

PHYSIOLOGICAL STUDIES ON MATURITY INDICES AND STORABILITY OF EARLY SUPERIOR TABLE GRAPES.

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ABSTRACT

This investigation was carried out during two successive seasons (2002 and 2003) at the Hort. Res. Inst., Fruit handling department. Grapes were picked from a private farm at Cairo-Alex desert road. To determine maturity stage of Early Superior table grapes, samples were taken at weekly intervals beginning from the second week of May. At maturity stage, samples for storage studies were picked in the early morning and directly transported to the laboratory to be examined and packed in carton boxes (2kg / box) lined with perforated polyethylene bags (luggage = 40 μ and 400 halls / m²) and stored at room temperature (27 \pm 5), 5 \pm C and 0 \pm C and 90 : 65 % RH. for 18, 70 and 70 days, respectively. The Early Superior table grape is considered to be mature during the second week of July. (Treatment with dormancy agent is necessary). Also total soluble solid contents must be more than 15 %, total acidity contents less than 0.66 % and total soluble solid / total acidity ratio must be more than 25. As physical properties are more affected by the agricultural practice, it is not, always suitable for the determination of maturity stage for grapes. This study also confirmed that, Early Superior table grapes are very sensitive to the high temperature. The storage life of Early Superior table grape at room temperature did not exceed 12 days even with SO₂ fumigation treatment. Fumigation with SO₂ is necessary in order to keep quality of grapes during transport or storage especially when these periods were expected to exceed 21 days either at 5 \pm C or 0 \pm C temperatures. This study also indicated that grapes stored at 0 \pm C had longer storability compared with grapes stored at 5 \pm C especially in the first season. However, it is clear that, for short time storage or transport (less than 45 days), 5 \pm C will be sufficient to keep grapes quality. While, for long time storage or transport, 0 \pm C will be necessary to keep grape quality. Therefore, in all previous cases, fumigation with SO₂ is necessary

INTRODUCTION

Grape is one of the most important and favorable fruit crops in Egypt. The planted area in 2002 reached 152488 feddan, while the productive area reached 133897 feddan producing 1073815 ton according to Horticulture General Administration, M.O.A. (unpublished data). Egypt has a good opportunity for increasing the Egyptian share in the international grape trade. One of the most promising new cultivars planted in Egypt is Early Superior. It is an early maturation cultivar with high productivity.

Mohamed (1994) reported that, bunch weight, berry weight and size, juice percentage, total soluble solid and total soluble solids / total acidity ratio increased continuously during the developmental stages of grapes while berry firmness and total acidity were decreased.

Grapes should be harvested as near as full maturity as possible, unlike many other fruits, grapes don't ripe after harvest and they should be picked only after they reach the optimum stage of acceptability appearance,

flavor, taste, and texture. Nelson, (1985) Mohamed, (1994), and the last author added that to determine fruit maturity, non physical and chemical constituents could be taken as an indicator for maturity in grapes, but most of them together may contribute to be a proper index.

Chikkasabbanna *et al* (1991) reported that TSS/Acid ratio could be used as an index of maturity the same results were concluded by Roberdo *et al* (1991). On contrast Mansour *et al* (1981), mentioned that total soluble solid /acid ratio could not be used as an indication for maturity stage. Also they added that, the proper indices to define maturity stage in grapes were acidity contents and TSS. Similar results were obtain by Abarac, Lizana (1988) and Mohamed (1994)

It has been reported that, sulfur dioxide post harvest fumigation reduced decay incidence in the stored grapes, Asker *et al* (1988). Asker *et al* (1988) mentioned that post harvest fumigation with sulfur dioxide significantly decreased weight loss percentage in the stored grapes. Similar results were obtained by Morris *et al* (1992), Mohamed (1994), Cenci and Ferreira (1996), Castro *et al* (1998), Baneh *et al* (1999) and Mohamed (2002).

Morris *et al* (1992) in his study on Reliance and Saturn grape cultivars found that fumigating grapes with SO₂ generators (quick and dual-release SO₂ beds) significantly reduced shatter incidence during storage. Similar results were suggested by Sarig *et al* (1996), Yiqiang *et al* (1997), Baneh *et al* (1999) and Ling *et al* (1999).

Wasel (1985) mentioned that, post harvest SO₂ treatment significantly reduced total spoilage of grapes during storage. Similar trends were recorded by Sandhu *et al* (1992), Mohamed (1994) Al-Bachir (1996) and Mohamed (2002).

Mansour *et al* (1984) mentioned that berries treated with SO₂ were firmer than untreated ones. The same results were reported by Mohamed (1994), (2002).

Mansour *et al* (1984) found that stem drying and browning was reduced in Banati grapes when using quick release grapes guard (Q.R) during storage. The stems remained green and relatively fresh in the QR treated samples. Same results were found by Mustonen (1992), Morris *et al* (1992), Mohamed (1994), Soylemezoglu *et al* (1994), Kim (1994), Baneh *et al* (1999) and Mohamed (2002). On contrast Castro *et al* (1998) reported that the SO₂ generating treatment (Q.R.G.G.) had no effect on cluster appearance or stem browning.

Mohamed (1994) mentioned that fumigation with SO₂ had a significant effect on reducing TSS in fumigated grapes. Moreover fumigation with SO₂ had no obvious effect on total acidity. Similar results were reported by Mohamed (2002). On the other hand Asker *et al* (1988) reported that post harvest SO₂ treatments of grapes had no effect on TSS or total acidity contents during storage. The same results were recorded by Morris *et al* (1992), Cenci and Ferreira (1996). Yiqiang *et al* (1998) mentioned that SO₂ treatments significantly reduced total acidity contents of grapes during storage.

Some reports, mentioned that grapes stored at low temperature significantly had a long storage period and less decay, weight loss, shatter incidence compared with grapes stored at room temperature and fruit quality and storability of grapes increased as storage temperature decreased. Also the most factors causing losses (decay, shatter, and water loss) and deterioration were inhibited at low storage temperature compared with high temperature. Kim (1994), Mohamed (1994) and Munoz (2000).

This investigation was carried out to determine: A)- The maturity indices of Early Superior grapes. B)- The effect of SO₂ generators and storage temperatures (room temperature, 5°C and 0°C) on quality of Early Superior grape bunches during transport or storage.

