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EFFECT OF PRESERVATION METHODS ON GREEN AND RED CABBAGE QUALITY TO USE AS NUTRACEUTICAL FOOD INGREDIENTS

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ABSTRACT

Green and red cabbage vegetables *(Brassica oleracea var.capitata)* are called “drug of the poor” due to their health benefits including curing the constipation, stomach ulcers, headache, excess weight, skin disorders, eye disorders, heart diseases, ageing, and Alzheimer's disease. Cabbage is cheap source of nutrient, healthful characteristics and cultivated in large scales in Egypt. The main object of the present investigation is using two types of cabbage to produce some preserved of green and red cabbage products. Also study the effect of storage on the properties of these products include of cooled, frozen, dried and prickled products. Chemical composition such as moisture, protein, carbohydrates, fat, fibers and minerals were measured. Also, indoles, chlorophyll (A& B), carotenoindes and anthocyanin in green and red cabbage and their products were estimated. High level of indoles was recorded in the inner layers of green and red cabbage. The methods used such as cooling, drying and pickling led to raise indoles concentration. Shelf life indicated that, dried were preserved products for consumption during 360 days, while the frozen was 312 days but cooled products recorded from one moth to 3 months of shelf life. Also, noticed that, the shelf life of red cabbage preserved in saline solution were 270 days. The sensory evaluation indicated that the dried products recorded slightly differences between color, taste, odor, texture, and appearance. On the other hand, prickled products recorded the highest value of organoleptic evaluation.
Keywords*:* Green and Red Cabbage Leaves; Indoles; Antioxidant Compounds.

INTRODUCTION

In European folk medicine, cabbage leaves are used to treat acute inflammation. Paste of raw cabbage may be placed in a cabbage leaf and wrapped around the affected area to reduce discomfort. Cabbage contains significant amount of glutamine which has anti-inflammatory properties. Cabbage is a source of indol-3-carbinol (I3C), a compound used as an adjuvant therapy for recurrent respiratory papillomatosis which grows in the airway that can lead to death (Rosen *et al*., 1998). I3C supplementation has shown promise as a potential preventive agent against breast cancer (Wong *et al*., 1997). Most studies have reported the protective effects of I3C against several experimental cancers in animals (He *et al*., 2000; Jin *et al*., 1999 and Grubbs *et al*., 1999).

Human diet contains not only a great variety of carcinogens but also many inhibitors of carcinogenesis including antioxidants (Se, retinols, flavones and indols). There has been growing interest in the potential of *Brassica vegetables* (cabbage, cauliflower, Brussels sprouts) as vectors for the introduction of anti-carcinogenic compounds into the diet (Dashwood, 1998). Red cabbage improves brain function and promotes heart health. Red

cabbage has anthocyanin as a group of healthful compounds that fall within flavoniod class of plants (Exon and Souoth, 2000). It is low in calories, and is a rich source of vitamins and minerals and it is a wonderful source of vitamin C which helps in anti-oxidation and is therefore involved in maintaining beautiful skin and delaying aging naturally. The outer leaves are rich in vitamin E which aids in producing a glowing complexion.

Cabbage is abundant in vitamin C – even more than orange. Vitamin C, being one of the best anti oxidant, reduces free radicals in our body which are the basic causes of ageing. It also helps repairing the wear and tears in the body United States Department of agriculture, 2007). Thus it is very helpful in treating ulcers, certain cancers, depressions, for strengthening immune system and fighting against cough and cold, healing of wounds and damaged tissues, proper functioning of nervous system and thereby help curing Alzheimer's disease (Ambrosone and Tang 2009).

Cabbage is very rich in fiber, this helps retain water and forms the bulk of the food and the bowels. Thus it is a good cure for constipation and related problems.

Cabbage is a good detoxifier, which purifies blood and removes toxins. This detoxifying effect is due to the presence of vitamin C and sulphur (Tang *et al*., (2007), Steinbrecher and Linseisen, (2009) and Silberstein and Parsons, (2010).

