RESULTS AND DISCUSSION

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1– Effect of pre-treatments, drying methods and storage periods on chemical composition of herbs:-

1– 1- Moisture content :-

Moisture content is considered to be one of the most important factors influence the quality attributes of dried herbs.

The results of moisture content of fresh herbs, pre-treatments and dried basil and marjoram herbs were tabulated in Tables (1 and 2, respectively) and illustrated in Figures (1and 2). Moreover, the changes in percentage of moisture content due to pre-treatments, drying or dehydration and storage periods of basil and marjoram were tabulated in Tables (3 and 4, respectively) .

The moisture content of fresh basil and marjoram were found to be 89.69 and 85.72 %, Tables 1,2, respectively.

A detectable increase in moisture content of basil and marjoram herbs as affected by pre-treatments, blanching by hot water at 90°C, steam blanching, blanching by Mg citrate solution (1%) at 90°C and blanching by sodium bicarbonate solution (1%) at 90°C were 1.97%, 1.54%, 3.18%, and 2.89% more in basil herb, respectively, and 1.99%, 1.36%, 2.27% and 1.76% more in marjoram herb, respectively. These results are in harmony with those reported by **El-Sherbiny *et al.* (1986)** and **El-Kady (1996).**

Concerning different drying methods in Tables (1 and 2) the data showed that moisture contents were ranged between

4.96% (for hot water blanching oven dehydration of basil) to 6.40% (for hot water blanching sun drying of marjoram) according to drying or dehydration methods. These levels are within the permissive range reported in **Egyptian ministerial decree (No. 90 and 91 /1979)**. In general, drying methods had effects on moisture contents of all samples (basil and marjoram). From the data in same Tables, it could be seen that, sun-dried samples had more average of moisture content than any other methods. These results could be attributed to high temperature used in protected-sun-drying, oven dehydration and microwave dehydration methods versus sun-drying. These results are in agreement with those obtained by **Hassan *et al.* (1989)** and **El-Kady (1996).** Moreover, we can decrease the moisture content in microwave samples down to 2 % but, it is not economic way.

As for storage, generally, it was found that the moisture contents in all treatments increased gradually during storage period, Tables (3 and 4). The moisture increments percentage were ranged between 16.20 – 32.09 %; 23.76 – 47.27 %; 19.96 – 41.53 % and 12.18 – 39.14 % for sun drying; protected-sun-drying; oven dehydration and microwave dehydration samples, respectively , after storage for 9 months at room temperature. The increase percentage in moisture content of basil sample pre-treated with Mg citrate solution (1%) at 90°C were 5.06% after storage for 9 months at room temperature, this result was less than the rang of increased in all samples. This result may be due to experimental wrong. Generally, in all samples the increase in moisture content probably due to the permeability to gases of jute and polyethylene pouches including the atmospheric vapour inducing a slight increase in moisture content of the dried herbs. The finding of **Darweesh (1980), El-Kady (1996) and Abd-El-Latif *et al.* (2001)** gave support to present study .

Moreover, the moisture content of local market sample and USA market sample of basil herb were 7.11 and 4.62%, respectively. On the other hand, the moisture content of local market and Hungarian sample of marjoram herb were to be 6.27 and 4.79%, respectively.

Finally, all samples under this study, local market sample and imported samples of basil and marjoram were under the maximum limit of moisture content as reported in **Egyptian ministerial decree No. 90/1979 and 91/1979** for exporting of dried basil and marjoram.

Table (1) :Effect of pre-treatments, drying or dehydration methods and storage period on moisture content (%) of basil herb.

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	89.69	5.92	6.77	7.23	7.82
H . W . B .	91.46	5.84	6.75	6.90	7.07
S . B .	91.07	6.25	6.63	6.97	7.29
Mg citrate B .	92.54	6.25	6.91	7.22	7.37
$NaHCO_3$. B .	92.28	5.72	6.12	6.51	6.89
Protected-sun-drying					
Control	89.69	5.05	5.41	5.93	6.25
H . W . B .	91.46	5.91	6.54	7.13	7.37
S . B .	91.07	5.11	5.82	6.48	7.50
Mg citrate B .	92.54	5.64	5.95	6.67	7.05
$NaHCO_3$. B .	92.28	5.77	5.59	7.21	7.54
Oven Dehydration					
Control	89.69	5.07	6.11	6.95	7.16
H . W . B .	91.46	4.96	5.75	6.41	7.02
S . B .	91.07	5.71	5.32	6.45	7.05
Mg citrate B .	92.54	5.86	6.46	6.75	7.25
$NaHCO_3$. B .	92.28	5.66	5.96	6.21	6.79
Microwave Dehydration					
Control	89.69	5.17	5.48	6.07	6.82
H . W . B .	91.46	5.91	5.99	6.22	6.63
S . B .	91.07	5.14	5.49	5.95	6.66
Mg citrate B .	92.54	5.34	5.86	6.18	5.61
$NaHCO_3$. B .	92.28	5.39	5.43	5.92	6.27
Moisture content of local market sample				7.11	
Moisture content of USA market sample				4.62	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$. B. : Blanching with hot Sodium bicarbonate solution (1%)

Table (2): Effect of pre-treatments, drying or dehydration methods and storage period on moisture content (%) of marjoram herb.

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	85.72	5.62	6.14	6.65	7.18
H .W .B.	87.43	6.40	7.12	7.33	7.64
S. B.	86.89	5.93	6.74	7.07	7.48
Mg citrate B.	87.67	6.22	6.86	7.21	7.53
$NaHCO_3$. B.	87.23	6.11	6.55	6.74	7.10
Protected-sun-drying					
Control	85.72	5.00	6.15	6.47	7.10
H. W. B.	87.43	5.80	7.02	7.23	7.76
S. B.	86.89	5.12	6.29	7.12	7.54
Mg citrate B.	87.67	5.57	6.21	6.88	7.39
$NaHCO_3$. B.	87.23	5.55	6.25	6.90	7.44
Oven Dehydration					
Control	85.72	5.24	5.85	6.60	7.06
H. W. B.	87.43	5.41	5.93	6.55	6.98
S. B.	86.89	5.44	5.84	6.43	6.64
Mg citrate B.	87.67	5.06	5.86	6.32	6.97
$NaHCO_3$. B.	87.23	5.63	5.95	6.34	6.89
Microwave Dehydration					
Control	85.72	5.88	6.23	6.93	7.18
H. W. B.	87.43	5.06	5.52	6.07	6.73
S. B.	86.89	5.01	5.84	6.42	7.01
Mg citrate B.	87.67	5.61	6.12	6.76	7.28
$NaHCO_3$. B.	87.23	5.11	6.10	6.67	7.11
Moisture content of local market sample				6.27	
Moisture content of Hungarian market sample				4.79	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
Sod. Bic. B. : Blanching with hot Sodium bicarbonate solution (1%)

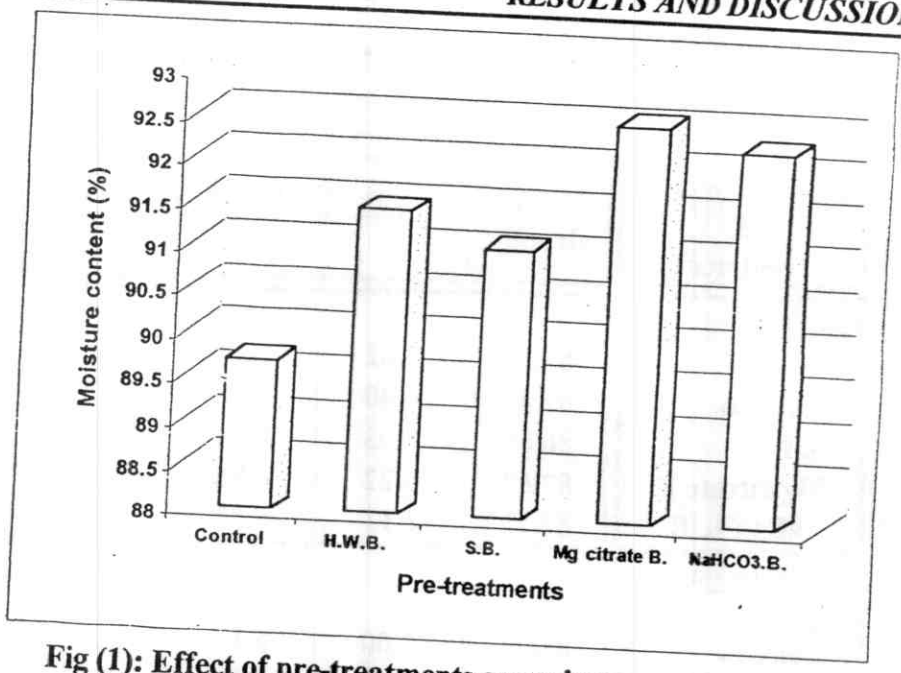

Fig (1): Effect of pre-treatments on moisture content (%) of basil herbs .

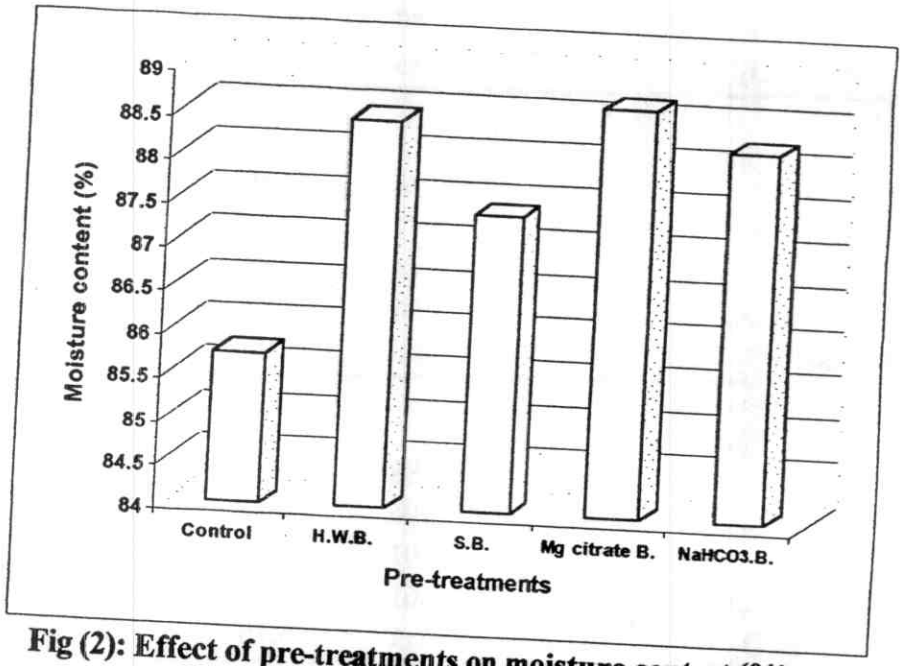

Fig (2): Effect of pre-treatments on moisture content (%) of marjoram herb.

H.W.B : Hot water blanching S.B : .Steam blanching
Mg citrate B : .Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

Table (3): Effect of pre-treatments, drying or dehydration methods and storage periods on percentage changes of moisture content (%) of basil herb.

Drying methods & Treatments	Before drying	The moisture loss (%) due to drying or dehydration process	The moisture increase (%) due to storage periods from zero time		
	The moisture increase(%) due to pre-treatments	Zero time	3	6	9
Sun drying					
Control	0.00	93.40	14.36	22.13	32.09
H .W .B.	1.97	93.61	15.58	11.82	21.06
S. B.	1.54	93.14	6.08	11.52	16.64
Mg citrate B.	3.18	93.23	10.56	15.52	17.92
$NaHCO_3$. B.	2.89	93.80	6.99	13.81	20.45
Protected-sun-drying					
Control	0.00	94.37	7.13	17.43	23.76
H. W. B.	1.97	93.54	10.66	20.64	24.70
S. B.	1.54	94.39	13.89	26.81	46.77
Mg citrate B.	3.18	93.91	5.50	18.26	25.00
$NaHCO_3$. B.	2.89	93.37	-3.12	24.96	30.68
Oven Dehydration					
Control	0.00	94.35	20.51	37.08	40.67
H. W. B.	1.97	94.58	15.93	29.23	41.53
S. B.	1.54	97.73	-6.83	12.96	23.47
Mg citrate B.	3.18	93.67	10.24	15.19	23.72
$NaHCO_3$. B.	2.89	93.87	5.30	9.72	19.96
Microwave dehydration					
Control	0.00	94.24	6.00	17.41	31.91
H. W. B.	1.97	93.54	1.35	5.25	12.18
S. B.	1.54	94.36	6.81	15.76	29.57
Mg citrate B.	3.18	94.23	9.74	15.73	5.06
$NaHCO_3$. B.	2.89	94.16	0.74	9.83	16.33

H.W.B : Hot water Blanching .
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%).

Table (4): Effect of pre-treatments, drying or dehydration methods and storage periods on percentage changes of moisture content (%) of marjoram herb.

Drying methods & Treatments	Before drying	The moisture loss (%) due to drying or dehydration process	The moisture increase (%) due to storage periods from zero time		
	The moisture increase(%) due to pre-treatments	Zero time	3	6	9
Sun drying					
Control	0.00	93.44	9.25	18.32	27.76
H .W .B.	1.99	92.68	11.25	14.53	19.38
S. B.	1.36	93.18	13.66	19.22	26.14
Mg citrate B.	2.27	92.91	10.29	15.92	21.06
$NaHCO_3$. B.	1.76	93.00	7.20	10.31	16.20
Protected-sun-drying					
Control	0.00	94.17	23.00	29.40	42.00
H. W. B.	1.99	93.37	21.03	24.66	33.79
S. B.	1.36	94.11	22.85	39.63	47.27
Mg citrate B.	2.27	93.65	11.49	23.52	32.68
$NaHCO_3$. B.	1.76	93.64	12.61	24.32	34.05
Oven Dehydration					
Control	0.00	93.89	11.64	25.95	34.73
H. W. B.	1.99	93.81	9.61	21.07	29.02
S. B.	1.36	93.74	7.35	18.20	22.06
Mg citrate B.	2.27	94.23	15.81	24.90	37.75
$NaHCO_3$. B.	1.76	93.55	5.68	12.61	22.38
Microwave dehydration					
Control	0.00	93.14	5.95	17.86	22.11
H. W. B.	1.99	94.21	9.09	19.96	33.00
S. B.	1.36	94.23	16.57	28.14	39.92
Mg citrate B.	2.27	93.60	9.09	20.50	29.77
$NaHCO_3$. B.	1.76	94.14	19.37	30.53	39.14

H.W.B : Hot water Blanching .
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%).

1.2- Chlorophyll content:-

The chlorophyll content of herbs is very important attribute and is considered as a good indicator of quality for drying methods. Thus, chlorophyll content was determined in fresh basil and marjoram herbs before and after pre-treatments, as well as after drying and also during storage periods. The obtained data are shown in Tables (5 to 8) and illustrated in Figures (3 to 6).

From these results it could be observed that the chlorophyll contents were 928.71 mg/100 g and 888.58 mg/100 g (on dry weight basis) for fresh basil and marjoram herbs, respectively. These results are in harmony with the range of data obtained by **Hanafy (1989); Jacoub (1995); EL-Gadban (1998); Jacoub (1999) and Abd EL-Aziz (2002).**

The heating during pre-treatment of herbs affected chlorophyll contents in both herbs. All pre-treatments decreased the percentage of chlorophyll contents. The losses in total chlorophyll due to pre-treatments ranged from 17.25 to 41.57 % in basil and from 17.52 to 32.79 % in marjoram. The decrease in chlorophyll contents was due to the effect of heat pre-treatments, conversion of chlorophyll to pheophytin and to its leaching into water during blanching. Data of **Jones *et al.* (1963); Foda *et al.* (1968); Schwartz and Von Elbe (1983); Steet and Tong (1996) and Choe *et al.* (2001)** are in agreement with these obtained results.