MATERIALS AND METHODS

This investigation was carried out during two successive seasons (2002 & 2003) at Hort. Res. Inst. Giza, Egypt. Fruits were picked from a private farm at Cairo-Alex. desert road. The vines were 5 years old, planted on a spacing of 1.5 x 3 m in sandy soil, trained according to cane pruning and under drip irrigation system. During the first week of May, vines were selected to be the source of samples during maturity indices study. Samples were taken at weekly intervals from the second week of May. For preharvest study, all fruit quality parameters, such as average bunch weight, berry weight and size, berry color and firmness, juice percentage, total soluble solid contents and total acidity contents, were measured and tabulated. Three cluster samples were left under room temperature for 5 days at every harvest date. Fruit samples were tested at the third and fifth day for bunch weight loss percentage, bunch conditions, berry firmness, TSS, acidity and TSS/acid ratio to determine maturity stage. When fruit reached maturity stage, samples for storage study were taken. Fruits were picked in the early morning and directly transported to the laboratory where packed into 24 carton box (2Kg / box) lined with perforated polyethylene (40 µ, 400 walls / m², 1hall = 0.5cm) with SO₂ generators sheet (12 boxes) or without SO₂ generators (control, (12 boxes)). All treatments were stored at room temperature, 5°C, 0°C for 18, 70 and 70 days, respectively. Fruits stored at room temperature were tested two times per week while fruits stored at low temperature were tested at 14 days intervals for all fruit physical and chemical parameters. Decay, shatter, weight loss percentage were calculated according to the equal (weight of decayed or shattered berries or weight loss per box * 100 / the initial weight of box), total spoilage percentage was calculated as the sum of the last three parameters. Berry firmness were estimated in 15 berries by Ifra texture analyzer instrument using a penetrating cylinder of 1 mm of diameter to a constant distance 1 mm inside the skin of berry and by a constant speed 2 mm per sec. and the peak of resistance was recorded per gram. Bunch freshness was calculated as the average of stem color, stem dryness and berry appearance, and were estimated as follow:

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The property	Degree	1	2	3	4
Stem color		Green	L. brown	Little green	Brown
Stem dryness		Plump	50% Dry	Dry	Very dry
Berry appearance		Excellent	Good	Acceptable	Poor

Total soluble solids were estimated by using the Abbè refractometer. (A.O.A.C., 1980). Total acidity contents were measured by titration against 0.1 N. Sodium hydroxide using phenolphthalein as indicator. (A.O.A.C., 1980). Data were subjected to analysis of variance as a three factorial experiment in random complete design as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Maturity indices

Physical characteristics:

Data presented in Table (1) show that, bunch weight, berry weight and size, juice percentage increased gradually and significantly till reached the maximum 14 days before harvest, while berry firmness was decreased with the extension of the maturity stage. These results are in line with those obtained by Mohamed (1994).

Chemical characteristics:

According to data presented in Table (1) and Figure (1) total soluble solids and TSS / total acidity ratio increased gradually and significantly till reached the maximum values at maturity stage while total acidity was decreased significantly to reach the minimum values at maturity stage.

These results are in accordance with those reported by Mohamed (1994).

Determination of maturity stage:

It is evident from the last illustrated tables and the changes of the physical and chemical properties during shelf life at different developmental growth stages (Table 2) during seasons (2002) and (2003) that, Early Superior could be considered as mature during the first week of June when TSS reach more than 15% and acidity reach less than 0.66 % and TSS acid ratio is more than 25:1.

Storage studies:

Decay, weight loss, shatter and total spoilage percentage:

Data presented in Tables (3, 4, 5 and 6) and Figures (2 and 3) clearly indicated that decay, weight loss, shatter and total spoilage percentage increased gradually and significantly with prolonging of storage period.

Data also show that, decay, weight loss, shatter incidence was decreased as storage temperature decreased. Also post harvest SO₂ treatments significantly reduced the incidence of all these parameters.

Table (1): physical and chemical properties development of Early Superior Berries during growing seasons (2002 and 2003).

D.B.H	Berry properties							
	Bunch weight		Berry weight		Berry size		Berry firmness	
	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.
21	227	248	2.3	2.1	2.2	2.1	37.9	42.0
14	557	471	2.8	3.9	2.7	3.8	36.6	40.6
7	706	624	3.5	4.0	3.4	3.9	33.1	38.1
0	651	667	3.5	4.1	3.4	3.9	31.9	35.9
Means	548	503	3.03	3.55	2.93	3.43	34.88	39.15
LSD at 5%	228	179	0.7	1.11	0.73	1.36	N.S.	N.S.

Cont.

D.B.H	Berry properties							
	Juice %		TSS %		T. Acidity %		TSS Acid ratio	
	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.
21	43.6	39.1	10.3	8.5	1.49	1.94	7.2	4.4
14	63.7	60.8	11.0	9.9	0.93	1.17	11.9	8.5
7	68.4	68.7	14.1	13.8	0.72	0.89	19.5	15.6
0	69.0	68.2	15.5	15.3	0.60	0.64	25.7	24.2
Means	61.16	59.21	12.73	11.86	0.94	1.16	16.08	13.18
LSD at 5%	10.86	10.29	1.65	1.45	0.30	0.13	2.61	3.31

Table (2): Changes in physical and chemical properties of Early Superior berries during maturation in 2002 and 2003.

Days before harvest	D.B.H	St. P.	Weight loss %		Bunch Condition		Berry firmness		TSS %		T Acidity %		TSS Acid ratio	
			Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.	Fst. S.	Sec. S.
21	0	0	0.0	0.0	G	G	38	42	10.3	8.5	1.49	1.94	7	4
	2	14.9	11.3	SH	SH	41	45	11.3	9.5	1.56	2.11	7	5	
	4	25.2	21.6	SH	SH	42	48	11.6	10.5	1.52	2.09	8	5	
14	0	0	0.0	0.0	G	G	37	41	11.0	9.9	0.93	1.17	12	9
	2	9.2	8.4	SH	SH	40	46	12.3	11.2	0.99	1.15	12	10	
	4	14.5	12.5	SH	SH	39	45	12.1	11.5	0.97	1.22	13	9	
7	0	0	0.0	0.0	G	G	33	38	14.1	13.8	0.72	0.89	20	16
	2	5.8	6.2	G	G	35	42	14.9	14.3	0.75	0.92	20	16	
	4	8.6	10.4	G	SH	36	43	15.3	14.6	0.75	0.88	20	17	
0	0	0	0.0	0.0	G	G	32	36	15.5	15.3	0.60	0.64	26	24