In Egypt cabbage is cultivating in vast ranges and used in forms fresh in salad and cooked. The aim of this investigation is using specific types of cabbage to produce some products with healthful characteristics. Also, study the chemical composition of outer leaves of cabbages which considered as a waste and used in preparing the products and study effect of shelf life of red and green properties quality of these products.

MATERIALS AND METHODS

Materials:

Green and red cabbage (*Brassica oleracea var.capitata*) season (2009) was obtained from local market in Giza, Egypt. Noodle was obtained from supermarket.

Methods

Both layers of green and red cabbage (outer and inner) leaves were washed, and cut into slices by using stainless steel knife, to prepare in different products preserved such as dried, cooled, freezed and salted cabbage.

Preservation methods of green and red cabbage

1-**Dried cabbage**: Both outer and inner green and red cabbage leaves layers were prepared by using steam blanching water for 2 min at 90°C, the other samples were without pre-treated, then were dried in an oven at (50- 55°C) over night.

2- **Cooled cabbage:**The outer and inner green and red cabbage leaves were prepared by storing both layers at 5ºC±2°C in refrigerator.

3-**Freezed cabbage**: leaves outer and inner of green and red cabbage were stored at frozen temperature (–18ºC).

4- **Salted cabbage**: Cabbage leaves were soaked in saline (1%, 1.5% and 2%) solution.

Chemical composition of green and red Cabbage:

1-Moisture, protein, carbohydrate, fat, ash, minerals and fiber were determined according to A.O.A.C, (2005).

2- Total phenolic compounds were determined by using Folin- Ciocalteu reagent according to Singleton and Sinkard (1977).

3-Total indole compounds were extracted and determined as described by Daniel and George (1972) and Larson (1962).

4- Chlorophyll, carotenoides, and anthocyanins were determined according to Ranganna (1979).

5- Antioxidant activity was determined using the DPPH Free radical scavenging method as described by Fernandes *et al*., (2007).

6- Shelf life: The shelf life of all products of green and red cabbage was estimated by taking samples of products at different intervals (each week) and examines the color, taste, odor, appearance and texture.

7- Rehydration ratio of dried samples was carried out according to Ranganna (1979) as follows: ten g of dried layer cabbage leaves were placed in a beaker (600 ml) and a definite volume (100 ml) of water was added, and then covered by a glass watch. Than boiled was brought for three minutes and continued for 30 min. The contents were then transferred to a Buchnner funnel and left for one minute, then weighted. The rehydration ratio was expressed as the ratio between the drained weight of the rehydration samples and the weight of the dried samples.

$$\text{Rehydration Ratio} = \frac{\text{The drained weight of the rehydration sample (WR)}}{\text{The origin weight of the dehydration sample ((WD)}} \times 100$$

8- Organoleptic evaluation: The organoleptic characteristics of salted cabbage in saline solution (1%, 1.5% and 2%), dried cabbage, dried steamed cabbage and dried cabbage with noodles in ratios of 10%, 20% and 30% were estimated according to Larmond (1970).

9- Statistical analysis: organoleptic data were analyzed according to the method described by Snedecor and Conchran (1984).

RESULTS AND DISCUSSION

Chemical composition of outer and inner leaves of red and green cabbage on dry weight basis was recorded in Table (1). The moisture content of outer leaves was lower than inner leaves in both green and red cabbage. The protein content of outer leaves of green cabbage was23.03%, meanwhile that the inner leaves had 22.46% protein. Carbohydrates, fats and ash were recorded the highest ratios in inner leaves of green cabbage (51.56%, 3.53% and 11.73%) compared with the outer leaves. While crude fiber was higher in outer (13.71%) than inner leaves. Red cabbage has high protein content in outer leaves (27.18%) than the inner leaves (22.57%). Carbohydrate, fat and ash were higher (49.44%, 3.26% and 15.16%), respectively in inner leaves of

cabbage. Crude fiber was higher in inner leaves (12.92%) than outer leaves (9.12%).