The less losses in both herbs in samples pre-treated with hot sodium bicarbonate solution (1%) may be due to pH value of solution (pH = 9.8), these results are in concordant with those reported by **Sweeney and Martin (1961); Clydesdale and Francis (1968);Laborde and Von Elbe (1994) and Abd-EL-Latif *et al.* (2001).** On the other hand, the highest loss was

Table (5) :Effect of pre-treatments, drying or dehydration methods and storage period on chlorophyll a, b and total chlorophyll content of basil herb (mg/100g dry weight)

Drying methods & Treatments	Before drying			Storage periods (months)											
				Zero time			3			6			9		
Sun drying	Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll		
	a	b	Total	a	b	Total	a	b	Total	a	b	Total	a	b	Total
Control	580.79	347.82	928.71	345.40	213.81	559.21	267.16	179.82	446.98	243.52	145.26	388.78	213.35	134.68	348.03
H . W . B .	395.45	246.91	642.36	305.05	183.24	488.39	254.30	152.09	406.39	231.14	135.11	366.25	214.09	124.98	339.07
S.B.	343.84	198.78	542.62	241.66	158.99	403.65	210.46	127.64	338.10	187.74	120.81	308.55	178.08	105.44	283.52
Mg citrate B .	432.36	256.87	689.23	321.65	176.89	498.54	267.80	145.89	413.69	244.40	131.98	376.38	225.65	122.01	347.66
$NaHCO_3$. B .	471.97	269.56	768.53	361.78	182.49	544.27	304.55	148.67	453.22	276.14	136.80	412.94	257.13	125.20	382.33
Protected-sun-drying															
Control	580.79	347.82	928.71	348.33	220.46	568.79	283.80	174.94	458.74	241.78	154.21	395.99	209.67	138.96	348.63
H . W . B .	395.45	246.91	642.36	310.05	168.89	478.94	279.03	111.63	390.66	252.13	103.45	355.58	233.13	95.32	328.45
S.B.	343.84	198.78	542.62	275.30	136.89	412.19	242.71	104.02	346.73	220.44	91.58	312.02	203.94	83.12	287.06
Mg citrate B .	432.36	256.87	689.23	361.12	163.86	524.98	306.95	126.58	433.53	276.47	119.08	395.55	259.30	108.51	367.81
$NaHCO_3$. B .	471.97	269.56	768.53	401.87	197.74	599.61	345.90	157.32	503.22	324.16	138.15	462.31	301.66	129.26	430.92
Oven dehydration															
Control	580.79	347.82	928.71	366.88	223.50	590.38	278.84	173.22	452.06	237.17	154.23	391.40	203.45	144.58	348.03-
H . W . B .	395.45	246.91	642.36	338.00	167.79	504.79	285.41	139.24	424.65	256.41	126.31	382.72	234.36	117.32	351.68
S.B.	343.84	198.78	542.62	288.28	143.11	431.39	238.93	120.28	359.21	219.86	108.54	328.40	202.89	100.78	303.67
Mg citrate B .	432.36	256.87	689.23	372.67	180.67	553.34	333.60	131.45	465.05	305.02	119.24	424.26	284.25	110.84	395.09
$NaHCO_3$. B .	471.97	269.56	768.53	394.24	203.98	598.22	338.18	162.09	500.27	311.73	145.81	457.54	293.45	133.24	426.69
Microwave dehydration															
Control	580.79	347.82	928.71	508.12	312.86	820.98	418.13	248.75	666.88	365.37	216.48	581.85	325.17	201.52	526.69
H . W . B .	395.45	246.91	642.36	371.23	223.21	594.44	315.92	190.60	506.52	305.46	154.71	460.17	281.73	146.23	427.96
S.B.	343.84	198.78	542.62	322.50	174.47	496.97	273.15	149.89	423.04	245.67	138.76	384.43	227.55	128.36	355.91
Mg citrate B .	432.36	256.87	689.23	402.94	231.01	633.95	345.91	198.59	544.50	315.56	181.19	496.75	292.54	170.48	463.02
$NaHCO_3$. B .	471.97	269.56	768.53	462.39	245.66	708.05	393.65	216.72	610.37	367.15	194.31	561.46	342.09	183.27	525.36
Chlorophyll content of local market sample										**a : 268.71**		**b : 139.91**		**Total : 408.62**	
Chlorophyll content of USA market sample										**a : 350.26**		**b : 163.01**		**Total : 513.27**	

H.W.B : Hot water Blanching .
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
S.B. : Steam blanching.
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

Table (6) :Effect of pre-treatments, drying or dehydration methods and storage period on chlorophyll a, b and total chlorophyll content of marjoram herb (mg/100g dry weight).

Drying methods & Treatments	Before drying			Storage periods (months)											
				Zero time			3			6			9		
Sun drying	Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll		
	a	b	Total	a	b	Total	a	b	Total	a	b	Total	a	b	Total
Control	561.90	326.68	888.58	331.08	248.88	579.96	255.02	204.19	459.21	215.06	183.08	398.14	185.84	164.02	349.86
H . W . B .	413.06	244.29	657.35	283.49	173.10	456.59	230.48	147.53	378.01	203.22	135.67	338.89	181.99	125.11	307.10
S.B.	375.16	222.05	597.21	248.22	145.02	393.24	202.98	118.45	321.43	181.47	104.14	285.61	161.41	94.10	255.51
Mg citrate B .	416.20	246.32	662.52	243.45	151.37	394.82	214.33	130.03	344.36	196.85	105.02	301.87	173.20	93.05	266.25
$NaHCO_3$. B .	469.33	263.57	732.90	329.08	192.25	521.33	281.45	161.33	442.78	249.63	151.94	401.57	228.17	139.06	367.23
Protected-sun-drying															
Control	561.90	326.68	888.58	346.60	251.31	597.91	260.80	199.69	460.49	218.01	185.29	403.30	189.73	168.33	358.06
H . W . B .	413.06	244.29	657.35	303.52	169.31	472.83	248.64	151.56	400.20	224.60	138.90	363.50	213.88	119.54	333.42
S.B.	375.16	222.05	597.21	256.85	150.18	407.03	214.50	127.91	342.41	190.76	116.32	307.08	166.78	103.08	269.86
Mg citrate B .	416.20	246.32	662.52	276.31	182.23	458.54	238.07	141.67	379.74	205.26	135.76	341.02	196.43	112.62	309.05
$NaHCO_3$. B .	469.33	263.57	732.90	353.23	188.54	541.77	300.40	170.69	471.09	275.78	155.59	431.37	242.72	146.30	389.02
Oven dehydration															
Control	561.90	326.68	888.58	338.00	257.87	595.87	268.17	215.27	483.44	231.14	192.58	423.72	201.92	174.38	376.30
H . W . B .	413.06	244.29	657.35	312.69	167.12	479.81	255.27	149.77	405.04	226.49	141.01	367.50	210.50	125.29	335.79
S.B.	375.16	222.05	597.21	259.90	157.63	417.53	227.07	121.42	348.49	204.11	108.64	312.75	174.80	108.73	283.53
Mg citrate B .	416.20	246.32	662.52	250.42	153.06	403.48	203.45	127.57	331.02	188.51	105.22	293.73	168.61	94.06	262.67
$NaHCO_3$. B .	469.33	263.57	732.90	337.53	211.47	549.00	302.43	165.32	467.75	264.40	163.31	427.71	244.30	151.01	395.31
Microwave dehydration															
Control	561.90	326.68	888.58	446.91	312.74	759.65	356.35	275.77	632.12	307.01	257.96	564.97	272.89	236.12	509.01
H . W . B .	413.06	244.29	657.35	388.34	215.27	603.61	330.60	192.10	522.70	316.64	160.88	477.52	292.97	148.64	441.61
S.B.	375.16	222.05	597.21	325.19	186.04	511.23	272.62	158.57	431.19	258.43	131.68	390.11	223.35	125.83	349.18
Mg citrate B .	416.20	246.32	662.52	341.61	174.64	516.25	289.36	149.39	438.75	255.75	134.95	390.70	234.44	117.07	351.51
$NaHCO_3$. B .	469.33	263.57	732.90	431.87	252.94	684.81	380.62	218.09	598.71	340.61	213.02	553.63	322.87	195.79	518.66
Chlorophyll content of local market sample										a : 200.16		b : 116.71		Total : 316.87	
Chlorophyll content of Hungarian market sample										a : 313.22		b : 198.14		Total : 511.36	

H.W.B : Hot water blanching.
Mg citrate B. : Blanching with hot Mg citrate solution.
S.B. : Steam blanching.
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

Table (7): Effect of pre-treatments, drying or dehydration methods and storage period on percentage losses of chlorophyll a, b and total chlorophyll content of basil herb.

Drying methods & Treatments	Before drying			Storage periods (months)											
				Zero time			3			6			9		
	The loss during pre-treatments (%)			The loss during drying or dehydration process (%)			The loss during storage period from zero time (%)								
Sun drying	Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll		
	a	b	Total	a	b	Total	a	B	Total	a	b	Total	a	b	Total
Control	00.00	00.00	00.00	40.53	38.53	39.79	22.65	15.90	20.07	29.50	32.06	30.48	38.23	37.01	37.76
H . W . B .	31.91	29.01	30.83	22.86	25.79	23.97	16.64	17.00	16.79	24.23	26.27	25.01	29.82	31.79	30.57
S.B.	40.80	42.85	41.57	29.72	20.02	25.61	12.91	19.72	16.24	22.31	24.01	23.56	26.31	33.68	29.76
Mg citrate B .	25.56	26.15	25.79	25.61	31.14	27.67	16.74	17.53	17.02	24.02	25.39	24.50	29.85	31.02	30.26
$NaHCO_3$. B .	18.74	22.50	17.25	23.35	32.30	29.18	15.82	18.53	16.73	23.67	25.04	24.13	28.92	31.39	29.75
Protected-sun- drying															
Control	00.00	00.00	00.00	40.02	36.62	38.75	18.53	20.65	19.35	30.59	30.05	30.38	39.81	36.97	38.71
H . W . B .	31.91	29.01	30.83	21.60	31.60	25.44	10.00	33.90	18.43	18.69	38.75	25.76	24.81	43.56	31.42
S.B.	40.80	42.85	41.57	19.93	31.13	24.04	11.84	24.01	15.88	19.93	33.10	24.30	25.92	39.28	30.36
Mg citrate B .	25.56	26.15	25.79	16.48	36.21	23.83	15.00	22.75	17.42	23.44	27.33	24.65	28.20	33.78	29.94
$NaHCO_3$. B .	18.74	22.50	17.25	14.85	26.64	21.98	13.93	20.44	16.08	19.34	30.14	22.90	24.94	34.63	28.13
Oven dehydration															
Control	00.00	00.00	00.00	36.83	35.74	36.43	24.00	22.50	23.43	35.35	30.99	33.70	44.55	35.31	41.05
H . W . B .	31.91	29.01	30.83	14.53	32.04	21.42	15.56	17.02	15.88	24.14	24.72	24.18	30.66	30.08	30.33
S.B.	40.80	42.85	41.57	16.16	28.01	20.50	17.12	15.95	16.73	23.73	24.16	23.87	29.62	29.58	29.61
Mg citrate B .	25.56	26.15	25.79	13.81	29.66	19.72	10.48	27.24	15.96	18.15	34.00	23.33	23.73	38.65	28.60
$NaHCO_3$. B .	18.74	22.50	17.25	16.47	24.33	22.16	14.22	20.54	16.37	20.93	28.52	23.52	25.57	34.68	28.67
Microwave dehydration															
Control	00.00	00.00	00.00	12.51	10.05	11.60	17.71	20.49	18.77	28.09	30.81	29.13	36.01	35.59	35.85
H . W . B .	31.91	29.01	30.83	6.12	9.60	7.46	14.90	14.62	14.79	17.72	30.69	22.59	24.11	34.49	28.01
S.B.	40.80	42.85	41.57	6.21	12.23	8.41	15.30	14.09	14.88	23.82	20.47	22.65	29.44	26.43	28.38
Mg citrate B .	25.56	26.15	25.79	6.80	10.07	8.02	14.15	14.03	14.11	21.69	21.57	21.64	27.40	26.20	26.96
$NaHCO_3$. B .	18.74	22.50	17.25	2.03	8.87	7.87	14.87	11.78	13.80	20.60	20.90	20.70	26.02	25.40	25.80

H.W.B : Hot water blanching.
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

Table (8) :Effect of pre-treatments, drying or dehydration methods and storage period on percentage losses of chlorophyll a, b and total chlorophyll content of marjoram herb.

Drying methods & Treatments	Before drying			Storage periods (months)											
				Zero time			3			6			9		
	The loss during pre-treatments (%)			The loss during drying or dehydration process (%)			The loss during storage period from zero time (%)								
	Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll			Chlorophyll		
	a	b	Total	a	b	Total	a	B	Total	a	b	Total	a	b	Total
Sun drying															
Control	00.00	00.00	00.00	41.08	23.82	34.73	22.97	17.96	20.82	35.04	26.44	31.35	43.87	34.10	39.68
H.W.B.	26.49	25.22	26.02	31.37	29.14	30.54	18.70	14.77	17.21	28.31	21.62	25.78	35.80	27.72	32.74
S.B.	33.23	32.03	32.79	33.84	34.49	34.15	18.23	18.32	18.26	26.89	28.19	27.37	34.97	35.11	35.02
Mg citrate B.	25.93	24.60	25.44	36.14	28.37	33.37	11.96	14.10	12.78	19.14	30.62	23.54	28.86	38.53	32.56
$NaHCO_3$. B.	16.47	19.32	17.52	29.88	27.06	28.87	14.47	16.08	15.07	24.14	20.97	22.97	30.66	27.67	29.56
Protected-sun-drying															
Control	00.00	00.00	00.00	38.32	23.07	32.71	24.75	20.54	22.98	37.10	26.27	32.55	45.26	33.02	40.11
H.W.B.	26.49	25.22	26.02	26.52	30.69	28.07	18.08	10.48	15.36	26.00	17.96	23.12	29.53	29.40	29.48
S.B.	33.23	32.03	32.79	31.54	32.37	31.84	16.49	14.83	15.88	25.73	22.55	24.56	35.07	31.36	33.70
Mg citrate B.	25.93	24.60	25.44	33.61	26.02	30.78	13.84	22.26	17.18	25.71	25.50	25.63	28.91	38.20	32.60
$NaHCO_3$. B.	16.47	19.32	17.52	24.74	28.47	26.08	14.96	9.47	13.05	21.93	17.48	20.38	31.29	22.40	28.19
Oven dehydration															
Control	00.00	00.00	00.00	39.85	21.06	32.94	20.66	16.52	18.87	31.62	25.32	28.89	40.24	32.38	36.85
H.W.B.	26.49	25.22	26.02	24.30	31.59	27.01	18.36	10.38	15.58	27.57	15.62	23.41	32.69	25.03	30.02
S.B.	33.23	32.03	32.79	30.72	29.01	30.01	12.63	22.97	16.54	21.47	31.08	25.10	32.74	31.02	32.09
Mg citrate B.	25.93	24.60	25.44	34.31	27.57	31.90	18.76	16.65	17.96	24.72	31.26	27.20	32.67	38.55	34.90
$NaHCO_3$. B.	16.47	19.32	17.52	28.08	19.77	25.09	10.40	21.82	14.80	21.67	22.77	22.09	27.62	28.59	27.99
Microwave dehydration															
Control	00.00	00.00	00.00	20.46	14.28	14.51	20.27	11.82	16.79	31.30	17.52	25.63	38.94	24.50	32.99
H.W.B.	26.49	25.22	26.02	6.01	11.88	8.18	14.87	10.76	13.40	18.46	25.27	20.89	24.56	30.95	26.84
S.B.	33.23	32.03	32.79	13.32	16.22	14.40	16.17	14.77	15.66	20.53	29.22	23.69	31.32	32.36	31.70
Mg citrate B.	25.93	24.60	25.44	10.39	17.36	12.87	15.30	14.46	15.02	25.13	22.73	24.32	31.37	32.96	31.91
$NaHCO_3$. B.	16.47	19.32	17.52	7.98	4.03	6.56	11.87	13.78	12.57	21.13	15.78	19.16	25.24	24.26	24.26

H.W.B : Hot water blanching.
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

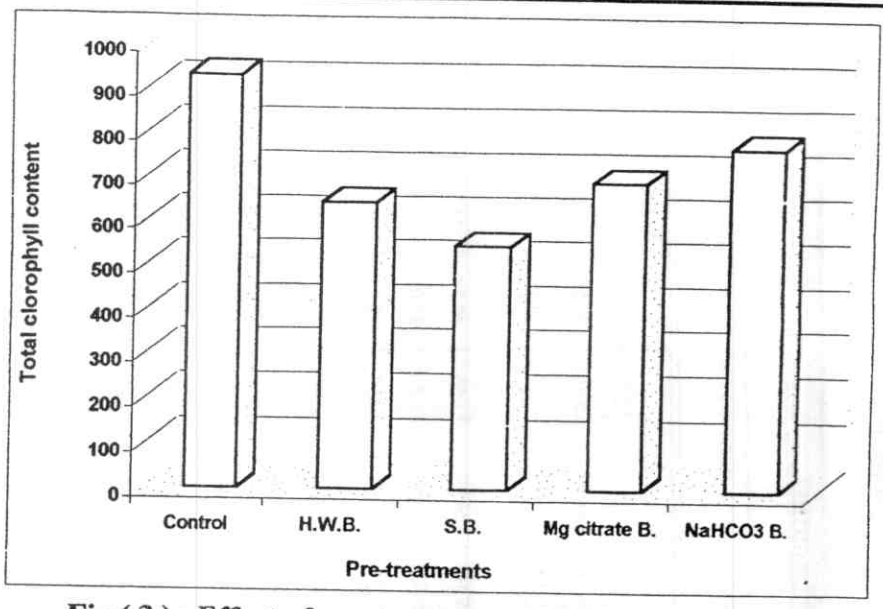

Fig (3) : Effect of pre-treatments on chlorophyll content (mg/100g dry weight) of basil herb .