G	Good
Fst. S.	First Season

SH	Shrinkage
Sec. S.	Second Season

(Table 3): Effect of fumigation with SO₂ and storage temperature on decay percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.	Room Temperature			Storage Tem.	5° C			0° C			Means		
	Treatments	No SO ₂	SO ₂ Tr.		Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂		SO ₂ Tr.	Means
First Season (2002)													
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0.0	0
	4	1.2	0.0	0.6		14	7.6	0.6	4.1	1.2	0.3	0.7	2.40
	7	7.8	2.3	5.0		28	15.5	2.2	8.9	3.6	0.4	2.0	5.45
	11	13.0	4.5	8.8		42	30.0	6.0	18.0	14.1	1.8	7.9	12.96
	14	26.4	11.4	18.9		56	38.1	9.9	24.0	20.5	4.4	12.5	18.24
St. Per	18	52.6	27.5	40.0	St. Per	70	50.0	13.3	31.6	33.3	9.7	21.5	26.58
Means		16.82	7.60	12.21	Means		23.52	5.34	14.43	12.12	2.77	7.44	
Second Season (2003)													
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0.0	0
	4	1.8	0.2	1.0		14	0.2	0.0	0.1	0.2	0.0	0.1	0.10
	7	2.7	0.7	1.7		28	2.6	1.0	1.8	3.6	0.3	1.9	1.86
	11	8.9	3.6	6.3		42	12.8	3.9	8.4	12.5	1.5	7.0	7.68
	14	24.5	6.2	15.4		56	26.7	5.9	16.3	24.8	5.6	15.2	15.73
St. Per	18	52.3	12.9	32.6	St. Per	70	38.4	10.2	24.3	33.5	6.8	21.2	22.73
Means		15.04	3.93	9.49	Means		13.45	3.51	8.48	12.41	2.70	7.55	
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	1.47	2.54	3.6	First Season	1.14	1.14	1.96	1.61	2.8	2.6	3.95		
Second Season	2.34	4.06	5.74	Second Season	N.S.	1.21	2.1	N.S.	N.S.	2.97	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per				

(Table 4): Effect of fumigation with SO₂ and storage temperature on weight loss percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.		Room Temperature			Storage Tem.		5° C			0° C			Means
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
St. Per	0	0.0	0.0	0.0	St. Per	0	0.0	0.0	0.0	0.0	0.0	0.0	0
	4	1.2	0.9	1.0		14	2.0	1.1	1.8	1.8	1.5	1.7	1.61
	7	4.8	2.9	3.8		28	3.4	1.9	2.6	2.4	2.1	2.2	2.42
	11	5.9	4.6	5.2		42	6.3	3.4	4.9	4.0	2.7	3.3	4.10
	14	9.5	7.5	8.5		56	9.2	5.9	7.6	5.7	3.9	4.6	6.19
	18	14.6	9.5	12.0		70	11.9	7.9	9.9	10.5	5.6	8.1	8.97
Means		5.96	4.22	5.09	Means		23.52	5.34	14.43	12.12	2.77	7.44	
Second Season (2003)													
St. Per	0	0.0	0.0	0.0	St. Per	0	0.0	0.0	0.0	0.0	0.0	0.0	0
	4	1.5	1.4	1.4		14	1.8	1.2	1.5	1.8	1.1	1.4	1.45
	7	3.7	3.1	3.4		28	3.1	2.3	2.7	3.4	2.4	2.9	2.79
	11	5.8	4.7	5.1		42	4.4	3.6	4.0	4.3	3.5	3.9	3.96
	14	8.1	5.3	6.7		56	6.4	5.0	5.7	5.7	4.4	5.0	5.37
	18	12.1	7.9	10.0		70	8.9	5.7	7.3	8.2	5.4	6.8	7.04
Means		5.17	3.74	4.46	Means		4.11	2.95	3.53	3.86	2.61	3.34	
LSD value. At 5%	SO ₂ Tr.	St. Per.	Inter.3	LSD value. At 5%	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	0.97	1.68	2.37	First Season	0.5	0.5	0.87	N.S.	1.23	1.23	N.S.		
Second Season	0.43	0.74	1.04	Second Season	N.S.	0.27	0.47	N.S.	N.S.	0.67	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per				

(Table 5): Effect of fumigation with SO₂ and storage temperature on shattering percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem. Treatments	Room Temperature			Storage Tem. Treatments	5° C			0° C			Means		
	No SO ₂	SO ₂ Tr.	Means		No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0	
	4	0.9	0.3	0.6		14	2.3	1.0	1.6	2.1	0.9	1.5	1.56
	7	2.6	1.7	2.2		28	3.1	1.4	2.2	2.8	1.2	2.0	2.13
	11	5.6	3.3	4.4		42	4.2	2.0	3.1	3.7	1.9	2.8	2.97
	14	16.3	6.2	11.2		56	6.7	3.0	5.8	6.0	2.6	4.3	5.08
St. Per	18	23.6	11.3	17.5	St. Per	70	13.2	4.0	8.6	10.4	3.5	7.0	7.79
Means		6.22	3.78	6.00	Means		5.25	1.90	3.57	4.18	1.70	2.94	
Second Season (2003)													
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0	
	4	2.6	1.4	2.0		14	2.3	0.9	1.6	1.6	0.7	1.1	1.35
	7	3.6	2.3	3.0		28	3.1	1.6	2.4	2.9	1.2	2.0	2.19
	11	5.2	3.6	4.4		42	5.1	3.3	4.2	3.7	2.0	2.8	3.52
	14	9.7	6.2	8.0		56	12.9	5.6	9.3	10.7	3.8	7.3	8.26
St. Per	18	18.3	8.3	13.3	St. Per	70	21.3	8.1	14.7	20.0	5.2	12.6	13.65
Means		6.56	3.63	5.10	Means		7.45	3.25	5.35	6.48	2.15	4.31	
LSD value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	LSD value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	1.39	2.41	3.41	First Season	0.3	0.3	0.52	0.42	0.73	0.73	1.03		
Second Season	0.89	1.54	2.18	Second Season	0.52	0.52	0.91	N.S.	N.S.	1.29	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per				