Table (1): Chemical composition of green and red cabbage leaves on dry weight basis (g/100g sample).

Samples	Moisture	Protein	Carbohydrate	Fat	Fiber	Ash
G.C.I.L.	93.01	22.46	51.56	3.53	10.72	11.73
G.C.O. L.	82.75	23,03	50.30	2.21	13.71	10.75
R. C.I. L.	91.03	22.57	49.44	3.26	9.12	15.16
R.C.O.L	89.97	27.18	46.47	2.26	12.92	11.17

G.C. I. L.: Green cabbage inner layer **R.CI.L: red cabbage inner layer**
G.C.O.L.: Green cabbage outer layer **R.C.O.L: red cabbage outer layer**

The results of mineral contents of inner and outer leaves of green and red cabbage were indicated in Table (2). The results showed some differences in minerals content of Ca, Fe, Mg, Zn, Mn, Na, and K in both inner and outer leaves of green and red cabbage. Both type of cabbage had high contents of minerals. Outer leaves of green cabbage had higher level of minerals content of Mg, Na, Mn, and K than inner leaves. The minerals content of Zn, Fe and Ca were lower in outer leaves. Red cabbage has high levels of Mg, Na and Ca in outer leaves while, lower the inner leaves were higher in Zn, Mn, Fe and K. Kurilich, *et al*., (1999) found that the outer leaves of cabbage has high level of mineral than the inner leaves.

Table (2): Minerals content of green and red cabbage leaves (mg /100g dry weight).

Samples	Mg	Na	Zn	Mn	Fe	Ca	K
G.C.I.L	448.76	373.17	947.28	34.91	373.17	4994.74	92.81
G.C.O.L	599.74	452.05	369.22	36.92	369.22	2347.71	234.51
R.C.I.L	490.05	414.53	696.52	77.94	696.52	7106.14	747.10
R.C.O.L	573.76	645.01	598.46	71.1	474.97	9052.91	501.57

Results in Table (3) showed the total phenols and antioxidants in cabbage leaves. Total phenols were determined in mg/100 g of cabbage leaves, while antioxidants were determined in µmol when 25 µmol, 50 µmol and 100 µmol of samples were taken. The results showed that, the inner layer of green cabbage contained the same content of antioxidant in 50 µmol and 100 (µmol) respectively. While, in 25 µmol sample was decreased. The results showed that cabbage contain high contents of phenols. When the antioxidants of green and red cabbage were compared, the results showed that, green cabbage was higher in antioxidant and total phenols contents than red cabbage. Total phenols were higher in inner than in outer layer in green cabbage. From these data, it could be concluded that, inner layer of green cabbage had higher contents of total phenols and antioxidants than the outer layer. Also, green cabbage had higher contents of total phenols and antioxidants than the red cabbage. These results are in agreement with Tang *et al*., (2007) who found that, cabbage contain high amounts of phenols and antioxidants.

Table (3): Total phenols and antioxidants contents in green and red cabbage leaves.

Samples	Total phenols as galic acid (mg/gm)	DPPH %		
		25 µmol	50 µmol	100 µmol
G.C.I.L	37.90	30.65	66.46	66.49
G.C.O.L	34.83	31.68	36.11	36.43
R.C.I. L	17.60	15.82	18.01	18.85
R.C.O.L.	16.50	15.00	17.99	18.5

Rehydration ratios of dried and pretreated (steam- dried) green and red cabbage were measured in different samples in times (5, 10 and 15 min.) and were recorded in Table (4). The dried samples were slightly different after 5, 10 and 15 min., showed different between two types of cabbage especially in outer layer of red cabbage, which was slightly increasing. Pre-treated samples indicate that the outer layers of two types of cabbage (green and red) taken more time of rehydration, than the inner layers. After 10 min. rehydration of green cabbage inner layer increased in ratio more than outer layer and inner and outer layer of red cabbage were the same approximately. The ratio of rehydration after 15 min. was the same as 10 min. in red and green cabbage. In comparing between dried and pretreated of rehydration of different cabbage samples' it can be concluded that rehydration ratio of inner green cabbage layer was ratios slightly affected rehydration in both inner and outer green cabbage leaves and rehydration also, in red cabbage by heated.