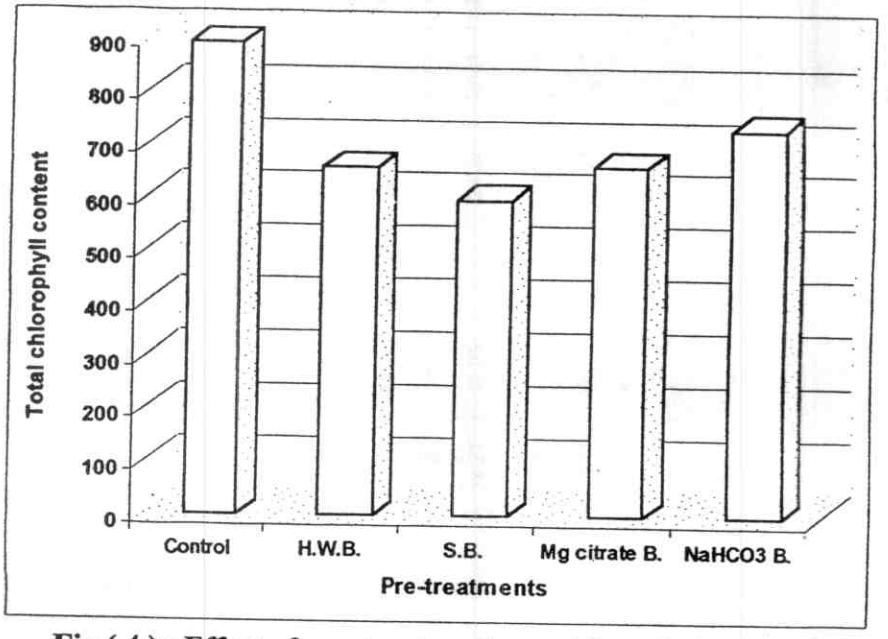

Fig (4) : Effect of pre-treatments on chlorophyll content (mg/100g dry weight) of marjoram herb.

H.W.B : Hot water blanching S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$-B. : Blanching with hot sodium bicarbonate solution (1%)

observed in samples pre-treated with steam blanching for both herbs, this may be due to high conversion of chlorophyll a and b to their corresponding pheophytin by steam blanching treated. These results are compatible with those obtained by **Foda *et al.* (1968) and Bahgat (1975).**

Total chlorophyll decreased in all samples of both herbs after drying. The chlorophyll content losses ranged from 23.97 to 39.79 %; 21.98 to 38.75 %; 19.72 to 36.43 %; and from 7.87 to 11.60 % for sun drying, protected-sun-drying, oven dehydration and microwave dehydration of basil herb, respectively. While, the losses in marjoram herb ranged from 28.87 to 34.73 %; 26.08 to 32.71 %; 25.09 to 32.94 %; and from 6.56 to 14.51 % for sun drying, protected-sun-drying, oven dehydration and microwave dehydration, respectively. These results are due to the effect of drying heat on chlorophyll and conversion of chlorophyll to pheophytin. These results are in the same direction with those reported by **Foda *et al.* (1968); Schwartz and Von Elbe (1983); Hassan *et al.* (1989); Canjura *et al.* (1991); Chen and Chen (1993) and Steet and Tong (1996).**

The highest chlorophyll losses in basil and marjoram samples during different drying process methods occurred in control samples. These results may be due to the lack of pre-treatments and caused more chlorophyllase enzyme activity and more conversion of chlorophyll to pheophytin. These results are in agreement with those reported by **Bahgat (1975); Nezam EL-Din and EL-Feky (1991); Youssef (1994) and Abd-EL-Latif *et al.* (2001).**

Different drying methods were effective on the amount of chlorophyll loss. Dehydration by microwave was the best method to retain the chlorophyll after dehydration. These results might be due to the short time of exposing the herb to heat and the effect of microwave on inhibition of chlorophyllase enzyme activity. These results are in harmony with those observed by **Younis (1994)**. On the other side, sun drying was the least method to retain the chlorophyll after drying; the great loss of chlorophyll in sun drying samples might be due to conversion of chlorophyll to pheophytin by the effect of sun heat, light and long time of drying. These results are in agreement with those found by **Hassan *et al.* (1989).** While, protected-sun-drying and oven dehydration methods were medium to retain the chlorophyll.

During storage up to nine months at room temperature the chlorophyll content degradation was gradually. The loss increased with increasing time of storage. The percentage of chlorophyll content losses at the end of storage period ranged from 29.75 to 37.76 %; 28.13 to 38.71 %; 28.60 to 41.05 %; and from 25.80 to 35.59 % for sun drying, protected-sun-drying, oven dehydration and microwave dehydration of basil herb, respectively. While, losses in marjoram herb ranged from 29.56 to 39.68 %; 28.19 to 40.11 %; 27.99 to 36.85 %; and from 24.26 to 32.99 % for sun drying, protected-sun-drying, oven dehydration and microwave dehydration respectively. These results might be due to conversion of chlorophyll to pheophytin. These results are in agreement with those reported by **LaJollo *et al.* (1971); Baardseth and Von Elbe (1989); Hassan *et al.***

(1989); Canjura *et al.* (1991); Schwartz and Lorenzo (1991); Nezam EL-Din and EL-Feky (1991) and Abd-EL-Latif *et al.* (2001).

Generally, at the end of storage period the results found that blanching treatments caused less losses of chlorophyll content for both herbs upon drying methods from zero time. While, the best pre-treatment was that with hot sodium bicarbonate solution (1%). This effect might be due to influence of pH value (pH = 9.8), which might prevent the degradation of chlorophyll. Moreover, the effect of pre-treated with hot magnesium citrate solution (1%) to preserve chlorophyll content was less than the effect of sodium bicarbonate. These results may be due to decline of magnesium citrate pH value (pH=8.2). On the other hand, the highest loss in chlorophyll was found in control samples (without any pre-treatments). These results were due to the atmosphere temperature, long time of storage period, suitable situation to conversion of chlorophyll to pheophytin and chlorophyllase enzyme activity. These results are in harmony with those reported by **Clydesdale and Francis (1968).** Moreover, the decreased in sun drying samples was more than the others samples. However, the decreased in microwave samples was less than the other samples. These results might be due to the moisture content, because water activity had an essential function in chlorophyll degradation. These results are in agreement with those observed by **LaJollo *et al.* (1971)**.

It could be concluded that, chlorophyll content (at zero time) of local market dried samples were 408.62 and 316.87 mg/100 g (on dry weight basis) for basil and marjoram herbs,

respectively. Chlorophyll content of these samples was less than any other samples under study. This result is due to manufacture practice and sunshine exhibition for long time. Moreover, chlorophyll content represented in USA basil dehydrated sample and Hungarian marjoram dehydrated samples was 513.27 mg/100 g and 511.36 mg/100 g. In comparison, USA and Hungarian samples were high quality than that of sun drying samples and slight goodness with best protected-sun-drying and oven dehydration samples. These results may be due to good manufacture practice and sorting with laser beam. On the other hand, microwave dehydrated samples had priority than imported samples.

1.3. Ash content-:

Ash content in herbs and its ground is very important parameter to know the levels of dust polluted during handling or in any other technical processing.

The results of ash content of fresh basil and marjoram herbs, pre-treated and dried herbs are tabulated in Tables (9 and 10) and Figures (7 and 8).

The ash content of fresh basil and marjoram herbs were found to be 13.44 and 9.68 % on dry weight, respectively. These results are in agreement with those obtained by **Farrel (1990)** and **Abdallah (2000).**

A slight increase in ash content of both herbs as affected by blanching in magnesium citrate or sodium bicarbonate solution. This increase could be due to the dipping of herbs in hot salt solution. While, a slight decrease occurred in other treatments due to blanching by hot water or steam. These results are in harmony with those obtained by **EL-Sherbiny *et al.* (1989).**

The initial ash contents of sun drying and protected-sun-drying samples of basil and marjoram were found to cause slight increase in ash content. The percentage of increase in sun drying ranged from 1.8 to 4.9 % in basil herb and from 3.93 to 4.96 % in marjoram herb. Moreover, the percentage of increase due to protected-sun-drying ranged from 0.71 to 2.1 % in basil herb and between 0.52 to 2.65 % in marjoram herb. These results revealed

Table (9) : Effect of pre-treatments and drying or dehydration methods on ash content of basil (on dry weight) .

Treatments	Before drying	Sun drying	Protected-sun-drying	Dehydration	Microwave dehydration
Control	13.44	14.10	13.62	13.34	13.39
B . W . B .	13.15	13.67	13.28	13.07	13.11
S . B .	13.34	13.58	13.62	13.22	13.33
Mg citrate B.	13.94	14.55	14.11	13.93	13.90
$NaHCO_3$. B .	14.00	14.44	14.10	14.00	14.04
Sample from local market	16.88	-----	-----	-----	-----
Sample from USA market	-----	-----	-----	14.76	-----

Table (10): Effect of pre-treatments and drying or dehydration methods on ash content of marjoram (on dry weight) .

Treatments	Before drying	Sun drying	Protected-sun-drying	Dehydration	Microwave dehydration
Control	9.68	10.16	9.73	9.59	9.58
B . W . B .	9.42	9.79	9.67	9.35	9.31
S . B .	9.58	9.98	9.73	9.51	9.55
Mg citrate B .	10.04	10.51	10.13	9.96	10.02
$NaHCO_3$. B .	10.05	10.45	10.24	9.99	10.00
Sample from local market	12.28	-----	-----	-----	-----
Sample from Hungarian market	-----	-----	-----	11.72	-----

B.W.B. : Hot water blanching S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$. B. : Blanching with hot Sodium bicarbonate solution (1%)

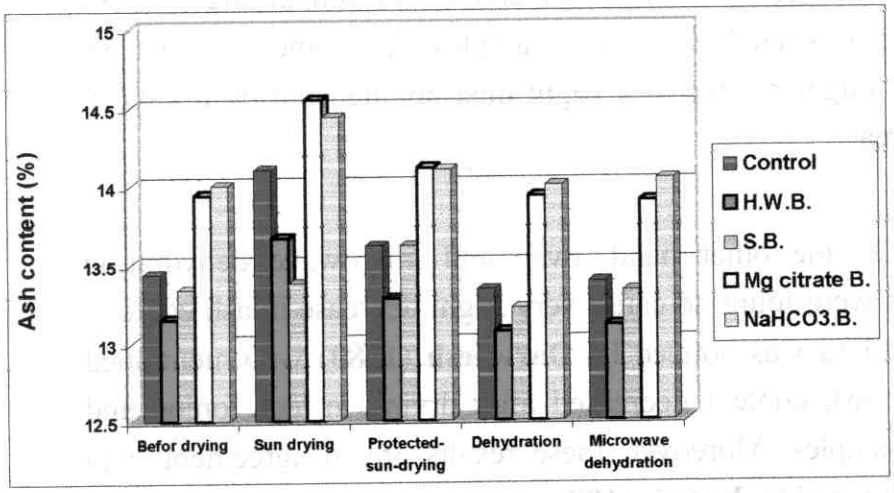

Fig (9) : Effect of pre-treatments and drying methods on ash content (%) of basil herb.

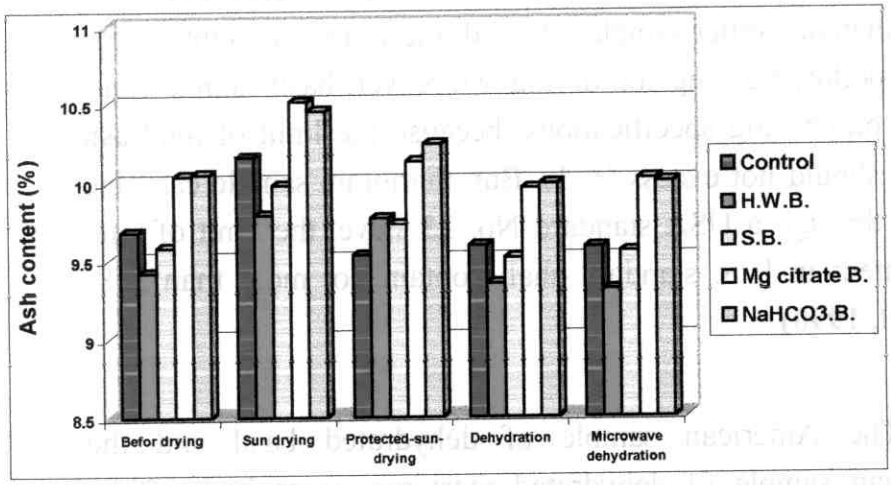

Fig (10) : Effect of pre-treatments and drying methods on ash content (%) of marjoram herb.

H.W.B : Hot water blanching **S.B.** : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

that the ash contents slightly increased in sun drying samples than in protected-sun-drying samples. This increase in ash content might be due to a slight dust polluted during drying in open area.

On the other hand, oven and microwave dehydration samples were found to cause very slight decrease in ash content. This finding was noticed by **Darweesh (1980)** who mentioned that the ash content decreased after drying in leek, onion and garlic samples. Moreover, these results are in agreement with those obtained by **Younis (1994)**.

In addition for comparison, the ash contents of dried basil and marjoram samples obtained from local manufacturer were higher than any other samples studied, these results might be due to dust polluted during sun drying. Moreover, basil sample can't able to purchasing specifications, because the limit of total ash content should not excess 16 %. But, marjoram sample can able to pass through a USA standard No. 35 sieve, the limit of total ash content in U.S. standard shall contain not more than 15% **(Farrell, 1990)**.

The American sample of dehydrated basil and the Hungarian sample of dehydrated marjoram were higher than samples studied in ash content, but American or Hungarian samples were processed under good conditions. These results might be due to geographical origin, climate or agronomic factors. These results are in agreement with those obtained by **Charalambous (1994), Gill and Randhawa (1996)**.

1.4 – Essential oil content: -

Essential oil content is considered to be the most important component in herbs and the main reason to judge the quality of herbs. Essential oil percentages were determined in herbs obtained from fresh, after pre-treatments and dried herbs immediately after drying and during storage periods.

The effect of pre-treatments on the essential oils content are tabulated in Tables (11, 12, 13 and 14) and illustrated in Figures (9 and 10). From these results, it could observe that the total essential oil percentages represented 2.04 % and 1.88 % on dry weight for basil and marjoram fresh leaves, respectively. These results are in agreement with the range obtained by **Erian (1969), Hanafy (1989), Charalambous (1994), Jacoub (1995), EL-Gadban (1988), Jacoub (1999) and Abd EL-Aziz (2002).**

From the obtained data, it was found that the pre-treatments caused noticeable reduction in essential oil contents and these reductions was more pronounced in the case of blanching with hot magnesium citrate solution (1%), Tables (13 and 14). The loss (%) of essential oil was 14.7, 10.3, 15.2 and 14.2 % for basil pre-treatments, blanching with hot water, steam blanching, blanching by hot magnesium citrate solution (1%) and blanching by hot sodium bicarbonate solution (1%), respectively, and for marjoram pre-treatments were 14.9, 10.1, 15.4 and 14.9 %, respectively. This loss of essential oils could be attributed to heat treatments.

The effect of drying methods on the percentage and the losses percentages of essential oils are shown in the same Tables

Table (9): Effect of pre-treatments, drying or dehydration methods and storage period on essential oil percentage of basil leaves (% dry weight).

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	2.04	1.50	1.19	0.96	0.78
H . W . B .	1.74	1.32	1.03	0.85	0.67
S . B .	1.83	1.37	1.08	0.89	0.70
Mg citrate B .	1.73	1.30	1.03	0.85	0.69
$NaHCO_3$. B .	1.75	1.32	1.02	0.87	0.66
Protected-sun-drying					
Control	2.04	1.65	1.43	1.31	1.11
H . W . B .	1.74	1.40	1.22	1.14	0.97
S . B .	1.83	1.46	1.27	1.17	0.98
Mg citrate B .	1.73	1.38	1.18	1.11	0.92
$NaHCO_3$. B .	1.75	1.37	1.19	1.09	0.91
Oven Dehydration					
Control	2.04	1.59	1.36	1.16	0.94
H . W . B .	1.74	1.34	1.15	0.95	0.76
S . B .	1.83	1.41	1.21	1.00	0.79
Mg citrate B .	1.73	1.33	1.12	0.94	0.78
$NaHCO_3$. B .	1.75	1.35	1.14	1.00	0.78
Microwave Dehydration					
Control	2.04	1.76	1.57	1.39	1.24
H . W . B .	1.74	1.44	1.29	1.18	1.11
S . B .	1.83	1.54	1.40	1.29	1.16
Mg citrate B .	1.73	1.44	1.29	1.17	1.09
$NaHCO_3$. B .	1.75	1.42	1.27	1.13	1.07
Essential oil percentage of local market sample				**1.12**	
Essential oil percentage of USA market sample				**1.24**	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$. B. : Blanching with hot Sodium bicarbonate solution (1%)

Table (10): Effect of pre-treatments, drying or dehydration methods and storage period on essential oil percentage of marjoram leaves (% dry weight).