(Table 6): Effect of fumigation with SO₂ and storage temperature on total spoilage percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.	Room Temperature			Storage Tem.	5° C			0° C			Means	
	No SO ₂	SO ₂ Tr.	Means		Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.		Means
First Season (2002)												
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0
	4	3.2	1.2	2.2		14	11.9	2.6	7.2	5.1	2.7	3.9
	7	15.2	6.8	11.0		28	22.0	5.5	13.7	8.8	3.7	6.3
	11	24.5	12.3	18.4		42	40.5	11.5	26.0	21.8	6.4	14.1
	14	52.1	25.1	38.6		56	56.0	18.8	37.4	32.3	10.9	21.6
St. Per	18	90.9	48.2	69.6	St. Per	70	75.1	25.2	50.1	54.2	18.9	36.5
Means		30.29	15.61	20.30	Means		34.23	10.59	22.41	20.38	7.09	13.73
Second Season (2003)												
	0	0.0	0.0	0.0		0	0.0	0.0	0.0	0.0	0.0	0
	4	5.8	3.0	4.4		14	4.3	2.1	3.2	3.4	1.8	2.6
	7	10.0	6.1	8.0		28	8.8	4.9	6.8	9.8	3.8	6.8
	11	19.7	11.8	15.8		42	22.4	10.8	16.6	20.5	7.0	13.7
	14	42.4	17.8	30.1		56	46.0	16.5	31.2	41.2	13.8	27.5
St. Per	18	82.8	29.1	56.0	St. Per	70	68.5	24.0	46.3	61.7	19.4	40.6
Means		26.79	11.31	19.04	Means		25.01	9.70	17.36	22.75	7.65	15.20
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4	
First Season	2.8	4.84	6.85	First Season	1.03	1.03	1.78	1.45	2.51	2.51	3.55	
Second Season	2.7	4.68	6.62	Second Season	1.56	1.56	2.7	N.S.	N.S.	3.82	N.S.	
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St. Per.			
	SO ₂ Tr.	With SO ₂ treatments		Inter. 2	St. Tem. X St. Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St. Per.			

Figure (1) Physical and chemical properties changes of Early Superior grapes during growth and maturation , (2002-2003).

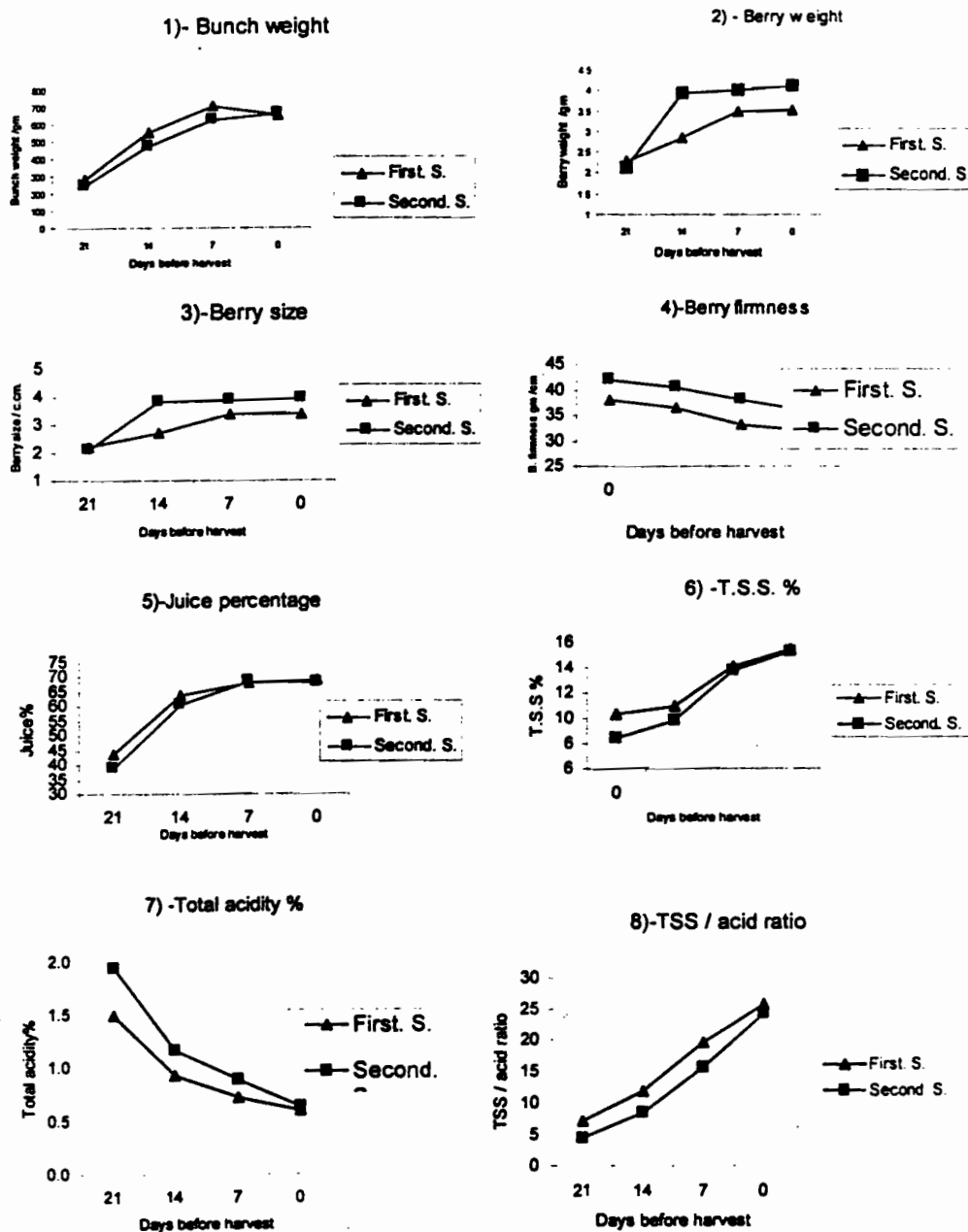


Figure (2) Effect of sulfur dioxide and storage temperature on decay percentage of Early Superior table grapes during storage, (A, at room temperature and B, at 5°C and 0°C temperature).