Table (4): Rehydration ratios of different treated dried samples of cabbage

Samples	Dried			Pre-Treated (Steam-dried)		
	Rehydration time					
	5 min	10 min	15 min	5 min	10 min	15 min
G.C.I.L	19.746	19.882	19.715	18.629	20.574	20.409
G.C.O.L	18.156	19.421	19.801	17.908	18.173	18.538
R.C.I.L	18.665	20.527	20.908	18.636	19.835	19.976
R.C.O.L	18.426	19.912	20.064	17.858	19.405	19.493

Results of total indoles of fresh (control), dried, steamed and frozen and salted (1% and 2%) inner and outer green and red cabbage leaves were indicated in Table (5). The results showed that, total indoles in fresh samples of red cabbage were found in large amount than green cabbage in inner and outer layers. Also, dried cabbage samples of inner and outer red cabbage layers had high level of indoles than inner and outer green cabbge layers. Steamed and frozen samples of indoles were high in ratio in inner green cabbage than red inner cabbage, while outer red cabbage layers had more total indoles. Salted samples showed lower level of total indoles in 1% of salin solution in outer than inner layers in green and red cabbages, in comparing with the inner layers, showed slightly increasing in total indole ratio in inner red cabbage. From the results it could be concluded that, both of the outer green and red cabbages had a considerable level total indoles for all treatments. The data showed that the effect of treatments such as drying

and salting preservation increase total indoles content in both green and red cabbage leaves samples.

Table (5): Determination of total indoles (mg/100gm) in different preservation methods of.

Samples	Fresh	Dried	frozen	Salted
G. C. I. L	0.1828	0.7360	0.3900	0.2582(1%)
G. C. O. L	0.1973	0.6827	0.1790	0.3271(2%)
R. C. I. L	1.2673	6.0413	0.2613	0.2927(1%)
R. C. O. L	0.8969	2.8162	0.4760	0.8424(%)

Table (6) showed the ratio of chlorophyll (A), chlorophyll (B), caroteniondes and anthocyanines in green and red cabbage. The data showed that chlorophyll (A) was found in outer layer of green cabbage only but chlorophyll (B) found in both outer and inner layers of green cabbage. Meanwhile, carotenionedes and anthocyanines were found in red cabbage and green cabbage. From these data it could be observed that chlorophyll (A) was found in the outer green cabbage leaves but being absent in inner green cabbage and red cabbage leaves. Chlorophyll (B) was absent in inner red layer of cabbage but present in the inner and outer layers green cabbage. Both carotenoides and anthocyanines were presented in all cabbage samples but the red cabbage had high level of these pigments. Kusznierewic *et al*., (2008) said that, red cabbage has high ratio of anthocyanins pigment as a group of healthful compounds.

Table (6): Chlorophyll [(A),(B)], caroteniodes and anthocyanins in (mg/100gm) fresh weight basis cabbage leaves.

Samples	Chlorophyll (A) (%)	Chlorophyll (B) (%)	Caroteniondes (%)	Anthocyanine (%)
G.C.I.L	N.D	0.010	0.006	00.02
G.C.O.L	0.116	0.105	0.023	00.01
R.C. I.L.	N.D.	N.D.	0.032	29.05
R.C.O.L.	N.D.	N.D.	0.031	28.95

Table (7) showed sensory evaluation of dried and dried steamed green and red cabbage after rehydration. It can be deduced that, inner layer of green cabbage had the high score for sensory evaluation. The green outer layer and red inner and outer layers of cabbage recorded slightly decreasing in scores of sensory evaluation in color, taste, odor, texture and appearance than inner green layer of cabbage. On the other hand the pretreatment of green and red cabbage samples treatment with steam blanching before dried showed decreased in sensory evaluation scores on all samples in comparing with a dried samples.