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	1.88	1.40	1.12	0.85	0.60
H . W . B .	1.60	1.28	0.99	0.72	0.46
S . B .	1.69	1.33	1.05	0.78	0.57
Mg citrate B .	1.59	1.26	0.98	0.71	0.53
$NaHCO_3$. B .	1.60	1.31	1.02	0.75	0.58
Protected-sun-drying					
Control	1.88	1.49	1.22	1.13	0.90
H . W . B .	1.60	1.32	1.11	1.00	0.76
S . B .	1.69	1.42	1.22	1.09	0.84
Mg citrate B .	1.59	1.33	1.15	1.04	0.80
$NaHCO_3$. B .	1.60	1.35	1.14	0.99	0.78
Dehydration					
Control	1.88	1.40	1.17	0.95	0.75
H . W . B .	1.60	1.25	1.04	0.84	0.65
S . B .	1.69	1.33	1.12	0.93	0.71
Mg citrate B .	1.59	1.26	1.06	0.90	0.67
$NaHCO_3$. B .	1.60	1.24	1.03	0.89	0.69
Microwave Dehydration					
Control	1.88	1.57	1.30	1.16	1.02
H . W . B .	1.60	1.38	1.13	1.00	0.88
S . B .	1.69	1.49	1.24	1.09	0.98
Mg citrate B .	1.59	1.41	1.18	1.04	0.93
$NaHCO_3$. B .	1.60	1.40	1.15	1.03	0.90
Essential oil percentage of local market sample				**0.97**	
Essential oil percentage of Hungarian market sample				**1.13**	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$. B. : Blanching with hot Sodium bicarbonate solution (1%)

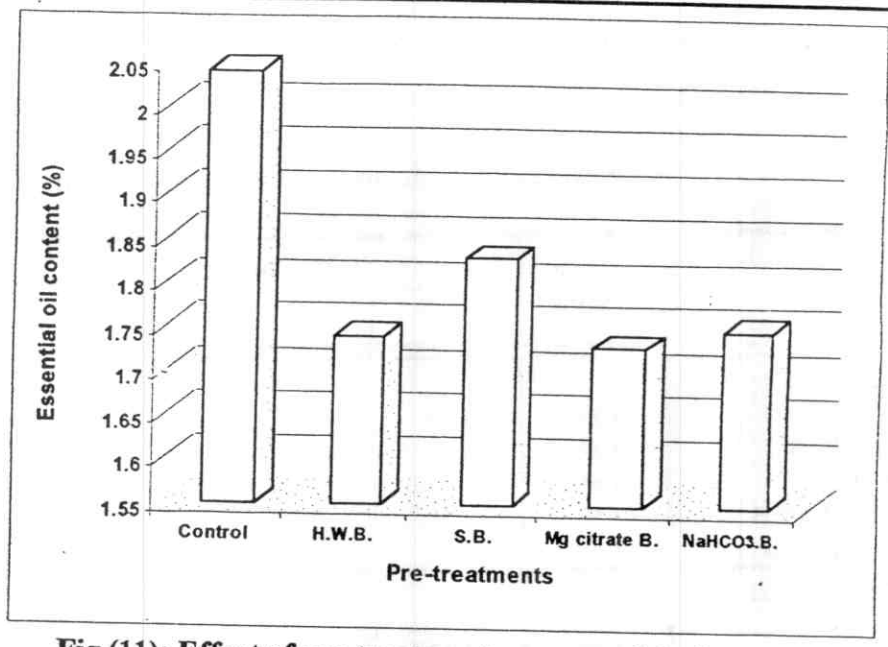

Fig (11): Effect of pre-treatments on essential oil content of basil leaves.

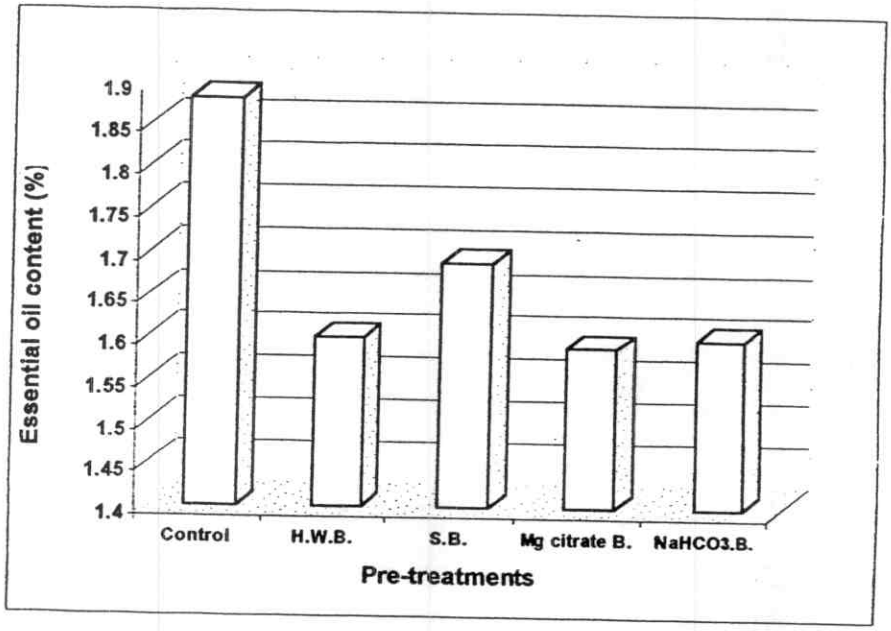

Fig (12) : Effect of pre-treatments on essential oil content of marjoram leaves .

H.W.B : Hot water blanching S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

Table (13): Effect of pre-treatments, drying or dehydration methods and storage periods on percentage changes of essential oil content (%) of basil herb.

Drying methods & Treatments	Before drying	The essential oil loss (%) due to drying or dehydration process	The essential oil decrease (%) due to storage periods from zero time		
	The essential oil decrease(%) due to pre-treatments	Zero time	3	6	9
Sun drying					
Control	00.00	26.47	20.67	36.00	48.00
H .W .B.	14.71	24.14	21.97	35.61	49.24
S. B.	10.29	25.14	21.17	35.04	49.91
Mg citrate B.	15.20	24.86	20.77	34.62	46.92
$NaHCO_3$. B.	14.22	24.57	22.73	34.09	50.00
Protected-sun-drying					
Control	00.00	19.12	13.33	20.61	32.73
H. W. B.	14.71	19.54	12.86	18.87	30.71
S. B.	10.29	20.22	13.01	19.86	32.88
Mg citrate B.	15.20	20.23	14.49	19.57	33.33
$NaHCO_3$. B.	14.22	21.71	13.14	20.44	33.58
Oven Dehydration					
Control	00.00	22.06	14.47	27.04	40.88
H. W. B.	14.71	22.99	14.18	29.10	43.28
S. B.	10.29	22.95	14.18	29.08	43.97
Mg citrate B.	15.20	23.12	15.79	29.32	41.35
$NaHCO_3$. B.	14.22	22.86	15.56	25.93	42.22
Microwave dehydration					
Control	00.00	13.73	10.80	21.02	29.55
H. W. B.	14.71	17.24	10.42	18.05	22.92
S. B.	10.29	15.85	9.09	16.23	24.68
Mg citrate B.	15.20	16.76	10.42	18.75	24.31
$NaHCO_3$. B.	14.22	18.86	10.56	20.42	24.65

H.W.B : Hot water Blanching .
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%).

Table (14): Effect of pre-treatments, drying or dehydration methods and storage periods on percentage changes of essential oil content (%) of marjoram herb.

Drying methods & Treatments	Before drying	The essential oil loss (%) due to drying or dehydration process	The essential oil decrease (%) due to storage periods from zero time		
	The essential oil decrease(%) due to pre-treatments	Zero time	3	6	9
Sun drying					
Control	00.00	25.53	20.00	39.29	57.14
H .W .B.	14.89	20.00	22.66	43.75	64.41
S. B.	10.11	21.30	21.05	41.35	57.14
Mg citrate B.	15.43	20.75	22.22	43.65	57.94
$NaHCO_3$. B.	14.89	18.13	22.14	42.75	55.73
Protected-sun-drying					
Control	00.00	20.74	18.12	24.16	39.60
H. W. B.	14.89	17.50	15.91	24.24	42.42
S. B.	10.11	15.98	14.08	23.24	40.85
Mg citrate B.	15.43	16.35	13.53	21.80	39.85
$NaHCO_3$. B.	14.89	15.63	15.56	26.67	42.22
Oven Dehydration					
Control	00.00	25.53	16.43	32.14	46.43
H. W. B.	14.89	21.88	16.80	32.80	48.00
S. B.	10.11	21.30	15.79	30.08	46.62
Mg citrate B.	15.43	20.75	15.87	28.57	46.83
$NaHCO_3$. B.	14.89	22.50	16.93	28.23	44.35
Microwave dehydration					
Control	00.00	16.49	17.20	26.11	35.03
H. W. B.	14.89	13.75	18.12	27.54	36.23
S. B.	10.11	11.83	16.87	26.85	34.23
Mg citrate B.	15.43	11.32	15.71	26.24	34.04
$NaHCO_3$. B.	14.89	12.50	17.86	26.43	35.71

H.W.B : Hot water Blanching .
S.B. : Steam blanching.
Mg citrate B. : Blanching with hot Mg citrate solution (1%).
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%).

It was found that the percentage of loss in sun-dried basil and marjoram ranged from 24.1 to 26.5 % for basil and 18.1 to 25.5 % for marjoram. While, the ranges of losses in protected-sun-dried samples were 19.1 to 21.7 % for basil and 15.6 to 20.7 % for marjoram. Moreover, the losses range were 22.1 to 23.1 % for oven dehydrated basil and between 20.8 to 25.5 % for oven dehydrated marjoram. On the other hand, the loss of essential oils during microwave dehydration ranged between 13.7 to 18.9 % for basil and 11.3 to 16.5 % for marjoram. These decrements might be due to volatilization by heat during drying process. These results are in the harmony with those obtained by **Venskutonis (1997)**. In addition, the essential oils residual after drying process in all samples under study were over minimum limit reported in **Egyptian ministerial decree (No. 90 and 91 / 1979)** to exported herbs .

During storage up to nine months at room temperature, the essential oils contents decreased gradually. The mean lost of essential oils from the sun dried samples about 48.8 % for basil and 58.5 % for marjoram. Meanwhile, the means of loss in protected-sun-dried samples were 32.7 % in basil leaves and 41 % in marjoram leaves. Moreover, the mean losses in dehydrated samples were 42.3 % for basil and 46.4 % for marjoram. Finally, the means of loss in microwave dehydrated samples were 25.2 % in basil leaves and 35.1 % in marjoram leaves. These gradually decreased due to volatilization and essential oil emission. These results are harmonized with those reported by **Hassan *et al.* (1989), Venskutonis *et al.* (1996) and Venskutonis (1997)**

By comparison, the essential oils percentage of locally prepared samples of basil and marjoram herbs were 1.12 and

0.97 %, respectively. These results showed that the essential oils percentage was less than samples under study in spite of the fresh herbs of local preparation samples and the herb samples used in this study bringing form same farm, these results due to bad manufacture practice. Moreover, the essential oils percentage of imported samples of basil and marjoram were 1.24 and 1.13 %, respectively.

1.5. Chemical composition of essential oils:-

Tables (15 and 20) and illustrated Figures (11 and 12) show the different components identified of essential oils obtained by water distillation of basil and marjoram plants treated by some blanched methods and dried with different methods. Moreover, Tables (16, 17, 19 and 20) show the effect of storage periods on chemical composition of essential oils.

The obtained chromatograms revealed the presence of many components from which 22 compound in basil and 13 compound in marjoram were identified by comparing the retention times with those authentic samples. The main identified compounds in fresh basil were Linalool (60%), Eugenol (11.1%), Eucalyptol (7.93%), Trans-α-Bergamotene (2.78%) and Germacrene-D (2.00%).

On the other hand, the major compounds in fresh marjoram herb were Trepinene-4-ol (30.7%), Linalool (18.5%), Sabinene (9.31%), γ-terpinene (6.97%), Trans-Sabinene hydrate (5.03%), Linalyl-acetate (4.64%), β-pinene (4.33%) and ρ-cymene (3.35%). These results are in agreement with those obtained by **Rhyu (1979), Hasan (1982), Kandeel, (1987), Charles and Simon (1990), Charalambous (1994), Circella *et al.* (1995), Abd El-Aziz (1996), Yousif *et al.* (1999) and Mostafa (2001).**

The unidentified components were 1.81% in fresh basil herbs and 10.81% in fresh marjoram herbs. Linalool increased after all pre-treatment in basil herbs. Moreover, α-pinene, Sabinen, β-pinene, Myrcene, d-limonene and Trans-β-ocimene

Table (15) : Effect of pre-treatment and drying methods on chemical composition (%) of basil oil .

S. N.	Component	Before drying					Drying methods																			
							Sun drying					Protected-sun-drying					Oven Dehydration					Microwave dehydration				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	Unknown	0.29	----	0.37	----	----	----	----	0.34	----	----	0.28	0.34	----	0.36	0.31	----	----	0.30	----	----	0.34	0.35	0.65	0.30	0.35
2	Unknown	----	----	----	----	----	----	----	0.26	----	----	0.32	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	α-pinene	0.42	0.20	0.30	0.19	0.22	0.96	0.36	0.31	0.36	0.39	0.44	0.35	0.36	0.33	0.39	0.37	0.34	0.35	0.34	0.39	0.37	0.27	0.30	0.32	0.28
4	Sabinene	0.26	0.16	0.19	0.17	0.14	0.15	0.22	0.22	0.20	0.22	0.22	0.21	0.20	0.24	0.20	0.26	0.24	0.25	0.25	0.24	0.23	0.19	0.18	0.21	0.18
5	β-pinene	0.87	0.49	0.63	0.46	0.51	1.00	0.73	0.67	0.74	0.78	0.87	0.74	0.77	0.71	0.77	0.72	0.71	0.71	0.72	0.70	0.58	0.63	0.65	0.65	0.65
6	Myrcene	1.16	0.61	0.71	0.64	0.59	0.60	0.76	----	0.71	0.96	----	0.76	0.72	0.79	0.73	0.74	0.74	0.79	0.72	0.70	0.62	0.75	0.65	0.71	0.73
7	d-Limonene	0.28	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
8	Eucalyptol	7.93	7.78	8.19	7.87	7.73	7.73	8.92	8.75	8.91	8.90	8.72	9.02	8.92	9.25	9.12	8.90	8.73	9.00	8.78	8.70	7.76	8.38	8.54	8.42	8.39
9	Trans-β-Ocimene	0.64	0.37	0.39	0.34	0.42	0.48	0.39	0.41	0.29	0.49	0.39	0.36	0.33	0.31	0.41	0.44	0.38	0.38	0.37	0.41	0.33	0.42	0.33	0.44	0.41
10	Linalool	60.0	65.9	62.9	64.8	65.1	64.7	64.8	63.4	64.9	64.2	63.2	61.5	64.7	61.3	61.4	64.8	64.1	61.5	64.1	64.0	63.5	64.6	60.9	64.4	64.6
11	Borneol	0.69	0.72	0.63	0.69	0.70	0.66	0.71	0.74	0.71	0.73	0.70	0.68	0.72	0.68	0.63	0.70	0.69	0.70	0.65	0.69	0.74	0.70	0.68	0.72	0.70
12	Terpinene-4-ol	0.26	0.26	----	0.23	0.26	0.24	0.25	----	0.24	0.26	----	----	0.24	----	----	0.23	0.25	----	0.23	0.27	0.72	0.26	0.24	0.29	0.29
13	Methyl chavicol	0.91	0.96	0.83	0.90	0.90	0.90	0.96	0.96	0.92	0.90	0.92	1.02	0.90	1.07	1.06	0.96	0.96	1.00	0.98	0.98	1.06	0.96	0.97	0.99	0.93
14	Geraniol	1.17	1.08	1.08	1.11	1.14	1.06	1.03	1.20	1.00	1.07	1.20	1.24	1.01	1.20	1.20	1.08	0.98	1.25	0.97	1.04	1.16	1.11	1.24	1.15	1.08
15	Eugenol	11.1	9.39	10.4	10.4	9.49	9.71	8.54	10.2	8.57	8.50	10.6	10.8	8.55	10.7	10.5	8.52	9.06	10.8	9.10	9.08	10.2	9.61	11.3	9.66	9.64
16	β-Elemene	1.38	1.35	1.44	1.36	1.30	1.33	1.53	1.62	1.50	1.54	1.22	1.81	1.51	1.85	1.83	1.51	1.55	1.80	1.52	1.53	1.79	1.87	2.57	1.82	1.86
17	Trans-α-Bergamotene	2.78	2.49	2.66	2.53	2.54	2.46	2.51	2.51	2.54	2.50	2.66	2.83	2.51	2.92	2.86	2.50	2.59	2.87	2.63	2.48	2.65	2.34	2.86	2.30	2.35
18	Unknown	0.53	0.47	0.51	0.49	0.49	0.51	0.48	0.47	0.52	0.47	0.43	0.54	0.49	0.55	0.51	0.53	0.50	0.50	0.49	0.51	0.50	0.43	0.54	0.47	0.45
19	α-Guainene	0.80	1.08	1.01	1.03	0.97	0.77	1.43	1.27	1.39	1.45	1.16	1.59	1.45	1.61	1.57	1.42	1.54	1.64	1.51	1.64	1.42	0.97	1.26	0.90	0.99
20	Unknown	0.50	----	0.55	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
21	Trans-β-Farnesene	0.61	0.53	1.29	0.56	0.59	0.60	0.47	0.43	0.52	0.55	0.46	0.50	0.50	0.48	0.52	0.45	0.49	0.45	0.52	0.47	0.46	0.37	0.40	0.40	0.33
22	α-Humulene	1.28	1.34	1.91	1.35	1.28	1.27	1.37	1.27	1.32	1.29	1.24	1.52	1.30	1.51	1.55	1.35	1.44	1.56	1.43	1.46	1.33	1.04	1.14	1.07	1.03
23	Germacrene-D	2.00	1.86	0.76	1.91	1.93	1.83	1.76	1.62	1.73	1.79	1.66	1.84	1.72	1.86	1.83	1.81	1.80	1.80	1.82	1.77	1.70	1.68	1.93	1.61	1.69
24	Germacrene-B	0.89	0.71	0.36	0.76	0.73	0.74	0.50	0.46	0.53	0.47	0.42	0.48	0.51	0.47	0.46	0.48	0.51	0.50	0.54	0.54	0.50	0.63	0.67	0.67	0.64
25	Unknown	----	0.37	----	0.45	0.69	0.45	0.37	0.39	0.39	0.41	0.48	----	0.38	----	----	0.35	0.38	----	0.36	0.35	0.35	0.36	0.37	0.40	0.35
26	δ-Guaiene	1.47	1.74	1.72	1.63	1.42	1.66	1.73	1.83	1.70	1.69	1.74	1.80	1.72	1.80	1.82	1.72	1.81	1.78	1.80	1.84	1.67	1.74	1.67	1.73	1.76
27	Unknown	0.45	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
28	γ-Cadinene	1.29	----	1.17	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.32	----	0.33	0.30

1 : Control (without pre-treatment)
2 : Blanched by hot water
3 : Steam blanched
4 : Blanched by hot magnesium citrate solution (1%)
5 : Blanched by hot sodium bicarbonate solution (1%)

Table (16) : Effect of storage periods on chemical composition (%) of basil oil.