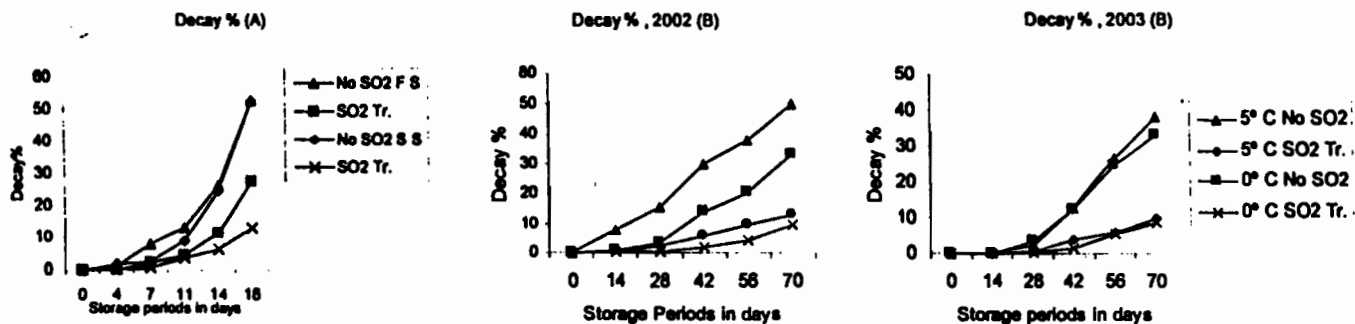
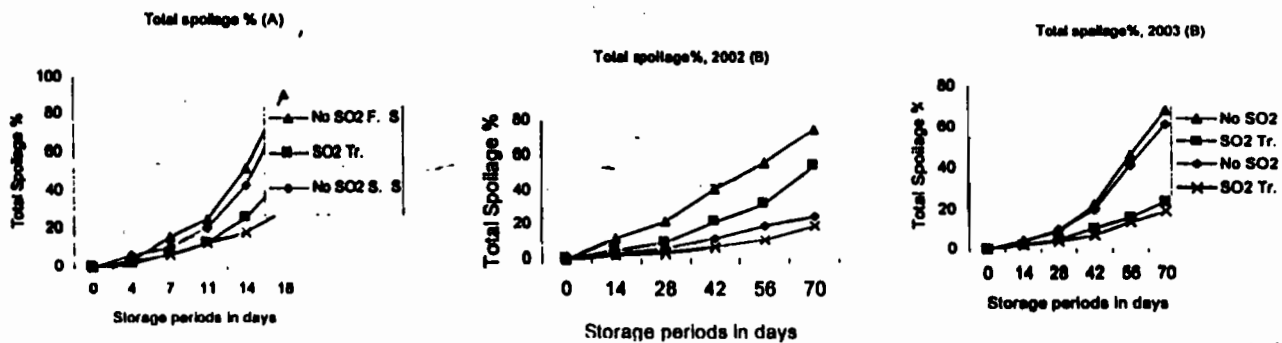


Figure (3) Effect of sulfur dioxide and storage temperature on total spoilage percentage of Early Superior table grapes during storage, (A, at room temperature and B, at 5°C and 0°C temperature).



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These results are in agreement with those obtained by Wasel (1985), Asker (1988), Dhillon and Sandhu (1990), Smilinick *et al* (1990), Auger *et al* (1991), Rould *et al* (1991), Morris *et al* (1992) Mustoren (1992), Sandhu *et al* (1992), Mohamed (1994), Soylemezoglu *et al* (1994), Cenci and Ferreiral (1996), Yun *et al* (1995), Sarig *et al* (1996), Castro *et al* (1998), Ling *et al* (1998), Baneh *et al* (1999), Ling *et al* (1991), Munoz *et al* (2000) and Mohamed (2002). They reported that post harvest SO₂ fumigation significantly reduced the incidence of decay, shatter, water loss and total spoilage in grapes during storage.

Berry firmness:

According to data shown in Table (7), berry firmness significantly decreased with the extension of storage period either at room temperature or at cold storage. The same data cleared that, there was no significant differences between berry firmness of grapes either stored at 5°C or 0°C.

Regarding post harvest SO₂ treatment, it is clear that, fumigation with SO₂ significantly reduced the softening rate of grape berry firmness, regardless of storage temperature.

These results are in line with the findings of Mansour *et al* (1984) and Mohamed (1994).

Bunch freshness:

Data illustrated in Table(8) cleared that, Bunch freshness (the average of stem color, dryness and berry appearance) significantly deteriorated with prolonging the storage period. Data also illustrated that SO₂ post harvest treatment significantly reduced the deterioration rate of bunch freshness. Moreover, the low storage temperature significantly decreased the deterioration incidence of bunch freshness. These results are in harmony with those obtained by Mansour *et al* (1984), Mustonen (1992), Morris *et al* (1992) Mohamed (1994), Soylemezoglu *et al* (1994), Kim (1994), Baneh *et al* (1999), Mohamed (2002).

Juice percentage:

It is obvious from data shown in Table (9) that although, juice percentage of Early Superior grapes decreased with prolonging storage period, there were no significant differences between juice percentage content of grapes either stored at 5°C or at 0°C and either fumigated with SO₂ or not fumigated with SO₂.

Total soluble solids, Total acidity and T.S.S / total acidity ratio:

Data recorded in Tables (10, 11 and 12) and Figures (4 and 5) cleared that , total soluble solids increased gradually and significantly during the first periods of storage till reached the maximum value then began to decrease until the end of the storage period. Also T.S.S / total acidity ratio increased gradually and significantly during storage. While, total acidity decreased till reached the lowest value then began to increase until the end of the storage period.

(Table 7): Effect of fumigation with SO₂ and storage temperature on berry firmness (gm/cm²) of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.	Room Temperature			Storage Tem.	5° C			0° C			Means		
	No SO ₂	SO ₂ Tr.	Means		Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.		Means	
First Season (2002)													
St. Per	0	31.9	31.9	31.9	St. Per	0	31.9	31.9	31.9	31.9	31.9	31.9	
	4	29.8	29.4	29.6		14	32.8	32.9	32.9	30.1	32.2	31.2	32.00
	7	26.9	28.4	27.7		28	29.9	31.3	30.6	30.2	31.5	30.9	30.73
	11	26.2	27.1	26.7		42	26.2	30.2	28.2	26.3	29.0	27.7	27.93
	14	24.5	28.0	26.3		56	25.2	28.6	26.9	23.7	27.6	25.7	26.28
	18	21.6	26.4	24.0		70	20.2	29.4	24.8	22.3	26.2	24.3	24.53
	Means	26.82	28.53	27.68		Means	27.70	30.72	29.21	27.42	29.73	26.58	
Second Season (2003)													
St. Per	0	35.9	35.9	35.9	St. Per	0	35.9	35.9	35.9	35.9	35.9	35.9	
	4	32.9	34.4	33.7		14	33.1	35.0	34.1	34.1	36.1	35.1	34.58
	7	30.7	33.3	32.0		28	32.3	35.2	33.8	32.7	35.4	34.1	33.90
	11	28.2	32.4	30.3		42	31.9	33.8	32.9	31.2	34.6	32.9	32.88
	14	25.5	30.7	28.1		56	28.5	32.5	30.5	30.0	33.5	31.8	31.13
	18	23.2	28.0	25.6		70	25.8	31.1	28.5	26.6	28.9	27.8	28.10
	Means	29.40	32.45	30.93		Means	31.25	33.92	32.58	31.75	34.07	32.91	
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	1.84	2.85	N.S.	First Season	N.S.	0.99	1.71	N.S.	N.S.	2.42	N.S.		
Second Season	1.52	2.63	N.S.	Second Season	N.S.	1.01	1.75	N.S.	N.S.	N.S.	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.				