Table (7): Sensory evaluation of dried cabbage and (steam and dried) after rehydration.

Sample	Color	Taste	Odor	Texture	Appearance
G.C.I.L(dried)	8.33 ± 0.87^{a}	8.22± 0.67^{a}	8.22± 0.97^{a}	8.67 ± 0.71^{a}	8.55 ± 0.53^{a}
G.C.O.L (dried)	7.6 ± 0.70^{bc}	7.5 ±0.97^{bc}	7.6 ± 1.26^{bc}	7.7± 1.16^{bc}	8 ± 0.94^{ab}
R.C.I.L (dried)	7.5±1.65^{bc}	7.8 ±1.54^{b}	7.9 ± 1.37^{b}	8.1 ± 0.99^{ab}	8.45 ±1.13^{a}
R.C.O.L (dried)	7.9 ± 0.74^{b}	7.9 ± 0.74^{b}	8.1 ± 0.88^{ab}	7.8 ± 1.14^{b}	8.2 ± 0.63^{a}
G.C.I.L (steam+ dried)	7.5 ± 1.27^{bc}	7.6 ± 1.26^{bc}	7.5 ± 0.85^{bc}	7.5 ± 1.08^{bc}	7.8 ± 0.79^{b}
G.C.O.L steam+dried)	7.6 ± 0.50^{bc}	7.8 ± 0.91^{b}	7.33 ± 1.12^{c}	7.6 ± 0.97^{bc}	7.5 ± 1.35^{bc}
R.C.I.L.(steam+ dried)	7 ± 1.05^{c}	7.2 ± 1.03^{c}	7.75 ± 0.87^{bc}	7.3 ± 0.82^{c}	7.6 ± 0.52^{bc}
R.C.O.L(steam+dried)	7.1±0.88^{c}	7.2 ±1.03^{c}	7.2 ± 0.92^{c}	7.4 ± 1.17^{c}	7.4 ± 0.84^{c}

All the values are means of three replications ±SD
Values with same letters are not statistically different at 0.05 levels.

Sensory evaluations of noodles supplemented by three ratios (10%, 20% and 30%) of different types of cabbage were recorded in Table (8). The results showed that sensory evaluation scores of dried green and red cabbage leaves with noodles were acceptable when using in different ratios. Meanwhile, they have slightly difference scores in taste, odor, texture and appearance of sensory evolution when using with different ratios of noodles. The dried red and green cabbage showed a high score of sensory evaluation when noodles added. The score was increased in dried red and green cabbage. In comparing between Score of dried red and green cabbage leaves with noodles the results showed that the supplemented ratio 30% of green and red cabbage was the best ratios when using with noodles. Therefore, from the above result it can be concluded that, noodles supplemented with 30% of red and green cabbage were suitable for using.

Table (8): Sensory evaluation of dried mixture of outer and inner green and red cabbage leaves with noodles in different ratios (means ± SD).