S. N.	Drying methods	Sun drying										Protected-sun-drying									
	Pre-treatments	1		2		3		4		5		1		2		3		4		5	
	Storage period	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8
1	Unknown	---	---	---	1.27	0.31	0.20	---	1.24	---	1.30	0.33	0.17	0.21	0.46	---	1.26	0.22	0.49	0.23	0.48
2	Unknown	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
3	α-pinene	0.38	0.33	0.33	0.32	0.36	0.24	0.38	0.30	0.34	0.34	0.36	0.22	0.22	0.35	0.34	0.33	0.25	0.37	0.26	0.33
4	Sabinene	0.23	0.23	0.26	0.20	0.24	0.21	0.25	0.19	0.23	0.21	0.20	0.20	0.18	0.24	0.21	0.19	0.21	0.25	0.22	0.28
5	β-pinene	0.77	0.72	0.71	0.70	0.73	0.58	0.71	0.74	0.70	0.67	0.75	0.59	0.61	0.74	0.69	0.71	0.56	0.75	0.55	0.70
6	Myrcene	0.97	0.73	0.73	0.85	0.78	0.58	0.69	0.87	0.73	0.83	0.75	0.60	0.60	0.78	0.76	0.84	0.57	0.80	0.56	0.79
7	d-Limonene	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	Eucalyptol	8.91	8.84	8.77	8.71	9.01	8.10	8.71	8.72	8.72	8.70	9.01	8.13	8.11	8.37	8.74	8.72	8.13	8.40	8.09	8.33
9	Trans-β-Ocimene	0.48	0.37	0.38	0.43	0.42	0.32	0.40	0.40	0.39	0.46	0.37	0.29	0.31	0.41	0.40	0.44	0.34	0.40	0.35	0.44
10	Linalool	64.8	64.0	64.2	61.07	61.4	63.80	64.0	61.05	64.1	61.09	61.5	63.78	63.78	62.29	64.07	61.08	63.81	62.27	63.82	62.24
11	Borneol	0.71	0.68	0.64	0.68	0.62	0.73	0.63	0.67	0.70	0.69	0.71	0.72	0.70	0.70	0.62	0.67	0.70	0.67	0.71	0.73
12	Terpinene-4-ol	0.23	0.26	0.22	0.28	---	0.26	0.25	0.31	0.24	0.28	---	0.27	0.27	---	0.23	0.29	0.24	---	0.23	---
13	Methyl chavicol	0.93	0.97	0.94	0.92	1.07	1.03	0.99	0.94	0.97	0.90	1.01	1.05	1.05	0.96	1.00	0.91	1.02	0.95	1.01	0.93
14	Geraniol	1.01	1.05	0.93	1.21	1.21	1.20	1.05	1.22	0.98	1.20	1.23	1.23	1.26	1.21	1.00	1.22	1.23	1.19	1.19	1.15
15	Eugenol	8.58	9.09	9.11	11.06	10.5	10.17	9.09	11.03	9.09	11.09	10.7	10.14	10.16	11.16	9.10	11.07	10.19	11.13	10.14	11.11
16	β-Elemene	1.51	1.52	1.51	1.41	1.82	1.76	1.52	1.39	1.54	1.43	1.86	1.74	1.74	1.50	1.51	1.42	1.77	1.51	1.74	1.46
17	Trans-α-Bergamotene	2.55	2.49	2.62	2.72	2.87	2.72	2.47	2.71	2.58	2.73	2.91	2.71	2.69	2.68	2.56	2.73	2.69	2.67	2.71	2.65
18	Unknown	0.51	0.52	0.50	0.52	0.50	0.49	0.51	0.55	0.52	0.49	0.54	0.50	0.50	0.51	0.51	0.53	0.47	0.49	0.52	0.49
19	α-Guainene	1.50	1.63	1.50	0.92	1.56	1.47	1.65	0.94	1.53	0.90	1.60	1.49	1.49	1.09	1.56	0.91	1.56	1.11	1.49	1.08
20	Unknown	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	Trans-β-Farnesene	0.46	0.53	0.53	0.02	0.49	0.43	0.48	0.03	0.50	0.02	0.49	0.46	0.46	0.54	0.52	0.03	0.46	0.57	0.44	0.60
22	α-Humulene	1.38	1.42	1.42	1.23	1.52	1.35	1.45	1.20	1.43	1.22	1.55	1.38	1.34	1.31	1.44	1.22	1.37	1.34	1.38	1.36
23	Germacrene-D	1.75	1.83	1.83	1.97	1.85	1.60	1.72	1.95	1.81	2.00	1.81	1.62	1.58	1.86	1.78	1.98	1.61	1.85	1.62	1.90
24	Germacrene-B	0.52	0.53	0.53	0.83	0.46	0.41	0.55	0.82	0.50	0.85	0.45	0.42	0.38	0.71	0.48	0.82	0.38	0.72	0.42	0.74
25	Unknown	0.36	0.35	0.37	—	—	0.40	0.36	—	0.40	—	—	0.39	0.41	—	0.39	—	0.38	—	0.37	—
26	δ-Guaiene	1.72	1.81	1.81	1.62	1.81	1.93	1.85	1.65	1.79	1.63	1.81	1.88	1.95	1.57	1.82	1.63	1.92	1.59	1.91	1.59
27	Unknown	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	γ-Cadinene	—	—	—	1.06	—	—	—	1.08	—	1.09	—	—	—	0.45	—	1.06	—	0.43	—	0.46

1 : Control (without pre-treatment) 2 : Blanched by hot water 3 : Steam blanched

4 : Blanched by hot magnesium citrate solution 5 : Blanched by hot sodium bicarbonate solution

Table (17) : Effect of storage periods on chemical composition (%) of basil oil.

S. N.	Drying methods	Oven dehydration										Microwave dehydration									
	Pre-treatments	1		2		3		4		5		1		2		3		4		5	
	Storage period	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8
1	Unknown	0.37	1.30	1.16	0.18	0.19	0.49	1.27	0.28	1.21	0.18	0.40	0.82	0.72	0.43	0.85	0.61	0.77	0.38	0.84	0.48
2	Unknown	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
3	α-pinene	0.41	0.42	0.24	0.24	0.25	0.35	0.32	0.33	0.30	0.22	0.23	0.25	0.16	0.25	----	0.21	0.21	0.21	0.26	0.26
4	Sabinene	0.28	0.21	0.11	0.20	0.31	0.31	0.21	0.28	0.18	0.22	0.20	0.18	0.10	----	0.17	0.10	0.15	----	0.17	----
5	β-pinene	0.76	0.77	0.64	0.56	0.69	0.74	0.72	0.63	0.71	0.55	0.53	0.59	0.52	0.59	0.49	0.52	0.57	0.56	0.57	0.58
6	Myrcene	0.80	0.84	0.78	0.60	0.66	0.84	0.83	0.66	0.85	0.58	0.57	0.61	0.55	0.63	0.57	0.59	0.60	0.61	0.66	0.73
7	d-Limonene	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
8	Eucalyptol	9.02	8.71	8.67	8.08	8.17	8.39	8.70	8.13	8.75	8.05	7.73	7.54	7.49	7.62	7.87	7.91	7.55	7.61	7.58	7.71
9	Trans-β-Ocimene	0.42	0.42	0.40	0.36	0.38	0.51	0.43	0.40	0.49	0.32	0.28	0.27	0.23	0.34	0.32	0.41	0.29	0.35	0.30	0.42
10	Linalool	61.39	61.05	61.05	65.00	63.85	62.32	61.06	65.03	61.03	64.95	62.64	61.81	61.78	64.89	64.35	63.95	61.84	64.91	61.83	64.96
11	Borneol	0.60	0.63	0.65	0.71	0.77	0.82	0.75	0.73	0.64	0.81	0.70	0.77	0.75	0.71	0.69	0.70	0.81	0.74	0.78	0.77
12	Terpinene-4-ol	----	0.29	0.28	0.25	0.29	----	0.36	0.26	0.28	0.34	0.36	0.47	0.46	0.27	0.23	0.23	0.52	0.31	0.42	0.32
13	Methyl chavicol	1.04	0.97	0.91	0.96	1.05	1.03	0.97	0.96	0.96	1.08	1.02	0.84	0.85	0.98	0.89	0.91	0.83	1.03	0.80	1.02
14	Geraniol	1.17	1.27	1.23	1.11	1.21	1.15	1.27	1.10	1.25	1.18	1.24	1.19	1.21	1.14	1.04	1.13	1.17	1.20	1.16	1.17
15	Eugenol	10.45	11.11	11.09	9.54	10.17	11.01	11.11	9.52	11.08	9.60	10.75	10.99	11.02	10.10	9.79	9.35	10.96	10.17	10.97	10.12
16	β-Elemene	1.76	1.45	1.45	1.52	1.75	1.57	1.45	1.49	1.44	1.57	2.06	1.83	1.87	1.66	2.07	1.94	1.79	1.74	1.81	1.67
17	Trans-α-Bergamotene	2.87	2.75	2.77	2.44	2.70	2.58	2.75	2.40	2.71	2.48	2.86	2.77	2.82	2.57	2.76	2.57	2.72	2.66	2.82	2.47
18	Unknown	0.47	0.54	0.58	0.43	0.46	0.42	0.54	0.38	0.53	0.46	0.54	0.61	0.67	0.46	0.51	0.47	0.62	0.56	0.65	0.37
19	α-Guainene	1.54	0.91	0.97	1.15	1.43	1.02	0.91	1.09	0.95	1.17	1.58	1.09	1.16	1.04	1.21	0.98	1.11	1.04	1.12	0.96
20	Unknown	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
21	Trans-β-Farnesene	0.48	0.02	0.10	0.44	0.38	0.56	0.02	0.37	0.05	0.45	0.47	1.47	1.55	0.42	0.44	0.39	1.50	0.36	1.49	0.35
22	α-Humulene	1.53	1.20	1.30	1.24	1.29	1.33	1.20	1.16	1.21	1.24	1.38	1.28	1.37	1.11	1.15	1.02	1.32	1.04	1.29	1.05
23	Germacrene-D	1.87	1.95	2.07	1.60	1.53	1.88	1.95	1.51	1.99	1.59	1.85	2.01	2.11	1.59	1.84	1.63	2.06	1.51	2.00	1.54
24	Germacrene-B	0.49	0.78	0.92	0.54	0.33	0.73	0.78	0.44	0.80	0.52	0.50	0.62	0.60	0.57	0.65	0.61	0.60	0.48	0.60	0.53
25	Unknown	----	----	----	0.36	0.31	----	----	0.34	----	0.33	0.35	0.29	0.31	0.35	0.37	0.29	0.28	0.25	0.26	0.33
26	δ-Guaiene	1.81	1.58	1.62	1.75	1.83	1.60	1.58	1.77	1.64	1.71	1.74	1.51	1.50	1.69	1.75	1.58	1.52	1.68	1.47	1.67
27	Unknown	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
28	γ-Cadinene	----	1.00	1.07	0.39	----	0.45	1.00	0.39	1.07	0.34	----	0.38	0.39	0.59	----	0.38	0.40	0.60	0.33	0.53

1 : Control (without pre-treatment)
2 : Blanched by hot water
3 : Steam blanched
4 : Blanched by hot magnesium citrate solution
5 : Blanched by hot sodium bicarbonate solution

Table (18) : Effect of pre-treatment and drying methods on chemical composition (%) of marjoram oil.

S. N.	Component	Before drying					Drying methods																			
							Sun drying					Protected-sun-drying					Oven Dehydration					Microwave dehydration				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1	α-pinene	0.85	0.42	0.41	0.41	0.36	0.38		0.60			0.63	0.64		0.69	0.59			0.63					0.61		
2	β-pinene	4.33	2.64	2.33	2.66	2.62	2.64	2.22	5.24	2.27	2.25	5.26	3.88	2.24	3.92	3.84	2.19	2.70	3.86	2.75	2.66	2.29	1.95	2.00	1.90	2.00
3	Sabinene	9.31	6.03	4.99	6.06	6.03	6.05	6.08	6.10	6.12	6.10	6.11	9.16	6.09	9.19	9.13	6.06	6.29	9.13	6.33	6.26	5.67	5.36	4.87	5.32	5.40
4	α-terpinene	1.33	0.72	0.74	0.76	0.74	0.77	0.68	2.25	0.71	0.70	2.22	1.88	0.65	1.90	1.86	0.67	0.71	1.84	0.74	0.69		0.69	0.77	0.66	0.72
5	1.8 Cineole		0.32		0.37	0.36	0.39		0.36			0.34	0.55		0.56	0.54			0.50				0.45	0.98	0.43	0.47
6	γ-terpinene	6.97	4.41	4.54	4.47	4.48	4.50	1.93	7.20	1.95	1.92	7.19	7.72	1.91	7.71	7.73	1.90	4.12	7.73	4.14	4.11	2.72	4.95	7.29	4.94	4.96
7	P-cymene	3.35	1.39	1.38	1.46	1.48	1.45	3.98	3.85	3.99	3.96	3.88	2.60	3.97	2.58	2.62	3.96	1.50	2.62	1.51	1.51	1.16	1.78	1.72	1.79	1.77
8	Trans-sabinene hydrate	5.03	2.67	2.92	2.75	2.78	2.73	2.07	4.66	2.06	2.04	4.68	4.16	2.10	4.13	4.19	2.06	2.84	4.21	2.83	2.86	2.36	2.65	4.03	2.67	2.63
9	Linalool	18.5	19.8	21.0	19.9	19.9	19.9	17.0	17.8	17.5	17.0	17.7	18.0	17.3	17.2	18.5	7.23	20.0	17.1	19.2	20.1	19.3	21.3	24.2	22.4	21.5
10	Linalyl-acetate	4.64	1.83	2.32	1.93	1.98	1.94	2.17	4.23	2.14	2.19	4.24	3.56	2.18	3.52	3.60	2.19	2.13	3.59	2.11	2.16	2.30	2.04	0.78	2.07	2.01
11	Terpinene-4-ol	30.7	43.4	43.3	43.1	43.2	43.1	45.7	30.8	45.2	45.7	30.9	31.8	45.4	32.6	31.3	45.5	42.5	32.7	43.3	42.4	46.5	43.4	33.8	44.3	43.7
12	α-terpineol	2.92	2.44	2.28	2.36	2.30	2.40	1.60	3.16	1.55	1.59	3.14	2.83	1.58	2.81	2.88	1.64	1.53	2.90	1.49	1.50	2.45	1.48	1.98	1.52	1.44
13	Neryl acetate	1.26	1.73	1.64	1.66	1.59	1.65	1.96	0.91	1.90	1.97	0.88	0.60	1.95	0.62	0.55	1.98	2.02	0.53	1.97	2.05	0.51	0.60	1.63	0.65	0.55

1 : Control (without pre-treatment) 2 : Blanched by hot water 3 : Steam blanched
4 : Blanched by hot magnesium citrate solution (1%) 5 : Blanched by hot sodium bicarbonate solution (1%)

Table (19) : Effect of storage periods on chemical composition (%) of marjoram oil.