(Table 8): Effect of fumigation with SO₂ and storage temperature on bunch general appearance of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.		Room Temperature			Storage Tem.		5° C			0° C			Means
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
St. Per	0	1.0	1.0	1.0	St. Per	0	1.0	1.0	1.0	1.0	1.0	1.0	1
	4	1.8	1.1	1.4		14	1.3	1.0	1.2	1.1	1.0	1.1	1.11
	7	2.7	1.9	2.3		28	2.3	1.2	1.8	2.0	1.0	1.5	1.64
	11	3.7	2.6	3.1		42	3.0	1.9	2.4	2.7	1.2	1.9	2.19
	14	4.0	3.4	3.7		56	3.9	2.7	3.3	3.4	2.3	2.9	3.08
	18	4.0	3.9	3.9		70	4.0	3.4	3.7	4.0	3.0	3.5	3.61
Means		2.85	2.31	2.58	Means		2.59	1.87	2.23	2.37	1.59	1.98	
Second Season (2003)													
St. Per	0	1.0	1.0	1.0	St. Per	0	1.0	1.0	1.0	1.0	1.0	1.0	1
	4	1.8	1.0	1.4		14	1.3	1.0	1.2	1.2	1.0	1.1	1.14
	7	2.8	1.8	2.3		28	2.3	1.3	1.8	2.0	1.1	1.6	1.69
	11	3.8	2.7	3.2		42	3.0	2.3	2.7	2.7	1.9	2.3	2.47
	14	4.0	3.7	3.8		56	3.8	2.8	3.3	3.6	2.6	3.1	3.17
	18	4.0	3.9	3.9		70	4.0	3.4	3.7	4.0	3.0	3.5	3.61
Means		2.89	2.33	2.61	Means		2.57	1.98	2.28	2.41	1.76	2.08	
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	0.16	0.28	0.40	First Season	0.11	0.11	0.19	N.S.	N.S.	0.27	N.S.		
Second Season	0.14	0.25	0.35	Second Season	0.15	0.15	0.26	N.S.	N.S.	0.37	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.				

(Table 9): Effect of fumigation with SO₂ and storage temperature on juice percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.		Room Temperature			Storage Tem.		5° C			0° C			Means
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
St. Per	0	69.7	69.0	69.4	St. Per	0	69.0	69.0	69.0	69.0	69.0	69.01	
	4	69.2	71.3	70.3		14	70.8	73.4	72.1	71.0	70.8	70.9	71.48
	7	73.2	69.1	71.1		28	70.5	71.2	70.9	68.6	71.0	69.8	70.33
	11	67.9	71.8	69.9		42	68.2	70.3	69.2	66.9	70.6	68.8	69.01
	14	69.2	69.6	69.4		56	69.8	69.2	69.5	67.1	69.5	68.3	68.88
	18	63.2	67.3	65.3		70	64.5	68.0	66.3	63.2	68.0	65.6	65.93
Means	68.74	69.70	69.22	Means	68.80	70.18	69.49	67.63	69.81	68.72			
Second Season (2003)													
St. Per	0	68.2	68.2	68.2	St. Per	0	68.2	68.2	68.2	68.2	68.2	68.21	
	4	69.9	70.1	70.0		14	69.2	71.0	70.1	72.2	70.0	71.1	70.58
	7	64.7	69.6	67.1		28	72.4	68.2	70.3	67.7	69.1	68.4	69.37
	11	71.1	69.9	70.5		42	70.7	70.0	70.4	64.3	68.9	66.6	68.48
	14	63.5	67.4	65.5		56	64.1	67.4	65.8	65.0	68.0	66.5	66.13
	18	62.0	66.8	64.4		70	61.5	64.1	62.8	61.9	64.9	63.4	63.10
Means	66.56	68.67	67.61	Means	67.67	68.16	67.92	66.56	68.19	67.38			
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	N.S.	N.S.	N.S.	First Season	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.		
Second Season	N.S.	N.S.	N.S.	Second Season	N.S.	N.S.	3.98	N.S.	N.S.	N.S.	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.				

(Table 10): Effect of fumigation with SO₂ and storage temperature on total soluble solid % of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.	Room Temperature			Storage Tem.	5° C				0° C			Means	
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
St. Per	0	15.5	15.5	15.5	St. Per	0	15.5	15.5	15.5	15.5	15.5	15.5	
	4	15.9	15.9	15.9		14	15.8	16.0	15.9	15.8	16.1	16.0	15.93
	7	16.3	16.0	16.1		28	16.2	15.9	16.0	16.4	16.0	16.2	16.13
	11	16.5	16.3	16.4		42	16.3	16.2	16.2	16.6	16.6	16.6	16.41
	14	16.4	16.4	16.4		56	16.5	16.4	16.4	16.5	16.7	16.6	16.49
	18	16.0	16.8	16.4		70	16.2	16.8	16.5	16.2	16.8	16.5	16.48
Means	16.08	16.14	16.11	Means	16.07	16.12	16.09	16.16	16.27	16.22			
Second Season (2003)													
St. Per	0	15.3	15.3	15.3	St. Per	0	15.3	15.3	15.3	15.3	15.3	15.3	
	4	15.7	15.6	15.7		14	15.7	15.6	15.7	15.8	15.7	15.8	15.73
	7	16.0	15.9	16.0		28	15.8	16.1	16.0	16.1	16.4	16.2	16.10
	11	16.0	16.0	16.0		42	16.0	16.5	16.2	16.5	16.3	16.4	16.33
	14	16.0	16.5	16.3		56	16.4	16.6	16.5	15.9	16.7	16.3	16.38
	18	16.1	16.4	16.3		70	15.9	16.7	16.3	15.8	16.8	16.2	16.25
Means	15.86	15.96	15.91	Means	15.84	16.14	15.99	15.88	16.20	16.04			
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	N.S.	0.51	N.S.	First Season	N.S.	N.S.	0.31	N.S.	N.S.	N.S.	N.S.		
Second Season	N.S.	0.5	N.S.	Second Season	N.S.	0.16	0.28	N.S.	N.S.	0.39	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.				