Samples.	Color	Taste	Odor	Texture	appearance
*M.G.C.L (10%+noodles)	7.45 ±1.29^{a}	6.2 ± 1.03^{c}	6.6 ± 1.35^{b}	7 ± 1.33^{ab}	6.8 ± 1.48^{b}
M.G.C.L (20%+noodles)	7.5 ± 1.43^{a}	5.9 ± 1.29^{c}	6.6 ± 1.51^{b}	6.8 ± 1.55^{b}	7 ± 1.56^{ab}
M.G.C.L (30%+noodles)	7.7 ± 0.94^{a}	6.3 ± 1.25^{c}	7.1 ± 1.52^{ab}	6.6 ± 1.26^{b}	7.3 ± 1.16^{a}
**M.R.C.L (10%+noodles)	7.6 ± 1.35^{a}	6.6 ± 1.35^{b}	7.0 ± 1.25^{ab}	6.8 ± 1.48^{b}	7.1 ± 1.1^{ab}
M.R.C.L (20%+noodles)	7.1 ± 0.97^{a}	6.9 ± 1.37^{ab}	7.2 ± 1.69^{ab}	7.2 ± 1.14^{ab}	7.3 ± 0.95^{a}
M.R.C.L (30%+noodles)	7.7 ± 1.16^{a}	7.4 ± 1.58^{a}	7.6 ± 1.72^{a}	7.1 ± 1.29^{ab}	7.4 ± 1.07^{a}

***M.G.C. L.: Mixture of dried green cabbage leaves**
M.R.C.L: Mixture of dried red cabbage leaves.
All the values are means of three replications ±SD
Values with same letters are not statistically different at 0.05 levels.

The results of sensory evaluation (color, taste, odor, texture and appearance) of different layers of red and green cabbage which preserved in different concentrations of slain were recorded in Table (9). The data showed that the score of sensory evaluation of red cabbage inner layer in saline in concentrations 1%, 1.5% and 2% recoded highest results. The inner layer of green cabbage recorded high score for sensory evaluation in saline concentrations (1% and 2%) however outer layer showed high score in 1.5%,

the same results were shown in red cabbage outer layer (1.5%). The results showed that sensory evaluation of cabbage leaves of both types were high in all items of organoleptic tests when preserved in saline.

Table (9): Sensory Evaluation of green and red cabbage preserved in different salineconcentrations 1%, 1.5% and 2% means ± SD).

Sample	Color	Taste	Odor	Texture	Appearance
G.C.I.L (1%)	8.7 ± 0.48^{ab}	8.4 ± 0.84^{b}	8.5 ± 0.53^{b}	7.6 ± 1.43^{c}	8.6 ± 0.52^{b}
G.C.O.L (1%)	7.91 ± 1.77^{c}	7.8 ± 1.23^{c}	7.9 ± 1.07^{bc}	7.23 ± 1.13^{c}	8.25 ± 1.22^{c}
G.C.I.L (1.5%)	6.8 ±1.23^{e}	6.4 ± 1.58^{e}	6.4 ± 1.43^{c}	5.4 ± 0.52^{d}	6.9 ± 1.47^{e}
G.C.O.L (1.5%)	8.56 ± 0.53^{b}	7.2 ± 1.23^{d}	6.4 ± 0.65^{c}	6.4 ± 1.55^{c}	8.1 ± 0.97^{c}
G.C.I.L (2%)	8.8 ± 1.03^{ab}	8.4 ± 1.14^{b}	7.8 ± 0.98^{bc}	7.6 ± 1.03^{c}	9.06 ± 0.67^{a}
G.C.O.L (2%)	8.27 ± 1^{bc}	8.09 ± 3^{bc}	8.09 ± 1.11^{b}	7.45 ±1.27^{c}	7.63 ± 1.35^{d}
R.C.I.L (1%)	9.03 ± 0.85^{a}	7.33 ± 1.31^{d}	7.78 ± 0.44^{bc}	8.25 ± 0.71^{b}	8.89 ±0.33^{ab}
R.C.O.L (1%).	7.8± 1.55^{c}	7.7 ± 0.48^{c}	7.7 ± 0.48^{bc}	9.03 ± 0.65^{a}	8.1 ± 0.67^{c}
R.C.I.L (1.5%).	9.00 ± 0.65^{a}	9.14 ± 1.02^{a}	9.23 ± 0.76^{a}	9.13 ± 0.91^{a}	9.15 ± 0.82^{a}
R.C.O.L (1.5%).	8.76 ± 0.82^{ab}	9.03 ± 0.79^{a}	9.16± 0.87^{a}	9.22± 0.68^{a}	9.23± 1.02^{a}
R.C.I.L (2%)	9.16 ± 1.11^{a}	9.21 ± 0.82^{a}	9.03 ± 0.92^{a}	9.32 ± 0.86^{a}	9.24 ± 0.87^{a}
R.C.O.L (2%)	7.1 ± 1.66^{d}	6.5 ± 1.35^{e}	9.21 ± 0.75^{a}	9.15 ± 0.69^{a}	7.25 ± 1.58^{d}