S. N.	Drying methods	Sun drying										Protected-sun-drying									
	Pre-treatments	1		2		3		4		5		1		2		3		4		5	
	Storage period	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8
1	α-pinene	----	----	----	----	0.46	0.37	----	----	----	----	0.52	0.31	0.43	0.34	----	----	0.40	0.29	0.50	0.38
2	β-pinene	2.20	2.65	2.72	3.28	3.84	3.29	3.68	3.43	3.78	3.38	3.90	2.25	2.33	4.71	2.70	3.42	2.23	4.68	2.34	4.73
3	Sabinene	6.07	6.25	6.32	5.81	9.12	6.16	6.28	5.93	6.35	5.89	9.18	6.14	6.18	9.68	6.29	5.92	6.11	9.66	6.20	9.63
4	α-terpinene	0.69	0.68	0.75	0.60	1.92	0.74	0.71	0.69	0.75	0.66	1.86	0.76	0.74	1.59	0.71	0.68	0.70	1.58	0.77	1.54
5	1.8 Cineole	----	----	----	----	0.59	0.41	----	----	----	----	0.53	0.45	0.39	0.24	----	----	0.38	0.25	0.43	0.20
6	γ-terpinene	1.95	4.10	4.17	----	7.76	2.20	4.13	----	4.14	----	7.75	2.26	2.16	6.67	4.12	----	2.18	6.69	2.21	6.64
7	P-cymene	3.95	1.49	1.45	6.92	2.58	7.63	1.52	6.98	1.50	6.96	2.63	7.62	7.57	2.61	1.50	6.97	7.62	2.64	7.62	2.59
8	Trans-sabinene hydrate	2.05	2.85	2.80	1.05	4.14	1.71	2.81	1.06	2.82	1.05	4.19	1.69	1.70	3.94	2.84	1.04	1.71	3.98	1.69	3.93
9	Linalool	18.01	21.2	18.30	21.26	18.7	23.48	17.70	21.23	19.0	21.16	17.85	23.45	17.49	24.21	20.00	21.14	17.56	20.26	16.45	27.22
10	Linalyl-acetate	2.18	2.15	2.10	2.90	3.58	2.00	2.16	2.86	2.09	2.88	3.53	2.01	1.99	4.30	2.13	2.85	2.06	4.25	1.94	4.32
11	Terpinene-4-ol	45.82	44.58	42.71	52.45	34.3	46.37	42.95	52.37	42.5	52.41	36.8	46.39	48.37	32.67	42.5	52.37	46.42	32.75	46.32	32.70
12	α-terpineol	1.62	1.56	1.51	1.79	2.85	1.28	1.49	1.68	1.47	1.73	2.80	1.31	1.25	2.88	1.53	1.70	1.32	2.83	1.21	2.92
13	Neryl acetate	1.99	2.11	2.01	2.86	0.60	2.62	2.06	2.70	1.94	2.78	0.57	2.64	2.66	0.98	2.02	2.81	2.68	0.94	2.55	1.03

1 : Control (without pre-treatment)
2 : Blanched by hot water
3 : Steam blanched
4 : Blanched by hot magnesium citrate solution
5 : Blanched by hot sodium bicarbonate solution

Table (20) : Effect of storage periods on chemical composition (%) of marjoram oil.

S. N.	Drying methods	Oven dehydration										Microwave dehydration									
	Pre-treatments	1		2		3		4		5		1		2		3		4		5	
	Storage period	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8	4	8
1	α-pinene					0.46	0.40									0.30					
2	β-pinene	2.75	3.35	3.41	2.27	2.27	4.58	3.28	2.16	3.17	2.23	2.43	1.24	1.09	2.17	2.04	1.85	1.14	2.06	1.23	2.00
3	Sabinene	6.34	5.88	5.92	0.76	6.13	9.56	5.80	0.66	5.71	0.73	5.01	3.69	3.52	5.06	4.00	3.57	3.58	4.94	3.67	4.06
4	α-terpinene	0.76	0.69	0.69	0.20	0.70	1.48	0.58	0.11	0.50	0.18				0.61	0.66	0.57		0.52		0.41
5	1.8 Cineole					0.36	0.14														
6	γ-terpinene	4.17			3.19	2.14	6.59		3.11		3.18	4.91	4.02	3.87	4.46	2.99	2.91	4.00	4.38	3.99	4.56
7	P-cymene	1.45	6.97	6.93	1.14	7.56	2.54	6.89	1.07	6.82	1.15	1.93	1.36	1.23	1.39	2.93	2.18	1.31	1.32	1.32	1.69
8	Trans-sabinene hydrate	2.79	1.04	1.02	1.56	1.63	3.88	0.99	1.50	0.93	1.58	2.12	1.98	1.87	2.23	2.06	1.94	1.93	2.17	1.93	2.43
9	Linalool	18.0	21.15	17.13	21.31	18.30	24.21	17.11	19.62	17.06	21.34	21.93	24.21	20.12	21.82	27.82	25.49	24.01	20.87	24.15	21.82
10	Linalyl-acetate	2.09	2.84	2.93	1.88	1.90	4.26	2.84	1.84	2.80	1.92	3.47	3.29	3.22	2.11	2.20	3.14	3.39	2.07	3.22	2.31
11	Terpinene-4-ol	42.55	52.45	52.36	50.61	46.26	38.64	52.38	50.58	52.35	50.66	32.79	41.20	41.15	43.95	49.32	45.39	44.20	43.92	41.12	43.45
12	α-terpineol	1.55	1.70	1.75	1.51	1.16	2.86	1.71	1.49	1.69	1.50	4.04	3.25	3.22	1.72	1.60	2.57	3.95	1.70	3.16	1.79
13	Neryl acetate	2.00	2.81	2.76	0.57	2.49	0.97	2.77	0.56	2.76	0.58	1.02	2.10	2.09	0.29	0.55	0.64	2.35	0.28	2.00	0.65

1 : Control (without pre-treatment) 2 : Blanched by hot water 3 : Steam blanched

4 : Blanched by hot magnesium citrate solution 5 : Blanched by hot sodium bicarbonate solution

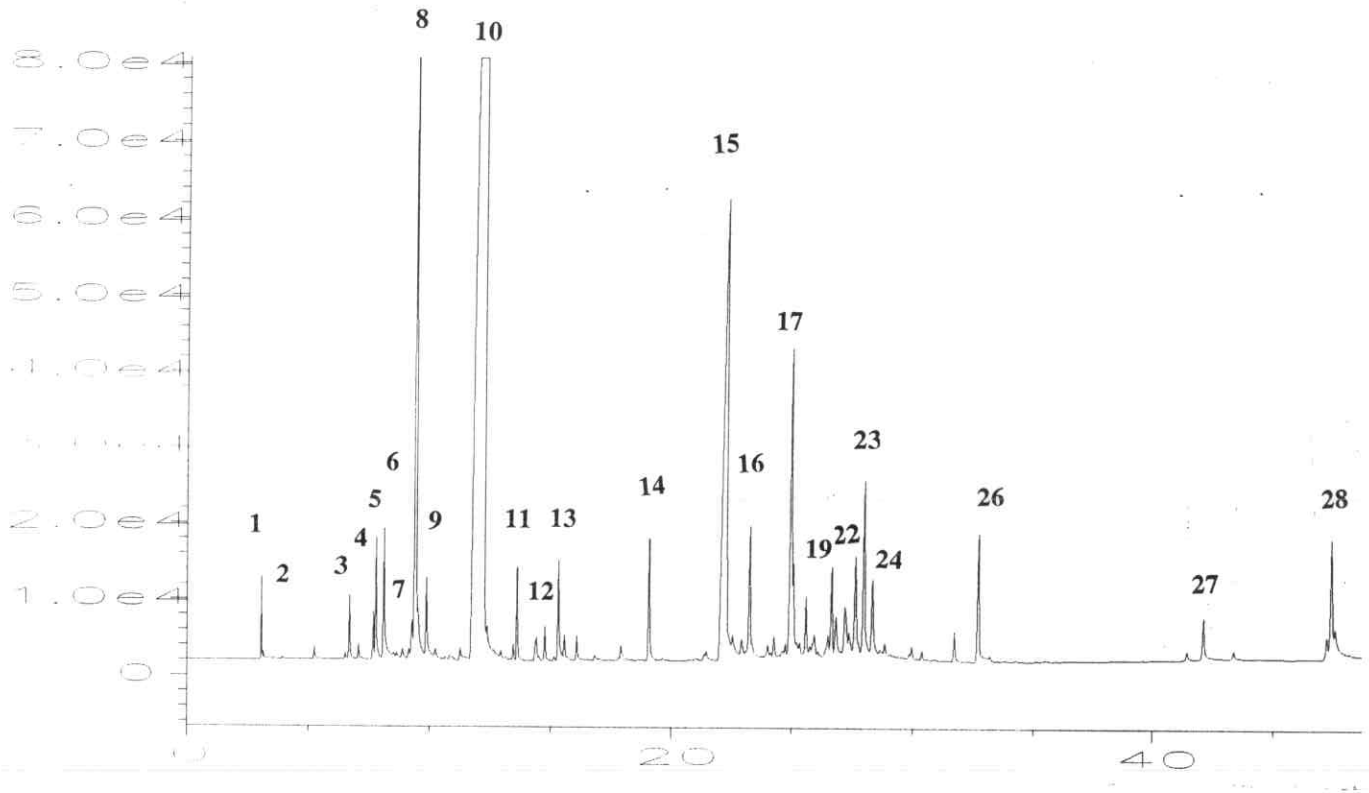

Fig. (10) : Gas chromatographic chart of essential oil separated from fresh basil herb

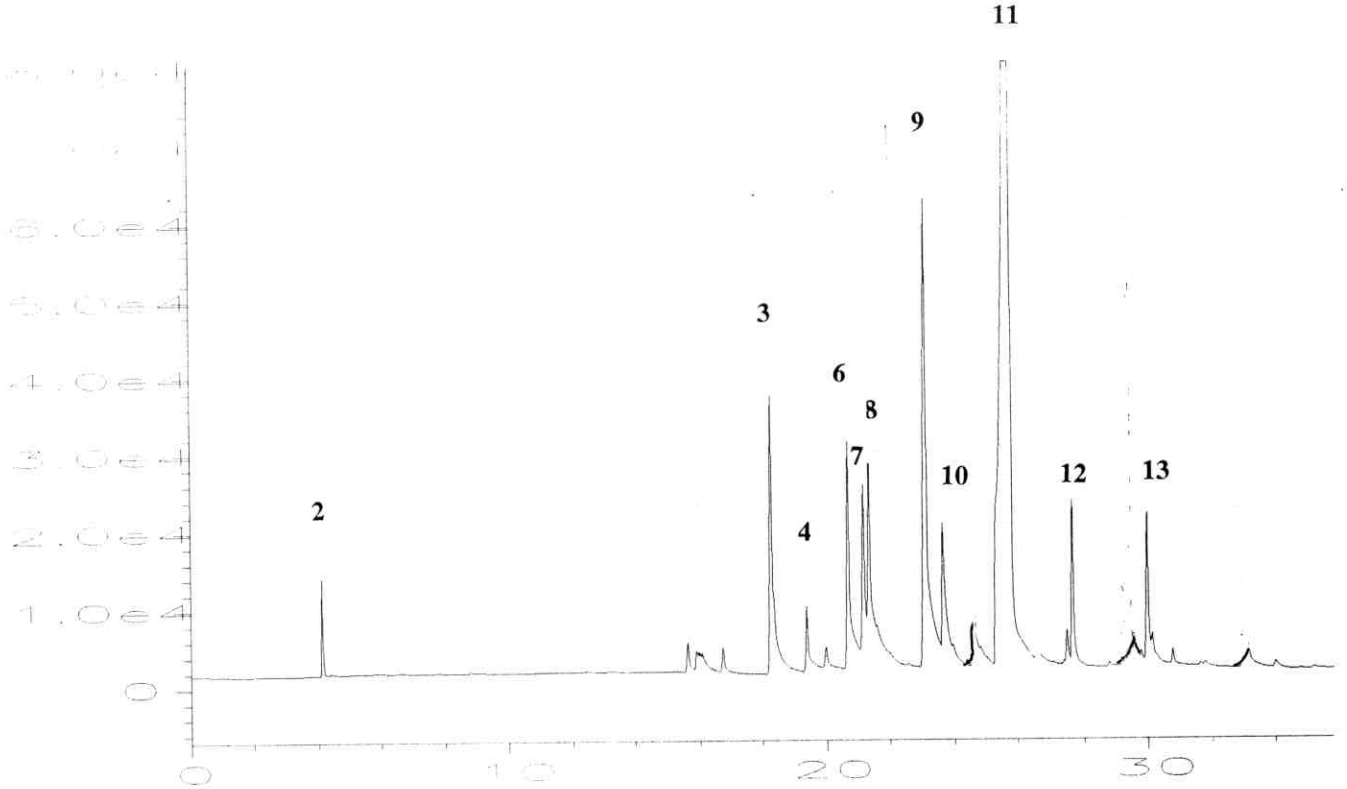

Fig. (11) : Gas chromatographic chart of essential oil separated from fresh marjoram herb

decreased. On the other hand, terpinene-4-ol and linalool of marjoram herbs increased due to pre-treatment and drying method. While, α-pinene, β-pinene, sabinene, α-terpinene, γ-terpinene, ρ-cymene and trans sabinene hydrate decreased. These results may be due to the effect of heating on essential oils content.

Generally, during storage the components percentages of both basil and marjoram essential oils, were not markedly changed.

2 – Drying rate:

Data of Tables (21 and 22) and illustrated Figures (13 and 14) indicate the moisture content for both basil and marjoram herbs in different drying methods.

From these data it could be observed that the moisture content during drying process were different, whereas it was high decreased during the first time of drying then, decreased gradually to nearly constant weight.

Generally, the decrease in moisture content of different samples during drying process were too difference. These difference might be due to the drying method, such as the decrease in moisture content in microwave dehydration was very speed (not more than few minutes), but in oven dehydration took about 9,10 or 11 hr. Moreover, protected-sun-drying took times ranged from 14 to 18 hours. While, sun-drying process ranged from 20 to 28 hr of both herbs.

In both herbs, the final moisture contents in sun drying samples were higher than other drying methods. These results referred to the relatively low drying temperature during process when comparison with drying or dehydration temperatures in other methods processes. These results are in agreement with **EL-Kady (1996) and Osman (1996).**

Paakkonen *et al.* (1990 a) reported that the drying periods of basil and marjoram were 24 hr at 35 – 37 °C. These results are in harmony with our sun drying results.

Table (21) : Moisture contents (%) of basil herb during drying or dehydration samples.

Time Of drying	Moisture content (%)																			
	Sun drying					Protected-sun-drying					Oven dehydration					Microwave dehydration				
	Pre-treatments					Pre-treatments					Pre-treatments					Pre-treatments				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
zero	89.69	91.46	91.07	92.54	92.28	89.69	91.46	91.07	92.54	92.28	89.69	91.46	91.07	92.54	92.28	89.69	91.46	91.07	92.54	92.28
1min																65.06	68.71	68.59	69.48	69.94
2min																44.84	49.29	49.44	48.63	50.81
3min																28.17	33.20	33.62	35.63	34.88
4min																13.24	20.44	21.13	21.56	22.17
5min																5.17	11.01	11.97	12.72	12.67
6min																----	5.91	5.14	5.34	5.39
1hr.																				
2hr.	74.29	77.22	76.93	76.93	76.60	62.52	66.24	65.13	67.35	66.43	69.95	78.33	74.03	78.03	76.36					
3hr.											51.1	65.76	58.10	64.94	63.36					
4hr.	60.38	63.84	63.55	63.55	63.33	39.41	42.35	41.24	43.43	41.44	35.17	54.05	43.28	53.72	54.35					
5hr.											24.16	43.29	29.57	43.51	42.29					
6hr.	48.09	51.46	51.19	51.19	51.06	22.58	25.26	24.15	24.34	25.63	15.42	33.58	19.99	33.76	33.68					
7hr.											10.74	24.97	14.54	24.64	23.47					
8hr.	37.27	40.38	40.29	40.29	40.09	11.73	14.31	13.20	14.40	15.12	8.00	17.26	10.20	17.39	17.96					
9hr.											6.18	10.44	6.97	11.03	11.34					
10hr.	27.88	30.80	30.73	30.73	30.62	7.24	8.06	7.95	8.15	8.61	5.07	4.96	5.71	5.86	5.66					
12hr.	20.16	23.02	22.95	22.95	22.95	5.05	6.35	6.24	6.44	6.54										
14hr.	13.85	17.04	16.97	16.97	17.08	----	5.91	5.11	5.95	6.19										
16hr.	9.00	12.56	12.18	12.18	12.70															
18hr.	7.49	9.38	9.18	9.18	9.62															
20hr.	5.92	7.20	7.63	7.63	7.45															
22hr.	----	6.44	6.38	6.38	5.98															
24hr.	----	6.00	6.25	6.25	5.72															
26hr.	----	5.84	----	----	----															

1 : Control
2 : Hot (90°C) water blanching
3 : Steam blanching
4 : Blanching by Mg citrate hot (90°C) solution (1%)
5 : Blanching by sodium bicarbonate hot (90°C) solution (1%)

Table (22) : Moisture contents (%) of marjoram herb during drying or dehydration samples .