(Table 11): Effect of fumigation with SO₂ and storage temperature on total acidity percentage of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.		Room Temperature			Storage Tem.		5° C			0° C			Means
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means			
First Season (2002)													
St. Per	0	0.60	0.60	0.60	St. Per	0	0.60	0.60	0.60	0.60	0.60	0.60	
	4	0.63	0.62	0.62		14	0.62	0.62	0.62	0.61	0.62	0.62	0.62
	7	0.59	0.60	0.60		28	0.60	0.61	0.60	0.59	0.61	0.60	0.60
	11	0.57	0.60	0.58		42	0.57	0.59	0.58	0.58	0.60	0.59	0.58
	14	0.61	0.58	0.60		56	0.56	0.57	0.56	0.57	0.58	0.57	0.57
	18	0.62	0.57	0.59		70	0.61	0.56	0.59	0.61	0.57	0.59	0.59
	Means	0.60	0.59	0.60		Means	0.59	0.59	0.59	0.59	0.59	0.59	
Second Season (2003)													
St. Per	0	0.64	0.64	0.64	St. Per	0	0.64	0.64	0.64	0.64	0.64	0.63	
	4	0.66	0.66	0.66		14	0.65	0.64	0.64	0.65	0.66	0.65	0.65
	7	0.64	0.65	0.64		28	0.61	0.63	0.62	0.63	0.64	0.64	0.63
	11	0.61	0.63	0.62		42	0.59	0.62	0.61	0.61	0.62	0.62	0.61
	14	0.60	0.62	0.61		56	0.63	0.60	0.61	0.59	0.60	0.60	0.61
	18	0.66	0.61	0.64		70	0.64	0.59	0.61	0.64	0.60	0.62	0.62
	Means	0.63	0.63	0.63		Means	0.63	0.62	0.62	0.63	0.63	0.63	
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter. 3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4		
First Season	N.S.	N.S.	N.S.	First Season	N.S.	N.S.	0.026	N.S.	N.S.	0.037	N.S.		
Second Season	N.S.	0.04	N.S.	Second Season	N.S.	N.S.	0.008	N.S.	N.S.	0.012	N.S.		
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.				
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.				

(Table 12): Effect of fumigation with SO₂ and storage temperature on TSS / total acidity ratio of Early Superior table grapes during seasons (2002 and 2003)

Storage Tem.		Room Temperature			Storage Tem.		5° C				6° C			Means
Treatments	No SO ₂	SO ₂ Tr.	Means	Treatments	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means	No SO ₂	SO ₂ Tr.	Means	
First Season (2002)														
St. Per	0	25.7	25.7	25.7	St. Per	0	25.7	25.7	25.7	25.7	25.7	25.7	25.73	
	4	25.4	25.9	25.7		14	25.7	25.9	25.8	25.8	26.1	25.9	25.85	
	7	27.7	26.6	27.1		28	27.2	26.1	26.6	27.6	26.5	27.1	26.85	
	11	29.2	27.2	28.2		42	28.7	27.4	28.0	28.8	27.8	28.3	28.18	
	14	26.9	28.3	27.6		56	29.7	28.8	29.2	29.0	29.0	29.0	29.11	
	18	25.7	29.6	27.7		70	26.6	29.9	28.2	26.8	29.4	28.1	28.17	
	Means	26.77	27.22	26.99		Means	27.26	27.30	27.28	27.28	27.43	27.35		
Second Season (2003)														
St. Per	0	24.2	24.2	24.2	St. Per	0	24.2	24.2	24.2	24.2	24.2	24.2	24.22	
	4	23.7	23.7	23.7		14	24.2	24.6	24.4	24.3	24.0	24.1	24.26	
	7	25.2	24.6	24.9		28	25.9	25.8	25.8	25.6	25.6	25.6	25.71	
	11	26.1	25.4	25.8		42	26.9	26.4	26.7	27.3	26.2	26.7	26.70	
	14	26.7	26.5	26.6		56	26.0	27.8	26.9	26.9	27.6	27.3	27.08	
	18	24.3	27.0	25.6		70	24.7	28.6	26.6	24.4	28.2	26.3	26.46	
	Means	25.05	25.23	25.14		Means	25.32	26.23	25.78	25.44	25.96	25.70		
L S D value. At 5 %	SO ₂ Tr.	St. Per.	Inter.3	L S D value. At 5 %	St. Tem.	SO ₂ Tr.	St. Per.	Inter. 1	Inter. 2	Inter. 3	Inter. 4			
First Season	N.S.	1.52	2.15	First Season	N.S.	N.S.	0.96	N.S.	N.S.	1.36	N.S.			
Second Season	N.S.	1.64	N.S.	Second Season	N.S.	0.56	0.97	N.S.	N.S.	1.37	N.S.			
	No SO ₂	Without SO ₂ treatments		Inter. 1	St. Tem. X SO ₂ Tr.			Inter. 3	SO ₂ Tr. X St.Per.					
	SO ₂ T.	With SO ₂ treatments		Inter. 2	St. Tem. X St.Per.			Inter. 4	St. Tem. X SO ₂ Tr. X St.Per.					

Figure (4) Effect of sulfur dioxide and storage temperature on total soluble solids contents of Early Superior table grapes during storage, (A, at room temperature and B, at 5°C and 0°C temperature).