All the values are means of three replications ±SD
Values with same letters are not statistically different at 0.05 levels.

The shelf life for storage of both two types of cabbage preserved in saline solution of (1%, 1.5% and 2%) was recorded in Table (10). The results showed that**,** the shelf life of inner and outer layers of cabbage leaves had no difference between them in the self life duration (244days) in different concentrations of NaCl saline. Red cabbage (both inner and outer layers) has self life duration 270 days. Also, red cabbage showed long shelf life than green cabbage. The long shelf life may be attributed to high pigments content found in red cabbage.

Table (10): Shelf life of green and red cabbage preserved in saline solution (1%, 1.5% and 2%).

Samples	Treatment pickling	Start storage	End storage	Shelf life
G.C. I. L.	(1.0%) NaCl	18-1-2009	4-8-2009	224 days
	(1.5%) NaCl	18-1-2009	4-8-2009	224 days
	(2.0%) NaCl	18-1-2009	4-8-2009	224 days
G.C.O.L.	(1.0%) NaCl	18-1-2009	4-8-2009	224 days
	(1.5%) NaCl	18-1-2009	4-8-2009	224 days
	(2.0%) NaCl	18-1-2009	4-8-2009	224 days
R.C.I.L.	(1.0%) NaCl	18-1-2009	18-10-2009	270 days
	(1.5%) NaCl	18-1-2009	18-10-2009	270 days
	(2.0%) NaCl	18-1-2009	18-10-2009	270 days
R.C.O.L.	(1.0%) NaCl	18-1-2009	18-10-2009	270 days
	(1.5%) NaCl	18-1-2009	18-10-2009	270 days
	(2.0%) NaCl	18-1-2009	18-10-2009	270 days

The shelf-life of cooling at 5 ±2 ºC, freezing at –18ºC, and drying at 50- 55ºC for two types of cabbage was indicated in Table (11). Green cabbage inner layers self life duration of cooling at 5 ±2 ºC was 38 days, while freezing at –18ºC and drying at 50- 55ºC had long shelf life duration

(270 days). The outer green cabbage leaves were showed the same results. Red cabbage inner layers shelf life duration cooling at 5 ±2 ºC was 98 days, freezing at –18ºC take 312 days and drying at 50- 55ºC had given the same shelf life duration (360 days). Also, outer layer of red cabbage indicated 27 days in cooling at 5 ±2 ºC, freezing at –18ºC and drying at 50- 55ºC had stayed at 312 days and also drying products had 270 days in shelf life duration. These results indicated that, both outer and inner green cabbage shelf life by cooling at 5 ±2 ºC was shorter than freezing and drying products of red cabbage, but the products of dried red and green cabbage were the same of (inner and outer layers) green cabbage leaves. The longest shelf life duration was for the freezing at –18ºC which taken 312 days, but the cooling products were the shortest in shelf life in both types of cabbage observed.

Table (11): Shelf - life of cooling, freezing and drying cabbage products.