Time Of drying	Moisture content (%)																			
	Sun drying					Protected-sun-drying					Oven dehydration					Microwave dehydration				
	Pre-treatments					Pre-treatments					Pre-treatments					Pre-treatments				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
zero	85.72	87.43	86.89	87.67	87.23	85.72	87.43	86.89	87.67	87.23	85.72	87.43	86.89	87.67	87.23	85.72	87.43	86.89	87.67	87.23
1min																64.16	70.45	68.40	68.84	67.91
2min																46.11	55.24	52.55	54.75	55.01
3min																31.50	41.70	38.85	41.70	40.73
4min																19.69	31.38	27.16	29.36	29.81
5min																11.43	22.81	17.58	19.78	18.98
6min																5.88	15.16	10.31	12.51	11.43
7min																----	9.68	5.01	7.82	7.77
8min																----	5.06	----	5.61	5.11
1hr.											68.35	72.89	72.27	73.05	72.97					
2hr.	70.40	75.29	75.23	74.36	75.48	65.27	69.26	66.35	68.65	68.52	53.32	59.93	58.93	59.93	59.76					
3hr.											40.36	48.42	47.02	48.26	48.09					
4hr.	56.42	63.88	64.11	63.08	63.54	46.97	53.34	48.32	52.74	52.10	29.57	38.40	36.61	38.09	37.87					
5hr.											20.94	29.87	27.58	29.38	29.11					
6hr.	43.38	52.86	53.32	51.92	51.89	31.72	39.61	32.81	38.53	38.17	14.38	22.83	20.35	22.19	21.23					
7hr.											10.17	17.27	14.48	16.46	15.83					
8hr.	32.11	43.00	42.12	42.01	43.12	19.03	28.20	19.84	26.40	26.73	6.45	13.14	9.95	12.21	11.81					
9hr.											5.24	9.65	6.87	9.34	9.16					
10hr.	23.04	34.63	32.29	33.43	33.79	8.45	19.11	9.27	17.34	17.83	—	6.93	5.44	6.91	6.77					
11hr.											—	5.41	—	5.06	5.63					
12hr.	17.25	27.45	23.18	26.26	26.67	5.91	12.23	6.93	10.46	11.31										
14hr.	12.89	21.62	16.45	20.51	20.83	5.00	7.55	5.68	7.18	7.13										
16hr.	9.67	17.28	13.70	16.07	17.15	—	6.23	5.12	5.89	5.97										
18hr.	7.32	14.10	9.67	12.88	13.45	—	5.80	—	5.57	5.55										
20hr.	6.01	11.92	7.43	10.81	10.73															
22hr.	5.62	9.31	6.25	8.79	8.54															
24hr.	----	7.54	5.93	7.08	6.98															
26hr.	----	6.73	—	6.54	6.49															
28hr.	—	6.40	—	6.22	6.11															

1 : Control 2 : Hot (90°C) water blanching 3 : Steam blanching

4 : Blanching by Mg citrate hot (90°C) solution (1%) 5 : Blanching by sodium bicarbonate hot (90°C) solution (1%)

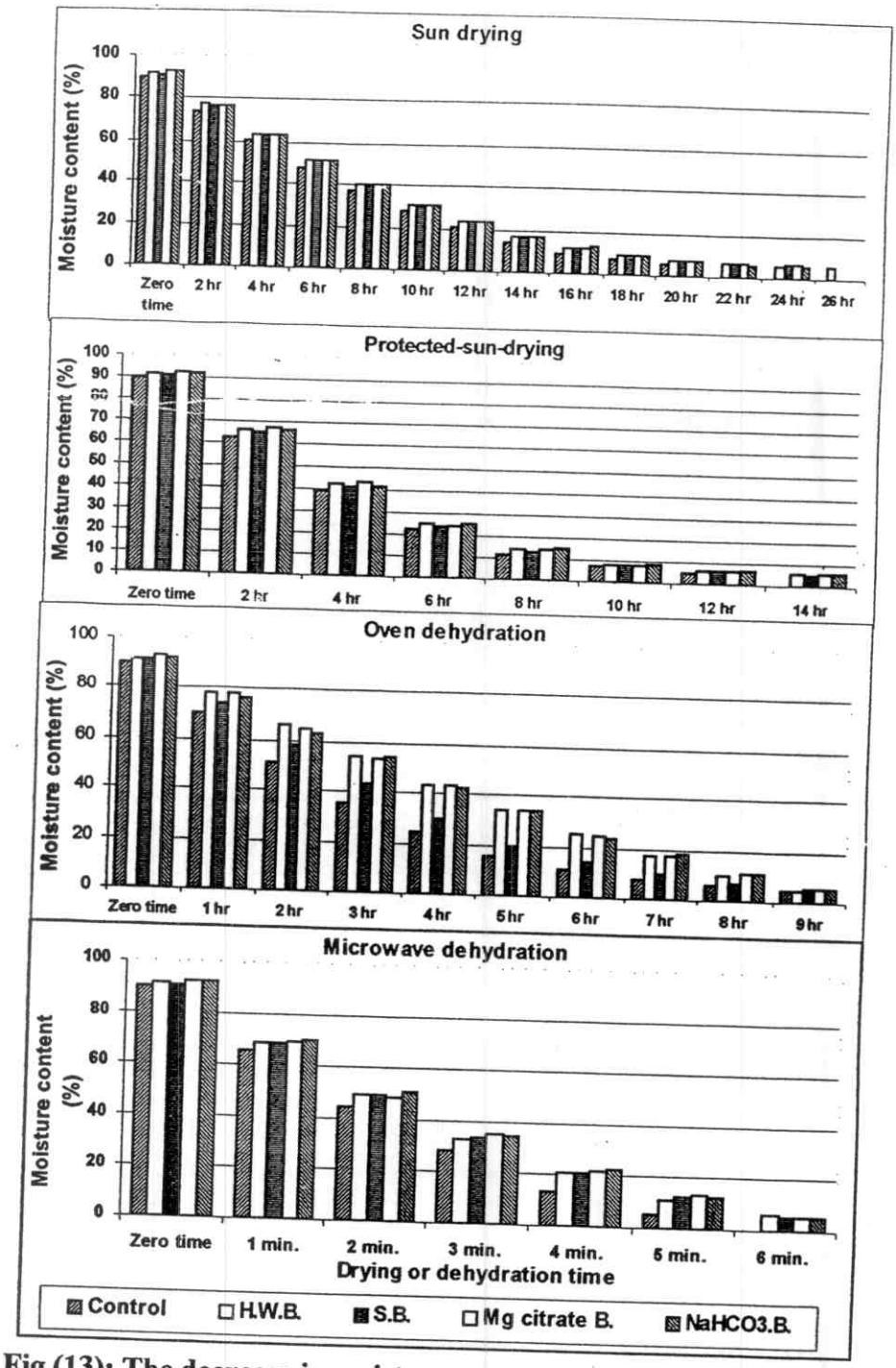

Fig (13): The decrease in moisture content during drying process of basil herb.

H.W.B : Hot water blanching **S.B.** : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

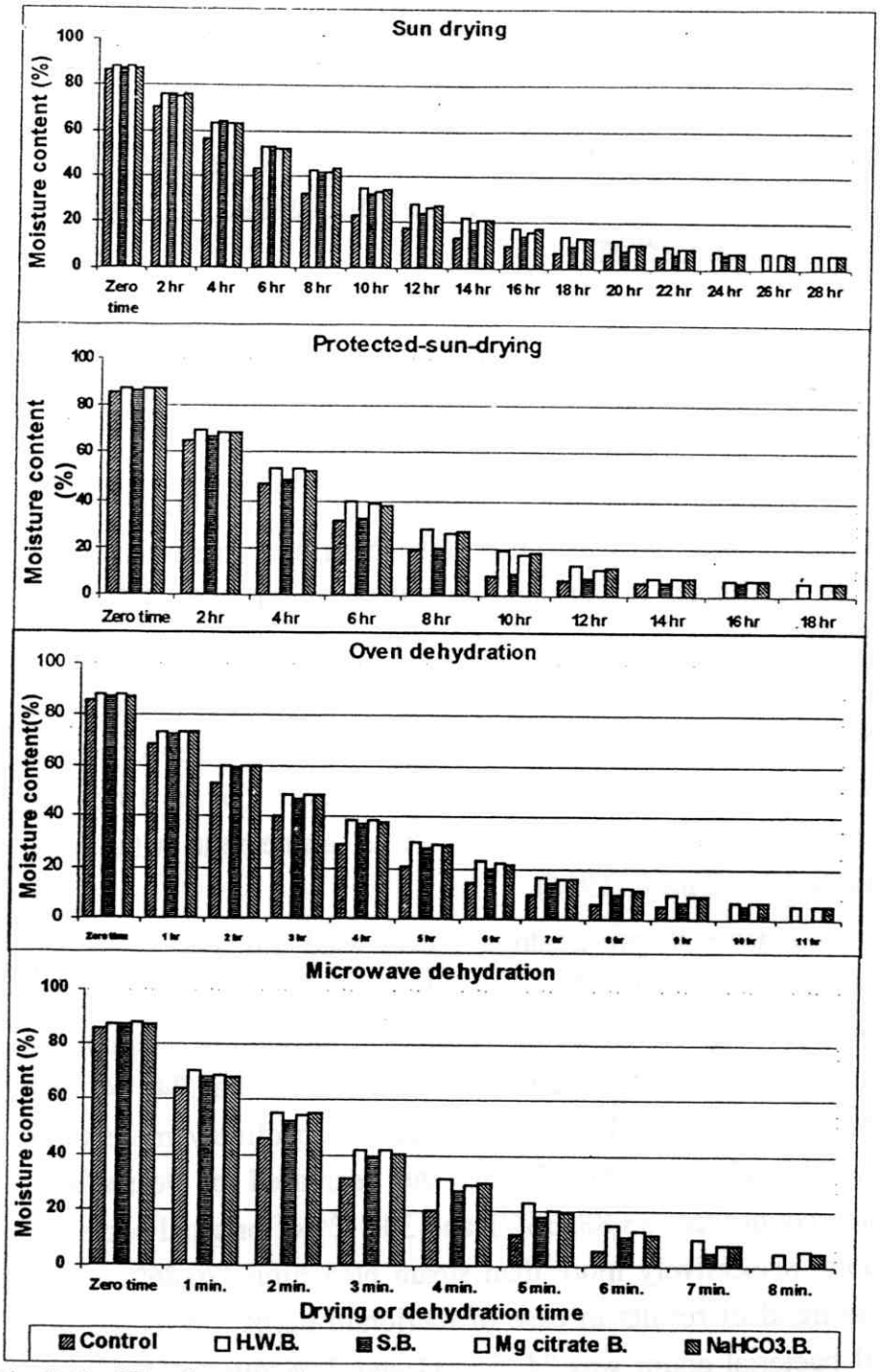

Fig (14) : The decrease in moisture content during drying process of marjoram herb.

H.W.B : Hot water blanching S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

3– Effect of pre-treatments, drying methods and storage period on the total microbial count of basil and marjoram herbs: -

Total bacterial, yeasts and molds count were determined in fresh and dried or dehydrated basil and marjoram herbs during different processing steps and throughout storage periods, the obtained data were tabulated in Tables (23 to 26).

The obtained data observed that the highest total microbial count was found in fresh basil and marjoram herbs. These results are in harmony with those reported by **EL-Kady (1996).**

Total bacterial, counts of fresh basil and marjoram herbs were 188 and 185 x 10^4cell/g, respectively. Moreover, Total yeast and mold counts were 242 and 77.5 x 10^3cell/g, respectively too. These results are in agreement with those obtained by **Osman (1996).**

In general, pre-treatments decreased the total microbial count of all treatments. Moreover, blanching basil herbs with hot water, hot magnesium citrate solution or hot sodium bicarbonate solution markedly decrease the bacterial count was 34, 34, and 36% of original total bacterial counts, respectively more than steam blanching (28%). While, the decreased of yeasts and molds count were 33.88, 34.71 and 33.47% of original bacterial counts, respectively more than steam blanching (26.86%). The same trend of results in case of marjoram herbs, decreased the total bacterial count was 34, 35, 34 and 27% due to blanching with hot water, hot magnesium citrate solution, hot sodium bicarbonate solution and steam blanching, respectively. And, the

Table (23) : Effect of pre-treatments , drying or dehydration methods and storage period on total bacterial count of basil herb (x 10^4 cell /g).

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	188	12	14	13.1	13.2
H . W . B .	124	10	10	10.9	11
S . B .	135	11	11.2	11.8	12.1
Mg citrate B .	124	9.3	9.9	10.1	10.2
$NaHCO_3$. B .	120	9.5	9.8	10.4	10.4
Protected-sun-drying					
Control	188	2.5	2.5	2.6	2.8
H . W . B .	124	2.0	2.1	2.2	2.2
S . B .	135	2.2	2.3	2.3	2.4
Mg citrate B .	124	2.1	2.2	2.2	2.3
$NaHCO_3$. B .	120	2.1	2.4	2.4	2.3
Dehydration					
Control	188	1.1	1.1	1.2	1.2
H . W . B .	124	0.9	0.9	0.9	1.0
S . B .	135	0.9	1.1	1.1	1.2
Mg citrate B .	124	0.9	1.0	1.0	1.0
$NaHCO_3$. B .	120	1.0	1.0	1.1	1.2
Microwave Dehydration					
Control	188	0.30	0.31	0.31	0.33
H . W . B .	124	0.23	0.23	0.25	0.25
S . B .	135	0.25	0.25	0.26	0.28
Mg citrate B .	124	0.23	0.24	0.24	0.25
$NaHCO_3$. B .	120	0.24	0.24	0.25	0.26
Total bacterial count of local market sample				**48.4**	
Total bacterial count of USA market sample				**2.20**	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching by hot Mg citrate solution (1%)
NaHCO3. B. : Blanching by hot Sodium bicarbonate solution (1%)

Table (24) : Effect of pre-treatments, drying or dehydration methods and storage period on total bacterial count of marjoram herb ($x10^4$ cell /g).

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	185	14.03	14.22	14.53	15.14
H . W . B .	122	9.61	9.84	10.54	10.64
S . B .	134	12.04	12.32	12.91	13.13
Mg citrate B .	120	8.83	9.11	9.42	9.72
$NaHCO_3$. B .	124	9.10	9.42	9.73	10.11
Protected-sun-drying					
Control	185	2.43	2.48	2.55	2.74
H . W . B .	122	2.12	2.24	2.90	2.33
S . B .	134	2.24	2.34	2.28	2.31
Mg citrate B .	120	2.05	2.15	2.23	2.32
$NaHCO_3$. B .	124	1.91	1.98	2.06	2.10
Dehydration					
Control	185	1.23	1.24	1.29	1.31
H . W . B .	122	0.72	0.78	0.83	0.82
S . B .	134	0.91	0.92	0.97	1.04
Mg citrate B .	120	0.80	0.80	0.83	0.84
$NaHCO_3$. B .	124	0.70	0.71	0.76	0.78
Microwave Dehydration					
Control	185	0.280	0.281	0.323	0.312
H . W . B .	122	0.223	0.228	0.237	0.241
S . B .	134	0.262	0.271	0.284	0.293
Mg citrate B .	120	0.234	0.239	0.242	0.245
$NaHCO_3$. B .	124	0.221	0.237	0.241	0.254
Total bacterial count of local market sample				**60.05**	
Total bacterial count of Hungarian market sample				**1.80**	

H.W.B. : Hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching by hot Mg citrate solution (1%)
NaHCO3. B. : Blanching by hot Sodium bicarbonate solution (1%)

Table (25): Effect of pre-treatments, drying or dehydration methods and storage period on total yeast and mold count of basil herb(x 10^3cell/g).

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	242	14.47	17.22	20.03	22.50
H . W . B .	160	10.25	12.51	14.38	15.98
S . B .	177	11.26	13.57	15.96	17.54
Mg citrate B .	158	9.94	11.83	13.75	15.46
$NaHCO_3$. B .	161	10.06	12.26	14.08	15.66
Protected-sun-drying					
Control	242	9.52	10.47	12.17	14.85
H . W . B .	160	6.30	7.08	8.13	9.80
S . B .	177	6.87	7.63	9.00	10.69
Mg citrate B .	158	6.48	7.12	8.28	10.10
$NaHCO_3$. B .	161	6.39	7.70	8.66	9.95
Dehydration					
Control	242	3.86	4.33	4.80	5.37
H . W . B .	160	2.42	2.66	3.02	3.38
S . B .	177	2.32	2.65	2.98	3.97
Mg citrate B .	158	2.51	2.75	3.13	3.50
$NaHCO_3$. B .	161	2.56	2.83	3.22	3.54
Microwave Dehydration					
Control	242	0.53	0.59	0.70	0.75
H . W . B .	160	0.33	0.38	0.42	0.49
S . B .	177	0.38	0.43	0.51	0.56
Mg citrate B .	158	0.32	0.35	0.40	0.47
$NaHCO_3$. B .	161	0.39	0.46	0.54	0.49
Total yeast and mold counts of local market sample				**51.48**	
Total yeast and mold counts of USA market sample				**3.37**	

H.W.B. : Hot water blanching **S.B.** : Steam blanching
Mg citrate B. : Blanching by hot Mg citrate solution (1%)
NaHCO3. B. : Blanching by hot Sodium bicarbonate solution (1%)

Table (26): **Effect of pre-treatments, drying or dehydration methods and storage period on total yeast and mold count of marjoram herb ($x10^3$cell /g).**

Drying methods & Treatments	Before drying	Storage periods (months)			
		0	3	6	9
Sun drying					
Control	77.5	5.07	6.03	7.01	7.88
H . W . B .	52.6	3.40	4.13	4.75	5.28
S . B .	56.9	3.67	4.42	5.21	5.72
Mg citrate B .	51.8	3.41	4.06	4.73	5.31
$NaHCO_3$. B .	50.7	3.40	4.14	4.76	5.29
Protected-sun-drying					
Control	77.5	3.43	4.09	4.54	5.34
H . W . B .	52.6	2.25	2.74	3.01	3.50
S . B .	56.9	2.51	3.02	3.39	3.90
Mg citrate B .	51.8	2.22	2.65	2.94	3.46
$NaHCO_3$. B .	50.7	2.27	2.77	3.04	3.54
Dehydration					
Control	77.5	1.24	1.36	1.60	1.91
H . W . B .	52.6	0.83	0.92	1.07	1.30
S . B .	56.9	0.91	1.02	1.17	1.41
Mg citrate B .	51.8	0.86	0.95	1.12	1.33
$NaHCO_3$. B .	50.7	0.90	0.99	1.10	1.29
Microwave Dehydration					
Control	77.5	0.176	0.210	0.244	0.274
H . W . B .	52.6	0.126	0.135	0.157	0.191
S . B .	56.9	0.127	0.143	0.172	0.198
Mg citrate B .	51.8	0.117	0.130	0.153	0.182
$NaHCO_3$. B .	50.7	0.126	0.139	0.159	0.192
Total yeast and mold counts of local market sample				**20.69**	
Total yeast and mold counts of Hungarian market sample				**1.23**	

H.W.B. : hot water blanching
S.B. : Steam blanching
Mg citrate B. : Blanching by hot Mg citrate solution (1%)
$NaHCO_3$. B. : Blanching by hot Sodium bicarbonate solution (1%)

decreased of yeast and mold counts were 32.13, 33.16, 34.58 and 26.58%, respectively. These results are conformable to those obtained by **Frazier (1978) and EL-Kady (1996).**

The same data also indicated that different drying processes caused great reduction in total bacterial, yeast and mold counts in all samples.The reduction in protected-sun-drying samples more than the reduction in sun drying samples. These finding agree with **Osman (1996).** Meanwhile, the reduction in Oven dehydration samples more than the reduction in protected-sun-drying samples. These results are in agreement with those obtained by **EL-Hadad (1994).** Moreover, the highest microbial count reductions were found in microwave dehydrated samples. These result due to lethal effect of microwave radiation on microorganisms. **Culkin and Daniel (1975); Fung and Cunninghan (1980) and Heddleson and doores (1994)** are in harmony with our results.

