sun dry condition. During the 40^{th}days of storage the value of Total Chl . was found lower in LDPE , HDPE, Aluminum foil 0.195 mg/gm, 0.210 mg/gm, 0.216 mg/gm at 60˚C. The data so obtained analysed by using three way ANOVA and found significant at 5% level.

Table: Determination of Total Chl. of dehydrated Mint sample at different interval of time under different packaging materials.

Temperature	**Packaging materials**	**No. of days**			
		10	20	30	40
40℃	LDPE	0.403	0.421	0.332	0.221
	HPDE	0.481	0.457	0.366	0.32
	Aluminum	0.549	0.481	0.372	0.318
50 C	LDPE	0.356	0.311	0.285	0.217
	HPDE	0.436	0.337	0.307	0.234
	Aluminum	0.477	0.362	0.326	0.276
60C	LDPE	0.393	0.32	0.37	0.195
	HPDE	0.438	0.347	0.302	0.21
	Aluminum	0.451	0.402	0.321	0.216
SUN DRY	LDPE	0.444	0.401	0.326	0.304
	HPDE	0.521	0.444	0.353	0.346
	Aluminum	0.581	0.488	0.407	0.33
		Result	S. Ed. (±)	C.D. at 5%	
Due to days		S	0.006	0.012	
Due to Temp		S	0.014	0.027	
Due to Packing		S	0.006	0.012	

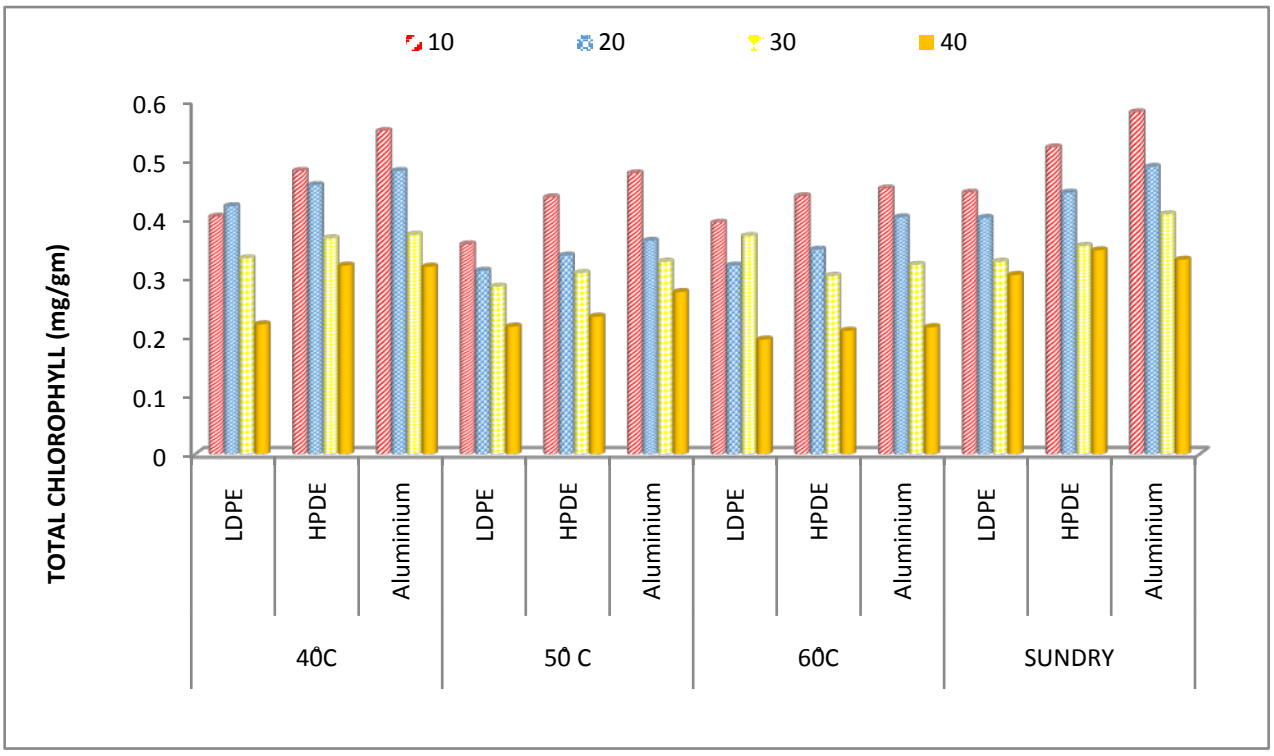

Fig. Variation in Total Chl. of dehydrated Mint sample

On critical evaluation of the result during storage it was found that the Total Chl. content decreased with increase in storage period and temperature as in Fig 4.5. The similar study show by **Straumite *et al.* (2015)** whose work was on pigments in mint leaves and stems and **Rubinskiene *et al.* (2015)**whose work was on effect of drying method on the chemical composition and colour of peppermint leaves.

Sensory properties of dehydrated mint leaves

Colour, taste, texture, appearance and overall acceptability, on the basis of sensory evaluation was done.

Effect of temperature and ambient storage on overall acceptability of dried mint leaves

Temperature	**LDPE (NO. of days)**				**HDPE (NO. of days)**				**ALUMINUM (NO. of days)**			
	10	**20**	**30**	**40**	**10**	**20**	**30**	**40**	**10**	**20**	**30**	**40**
40C	8.5	7.9	7.4	7.6	8.5	8.0	7.8	7.8	9.0	8.2	8.0	8.0
50C	8.0	7.8	7.6	7.4	8.2	8.0	8.0	7.6	8.6	8.3	8.1	8.0
60C	7.6	7.2	7.0	7.0	7.8	7.6	7.2	7.3	8.0	7.6	7.5	7.3
Sun dry	9.0	8.5	8.3	7.9	9.0	8.8	8.4	8.4	9.0	9.0	8.6	8.4

Sensory evaluation are done by using 9- point hedonic test.

The result are as follows:

- 40ºC temperature and aluminum foil was found as best for dehydrated of mint leaves.
- Aluminum foil was found best among different packaging materials.
- Ash content was found best at 40ºC and sun dried.
- Beta carotene was found as best under sun dry condition and

Conclusion

Mint leaves were dried at 40C, 50 C, 60 C and Sun dry and after that they packed into different packaging material and stored for a long time. After 10 days interval, the physico-chemical properties of dehydrated mint were tested and also checked the sensory attributes of the sample

aluminum foil packaging material.

- The amount of chlorophyll also observed best in aluminum foil at 40ºC.

On the basis of results, it can be concluded that –

- 40ºC dehydrating temperature and aluminum foil were found optimum for sensory attributes of mint.

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