Samples	Treatment	Start storage	End storage	Shelf life
G.C.I.L	Cooling at 5 ºC±2	18-1-2009	26-2-2009	38 days
	Freezing at –18ºC	18-1-2009	18-10-2009	270 days
	Drying at 50- 55ºC	18-1-2009	18-10-2009	270 days
G.C.O.L	Cooling at 5 ºC±2	18-1-2009	26-2-2009	38 days
	Freezing at –18ºC	18-1-2009	18-10-2009	270 days
	Drying at 50- 55ºC	18-1-2009	18-10-2009	270 days
R.C.I.L	Cooling at 5 ºC±2	18-1-2009	26-4-2009	98 days
	Freezing at –18ºC	18-1-2009	30-11-2009	312 days
	Drying at 50- 55ºC	18-1-2009	17-1-210	360 days
R.C.O.L	Cooling at 5 ºC±2	18-1-2009	15-2-2009	27 days
	Freezing at –18ºC	18-1-2009	30-11-2009	312 days
	Drying at 50- 55ºC	18-1-2009	30-11-2009	312 days

Conclusion: The chemical measurements, organoleptic and different treatments of preservation showed that, the two types of cabbage had large amounts of antioxidants (phenolic compound). Cabbage is abundant in vitamin C. which, being one of the best antioxidants, reduces free radicals in your body which are the basic causes of ageing. Also, sensory evaluation of cabbage leaves of both types were high in all items of organoleptic tests when preserved dried, cooling freezing and in saline. Thus it can be used in all the year. It is helpful in treating ulcers, certain cancers, depressions, for strengthening immune system and fighting against cough and cold, healing of wounds and damaged tissues, proper functioning of nervous system and thereby help curing Alzheimer's disease.

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تأثير طرق الحفظ على جودة الكرنب الاخضر و الاحمر لاستخدامه كإضافات غذائية صحية للطعام.

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يهدف هذا البحث ألى أستخدام طرق حفظ مختلفة لكل من الكرنب الأخضر والأحمر، مثل المنتجات المبردة والمجففة والمنتجات المحفوظة فى محلول ملحى لكى تكون متوافرة معظم فترات السنة نظرا لما يحتويه الكرنب الأخضر والأحمر على قيمة غذائية ومركبات حيوية لها دور فعال قوى ونشط فى التأثير على تحسين الحالة الصحية للإنسان وتم عمل التحليل الكيميائى (رطوبة، رماد، بروتين، كربوهيدرات ومعادن) وأيضا تم قياس الصبغات مثل الكلوروفيل(ا،ب) والاندول ومضادات الاكسدة، أشارت النتائج إلى أنه يحتوى على محتوى عالى من المعادن ومركبات الإندول بكلا نوعى الكرنب ومنتجاتهم، فكانت النتائج كالتالى...أن الطبقات الداخلية للكرنب الأخضر والأحمر أعلى فى محتواها من المعادن ومركب الاندول عن الطبقات الخارجية ... كما أن عمليات التصنيع المختلفة من تجفيف ، تبريد، وحفظ فى محلول ملحى أدت إلى زيادة محتوى تلك المركبات الحيوية ألا وهى "الإندول" .

أشارت نتائج إختبارات قياس إطالة فترة الحفظ (الصلاحية) إلى أن فى حالة المنتجات المجففة من كلا نوعى الكرنب الأخضر والأحمر يمكننا إطالة فترة الصلاحية للمستهلك لفترات تصل إلى ٣٦٠ يوم... بينما تقل هذه الفترة فى حالة المنتجات المجمدة... أما فى حالة المنتجات المحفوظة بالتبريد على درجة الحرارة(٥°م±٢) فقد تصل فترة الصلاحية لاقل من الكرنب المحفوظ فى المحلول الملحى من شهر إلى ٣ شهور تقريبا وذلك حسب نوع الكرنب مع العلم ان الكرنب الاحمر تصل فترة الصلاحية الى ٢٧٠يوم عن الاخضر وهذا راجع الى محتواه من الصبغات...كما أشارت نتائج التقييم الحسى إلى أنه لا توجد هناك فروق معنوية كبيرة فى الطعم ، اللون، الرائحة، القوام، والمظهر العام، وذلك بين المنتجات المجففة و المملحة.

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