On the other hand, the results in Tables (23 to 26) revealed that there was a gradual increase in bacterial, yeast and mold counts of all dried basil and marjoram samples upon storage for nine months at room temperature. In general, the increase in such counts could be due to the increase in moisture content during storage as mentioned by **Hassan (1995) and EL-Kady (1996)** or contamination from handling and packaging material or during evaluation of total microbial count.

In addition, the total bacterial count of American dehydrated basil sample was 2.2 x 10^4cell/g. This count is in the range of total bacterial count in protected-sun-drying samples; but, the dehydrated samples and microwave dehydrated studied samples were better than American samples. Moreover, the total count of yeast and mold were 3.37 x 10^3cell/g, this count is in the range of dehydrated samples. Meanwhile, the microwave-dehydrated samples had the lowest count of total bacterial, yeast and mold than the American sample or any other samples under study.

On the other hand, the total bacterial, yeasts and molds count of Hungarian dehydrated marjoram sample were 1.8 x 10^4 and 1.23 x 10^3cell/g, respectively. This count was near the range of total microbial count of dehydrated samples, but in general the dehydrated samples and microwave dehydrated samples had the lowest count of total bacterial, yeast and mold than Hungarian sample.

Finally, the total bacterial count of local market samples were 48.4 and 60.05 x 10^4cell/g. for basil and marjoram herbs, respectively. While, the total yeasts and molds count of local manufactured samples were 51.48 and 20.69 x 10^3cell/g. These samples could not be accepted by importing countries.

4 - Effect of pre-treatments, drying methods and storage period on sensory evaluation of dried basil and marjoram herbs: -

Sensory evaluations of dried herbs are very important in degree and exporting price limitation. Moreover, sensory characteristics are important indicator for essential oil content and total microbial count in dried herbs.

All samples in this study were judged for color, odor, general appearance and over all quality attributes using a panel of ten experts judged (Exporters, Owners of drying food factory and Specialists).

Concerning dried herbs, results in Tables (27 and 28) indicated that all dried samples under this study were acceptable but, the local manufacture sample of basil was unacceptable. Moreover, in dried basil herb, all microwave samples and control samples of protected-sun-drying and oven dehydration were very good acceptable (++). While, in dried marjoram herb, all microwave and protected-sun-drying samples, control and magnesium citrate pre-treated samples of sun drying and oven dehydration and finally Hungarian sample were very good acceptable (++).

The score values of samples were statistical analyzed to arrange samples to their quality attributes, and the results were tabulated in previous Tables From the results of statistical

Table (27) : Acceptability and statistical analysis of sensory evaluation of sun, solar, oven dehydration and Microwave dehydration samples of dried basil after storage for eight months.

Drying methods & Treatments	Color (10)	Odor (10)	General appearance (10)	Over all quality (30)	Over all quality Acceptability
Sun drying					
Control	6.50 d e f g	6.96 e f g h	6.13 f g	19.58 e	+
H.W.B.	5.46 h i	6.38 h i j	5.38 h i	17.21 g	+
S.T.	5.00 i j	6.67 g h i	5.13 i	16.79 g	+
Mg citrate B.	5.75 g h i	6.17 i j	5.38 h i	17.29 f g	+
$NaHCO_3$. B.	6.13 e f g h	6.21 i j	5.38 h i	17.71 f g	+
Protected-sun-drying					
Control	7.50 b c	7.75 b c d	7.00 c d	22.25 b c	+ +
H.W.B.	6.50 d e f g	6.92 e f g h	6.25 f	19.67 e	+
S.T.	5.88 f g h	7.38 c d e f	5.75 g h	19.00 e f	+
Mg citrate B.	6.79 c d e	6.92 e f g h	6.13 f g	19.83 d e	+
$NaHCO_3$. B.	7.17 b c d	6.92 e f g h	6.13 f g	20.21 d e	+
Oven dehydration					
Control	7.50 b c	7.54 c d e	7.00 c d	22.04 b c	+ +
H.W.B.	6.54 d e f g	6.75 f g h i	6.38 e f	19.67 e	+
S.T.	5.88 f g h	7.13 d e f g	6.00 f g	19.00 e f	+
Mg citrate B.	6.71 c d e f	6.79 f g h i	6.46 e f	19.96 d e	+
$NaHCO_3$. B.	7.13 b c d	6.75 f g h i	6.38 e f	20.25 d e	+
Microwave dehydration					
Control	8.46 a	8.67 a	8.00 a	25.13 a	+ +
H.W.B.	7.21 b c d	7.83 b c	7.25 b c d	22.29 b c	+ +
S.T.	6.50 d e f g	8.25 a b	6.83 d e	21.58 b c d	+ +
Mg citrate B.	7.54 b c	7.71 b c d	7.50 b	22.75 b	+ +
$NaHCO_3$. B.	7.83 a b	7.79 b c	7.33 b c	22.96 b	+ +
Local market	4.38 j	5.96 j	4.13 j	14.46 h	-
USA Market	7.13 b c d	6.69 g h i	6.94 c d	20.75 c d e	+

Any two means at the same column have the same letter are not differ significantly at $P \geq 0.05$

H.W.B: Hot water blanching S.B. : Steam blanching
Mg citrate B.: Blanching by hot Mg citrate solution (1%)
$NaHCO_3$.B : Blanching by hot sodium bicarbonate solution (1%)

Table (28) : Acceptability and statistical analysis of sensory evaluation of sun, solar, oven dehydration and microwave dehydration samples of dried marjoram after storage for eight months .

Drying methods & Treatments	Color (10)	Odor (10)	General appearance (10)	Over all quality (30)	Acceptability
Sun drying					
Control	7.04 e f	7.67 c d	7.17 d e f	21.88 c d e f	+ +
H.W.B.	7.04 e f	6.92 f g	6.79 f g h	20.75 f g h	+
S.T.	6.54 g h i	7.29 d e f	6.75 f g h	20.58 g h	+
Mg citrate	7.54 c d	6.79 g	7.04 e f g	21.37 d e f g	+ +
$NaHCO_3$	7.04 e f	6.79 g	6.79 f g h	20.62 g h	+
Protected-sun-drying					
Control	7.04 e f	8.29 b	7.58 b c d	22.91 b c	+ +
H.W.B.	6.79 f g h	7.42 d e	7.00 e f g	21.21 e f g	+ +
S.T.	6.79 f g h	7.92 b c	7.25 d e	22.00 c d e	+ +
Mg citrate	8.04 b	7.29 d e f	7.50 c d	22.83 b c	+ +
$NaHCO_3$	7.42 c d e	7.29 d e f	7.25 d e	21.96 c d e	+ +
Oven dehydration					
Control	7.04 e f	7.54 c d	7.25 d e	21.83 c d e f	+ +
H.W.B.	6.92 f g	6.79 g	6.71 g h	20.42 g h i	+
S.T.	6.29 i	7.04 e f g	6.54 h	19.87 h i	+
Mg citrate	7.54 c d	6.79 g	7.04 e f g	21.37 d e f g	+ +
$NaHCO_3$	7.04 e f	6.67 g	6.75 f g h	20.46 g h i	+
Microwave dehydration					
Control	8.54 a	9.04 a	8.67 a	26.25 a	+ +
H.W.B.	7.67 b c	8.29 b	7.92 b	23.88 b	+ +
S.T.	7.17 d e f	8.79 a	7.88 b c	23.83 b	+ +
Mg citrate	7.75 b c	8.29 b	7.92 b	23.96 b	+ +
$NaHCO_3$	6.92 f g	8.17 b	7.42 d e	22.50 c d	+ +
Local market	6.42 h i	6.88 f g	6.04 i	19.38 i	+
Hungarian market	7.50 c d	6.81 g	7.31 d e	21.62 d e f g	+ +

Any two means at the same column have the same letter are not differ significantly at $P \geq 0.05$

H.W.B: Hot water blanching **S.B. :** Steam blanching
Mg citrate B.: Blanching by hot Mg citrate solution (1%)
$NaHCO_3$.B : Blanching by hot sodium bicarbonate solution (1%)

analyses we could be observed that control microwave dehydrated samples in both herbs had the highest color score followed by microwave dehydrated samples blanched with sodium bicarbonate solution in basil herb, and protected-sun-dried sample blanched with magnesium citrate solution in marjoram herb in comparison with other treatments under studied, local manufacture samples and imported samples especially local manufacturer sample and sun dried of steam blanched sample in basil herb and protected-sun-dried of steam blanched sample and local manufacture sample in marjoram herb, which were significantly different and had the lowest color score.

Also, some samples had the highest content of chlorophyll but had not the highest score in color and the reverse was sound. These results may be due to some changes in leaves appearance especially after heat pre-treatments such as leaves shrinkage.

As for odor character, from the same Tables (27 and 28) observed that control and steam blanched microwave dehydrated samples of both herbs had the highest odor score in comparison with other treatment especially local manufacture, sun dried of magnesium citrate solution treated and sodium bicarbonate solution treated samples in basil herb. And oven dehydrated of sodium bicarbonate solution treated, hot water blanched, magnesium citrate solution blanched, sun dried of magnesium citrate solution blanched, sodium bicarbonate solution blanched

and Hungarian samples in marjoram herb which had the lowest significant odor score.

Regarding general appearance from the same Tables we observed that microwave dehydrated control samples of both herbs were the better samples in comparison to other treatments especially local manufacture samples which had the minimized general appearance score.

From the results in the same Tables (27 and 28), it could be observed that microwave dehydrated control samples of both herbs had the highest over-all quality attributes score, whereas there were highly significant differences between this samples and local manufacture samples which had the lowest score values in over-all quality attributes.

Finally, concerning of sensory evaluation in general, microwave dehydrated samples of both herbs were preferable samples. On the other hand, oven dehydrated of marjoram herb samples were the lowest acceptability samples, these results may be due to high temperature and very short time during drying. Moreover, sun dried of basil and marjoram herbs samples especially local manufacture sample were unpromising samples, these results due to different climatic conditions such as direct sunshine, dust, rain, insect... etc.

5 - Percentage of economic part: -

The percentage of economic parts, specially leaves in herbs considerably varied with the effect of the soil kind, chemical and organic fertilization, salinity, growth regulation, atmosphere temperature and humidity, and many specific factors **(Kandeel, 1987; Hanafy, 1989; Jacoub, 1995; EL-Ghadban, 1998 and Jacoub, 1999).**

5.1 - Fresh herbs:-

The average percentage of economic part in fresh basil and marjoram were 64.2 and 65.2 %, respectively. These results are in the range reported by **Hanafy (1989), Jacoub (1995), EL-Ghadban (1998) and Jacoub (1999).**

5.2 - Dried herbs: -

The average percentage of economic part in dried basil and marjoram herbs were 67.1 % and 58.4 % respectively.

6 – Mass volume (bulk density): -

In case of fresh herbs mass volume is very important to limitation the drying area in sun drying or the capacity of dryer in other methods. Meanwhile, it is very important in situation of dehydrated herbs to determination the volume of packaging materials and the cost of end product shipping.

6.1 – Fresh herbs: -

The average mass volumes in fresh basil and marjoram herbs were 176 and 155 kg/m^3, respectively.

6.2 – Dried herbs: -

The average mass volumes in dried basil and marjoram herbs were 199 and 142 kg/m^3, respectively.

7 – Effect of pre-treatments and drying methods on drying ratio and final prepared herb ratio: -

Values of drying ratio and final prepared herb ratio are very important factors, which affect the efficiency of drying methods. Moreover, both values are of close relationship from viewpoint of the economic cost of production.

The values of drying ratio and final prepared herb ratio for both herbs are presented in Table (29). From these data, it could be noticeable an increase in these values due to pre-treatments.

Regarding the effect of drying methods on drying ratio, it could be observed that, the mean ratio of sun-drying method had the lowest drying ratio followed by protected-sun-drying then oven dehydration and finally microwave dehydration. These results may be due to drying temperature and time, and consequently the percentage of combined water content in dried herbs.

As for final prepared herb ratio, after separated and elimination stalks, the percentage of removed part was depending on pre-treatments and drying methods. Pre-treatments were decreased of removed parts, so control samples had the highest removed part comparison with other samples in each drying methods. Moreover, the removed part in sun drying was the highest value followed by protected-sun-drying then oven dehydrated and finally microwave dehydrated samples. These results may be due to exposed to all climatic conditions such as

Table (29) :Effect of pre-treatments and drying methods on drying ratio and the ratio after prepared herbs to export .

Drying methods & treatments	BASIL			MARJORAM		
	Drying ratio	Ratio of final prepared herb	% of separated parts	Drying ratio	Ratio of final prepared herb	% of separated parts
Sun drying						
Control	6.15 : 1	10.83 : 1	15.41	5.03 : 1	10.30 : 1	16.43
H . W . B .	6.95 : 1	11.83 : 1	12.48	5.27 : 1	10.31 : 1	12.48
S . B .	6.59 : 1	11.35 : 1	13.46	5.25 : 1	10.47 : 1	14.15
Mg citrate B .	7.29 : 1	12.14 : 1	10.49	5.39 : 1	10.37 : 1	11.05
$NaHCO_3$.B.	7.44 : 1	12.38 : 1	10.37	5.30 : 1	10.31 : 1	12.05
Protected-sun-drying						
Control	6.51 : 1	10.93 : 1	11.24	5.19 : 1	10.15 : 1	12.46
H . W . B .	6.92 : 1	11.17 : 1	7.65	5.44 : 1	10.21 : 1	8.77
S . B .	7.12 : 1	11.64 : 1	8.77	5.49 : 1	10.50 : 1	10.49
Mg citrate B .	7.63 : 1	12.14 : 1	6.31	5.59 : 1	10.33 : 1	7.36
$NaHCO_3$.B.	7.41 : 1	11.81 : 1	6.46	5.46 : 1	10.17 : 1	8.13
Oven dehydration						
Control	6.50 : 1	10.44 : 1	7.13	4.99 : 1	9.34 : 1	8.53
H . W . B .	7.41 : 1	11.47 : 1	3.79	5.56 : 1	10.00 : 1	4.83
S . B .	6.83 : 1	10.71 : 1	4.88	5.39 : 1	9.86 : 1	6.43
Mg citrate B .	7.51 : 1	11.61 : 1	3.68	5.45 : 1	10.49 : 1	6.15
$NaHCO_3$.B.	7.47 : 1	11.49 : 1	3.13	5.43 : 1	9.72 : 1	4.25
Microwave dehydration						
Control	6.46 : 1	10.13 : 1	2.48	4.83 : 1	8.64 : 1	4.20
H . W . B .	6.92 : 1	10.47 : 1	1.48	5.67 : 1	10.01 : 1	2.79
S . B .	7.11 : 1	10.82 : 1	2.11	5.52 : 1	9.79 : 1	3.46
Mg citrate B .	7.81 : 1	11.76 : 1	1.02	5.57 : 1	9.82 : 1	2.47
$NaHCO_3$.B.	7.63 : 1	11.52 : 1	1.37	5.59 : 1	9.72 : 1	1.75

H.W.B : Hot water blanching S.B. : Steam blanching
Mg citrate B. : Blanching with hot Mg citrate solution (1%)
$NaHCO_3$.B. : Blanching with hot sodium bicarbonate solution (1%)

direct sunshine, dust, rain, insect... etc. in sun drying and few of dust and insect in protected-sun-drying and high temperature in oven dehydration and long time of drying in all drying methods except microwave dehydration. The range of removed parts were from 10.37 to 15.41%, 6.31 to 11.24%, 3.13 to 7.13% and 1.37 to 2.48% in basil herb and from 11.05 to 16.43%, 7.36 to 12.46%, 4.25 to 8.53% and 1.75 to 4.2% in marjoram herb for sun drying, protected-sun-drying, oven dehydration and microwave dehydration, respectively.

In addition, the removed parts during preparation herbs to export in local traditional manufacture were higher than samples under this study. The removed parts in local traditional manufacture reached to more than 20 %.

Generally, the advanced drying methods have the highest drying ratio but, the remove parts are lowest than traditional method. So, the ratio of final prepared herbs for exporting was lowest than traditional method. Moreover, the quality and price of herbs in advanced methods are very higher than traditional method.