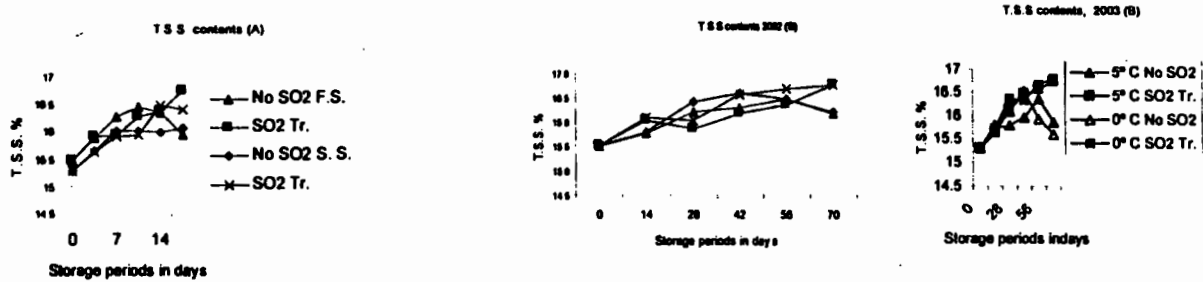
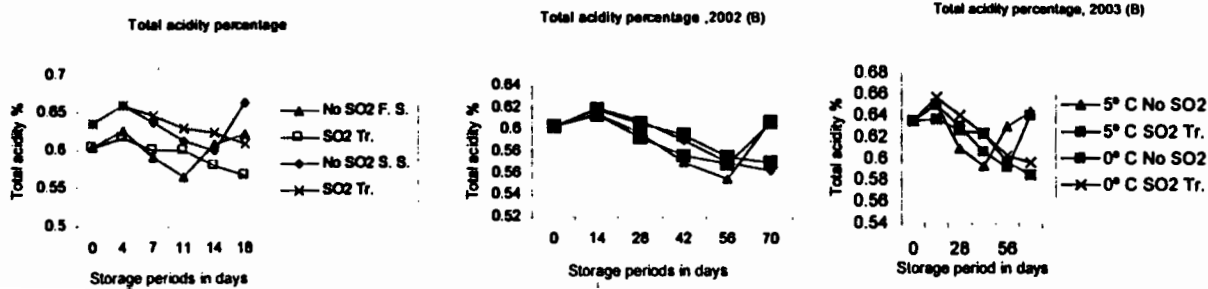


Figure (5) Effect of sulfur dioxide and storage temperature on total acidity contents of Early Superior table grapes during storage, (A, at room temperature and B, at 5°C and 0°C temperature).



Concerning the effect of post harvest SO₂ treatments, data also indicated that, post harvest SO₂ treatments had no effect on total soluble solids, total acidity content and total soluble solids / total acidity ratio of grapes during storage. However, data illustrated in Figures (4, 5) cleared that post harvest fumigation with SO₂ forbid or delayed the reverse point in the total soluble solid and total acidity of grapes during storage.

These results are in accordance with those found by Mohamed (1994), and (2002) and partially agree with those reported by Asker et al (1988), Morris et al (1992), Cenci and Ferreira (1996), as they mentioned that SO₂ fumigation had no effect on TSS and total acidity. On contrast these results disagree with those reported by Yiqiang (1998) who mentioned that, grapes fumigated with SO₂ had the highest TSS and TSS / acid ratio contents and the lowest total acidity contents.

The effect of storage temperature:

In brief, from all the above tables it is concluded that, storage at the lowest temperature (0°C) significantly maintained grape fruits quality and increased storability of grapes compared with higher storage temperatures (room temperature and 5°C) as expressed by decreasing decay, shatter, weight loss and spoilage incidence. Moreover, keeping all fruit quality parameters (berry firmness, bunch freshness, TSS and total acidity contents) at the proper levels. These results are in harmony with the finding of Kim (1994), Mohamed (1994) and Munoz (2002).

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دراسات فسيولوجية لتحديد مرحلة اكتمال النمو والقدرة التخزينية لعنقب المائدة صنف إيرلى سوبريور

محمود على احمد محمد- جمال فتحي عبد العزيز حسن
معهد بحوث البساتين - قسم بحوث تداول الفاكهة

اجري هذا البحث خلال موسمي ٢٠٠٢&٢٠٠٣ بمعهد بحوث البساتين قسم بحوث تداول الفاكهة. تم الحصول على العناقيد من مزرعة خاصة بطريق القاهرة-الإسكندرية الصحراوي. أخذت عينات دورية من الثمار ابتداء من الأسبوع الثاني من شهر مايو بغرض تحديد مرحلة اكتمال النمو. عند الوصول إلى مرحلة اكتمال النمو تطففت الثمار ونقلت مباشرة إلى المعمل في الصباح الباكر لدراسة القدرة التخزينية للصنف. في المعمل تم فرز العناقيد وتعبئتها داخل كراتين (٢ كجم / كرتونة) مع التبتطين بالبولي ايثيلين المتقّب (٤٠ ميكرون) نصّف كراتين الثمار عوملت بمولدات ثاني أكسيد الكبريت والنصف الآخر لم يعامل. تم تخزين الثمار على درجة حرارة الغرفة (٢٧±٥°م) وعلى درجة حرارة ٥°م وصفر منوى (٩٠ : ٩٥ % رطوبة نسبية) لمدة ١٨ و٧٠ و٧٠ يوما على التوالي بحيث أن كل درجة من درجات التخزين الثلاثة تحتوى على كراتين عوملت بـ ثاني أكسيد الكبريت والأخرى لم تعامل.

يمكن اعتبار الصنف إيرلى سوبريور مكتمل النمو في الأسبوع الثاني من شهر يوليو (المعاملة بكاسرات السكون ضرورية عندئذ) وعندها تكون نسبة المواد الصلبة الذائبة أكبر من ١٥% ونسبة الحموضة الكلية أقل من ٠,٦٦% ونسبة المواد الصلبة الذائبة إلى الحموضة الكلية أكبر من ٢٥.

ولقد تبين من هذه الدراسة إن استخدام مولدات ثاني أكسيد الكبريت ضروريه للمحافظة على حيوية الثمار سواء أثناء الشحن أو التخزين لفترات طويلة وعلى الأخص عندما تزيد فترة الشحن عن ٢١ يوما. أوضحت الدراسة أن الصنف إيرلى سوبريور حساس للحرارة العالية حيث لم تتعدى الفترة التخزينية على درجة حرارة الغرفة ١٢ يوما حتى مع استخدام مولدات ثاني أكسيد الكبريت. أيضا أوضحت هذه الدراسة أن تخزين الثمار على درجة الصفر المنوي كان له أكبر الأثر في تحسين القدرة التخزينية للصنف إيرلى سوبريور مقارنة بالتخزين على درجة ٥°م خاصة في الموسم الأول (٢٠٠٢) ومع هذا فإنه خلال المراحل الأولى من التخزين (أقل من ٤٥ يوما) فإن استخدام ٥°م درجة منوي يكون كافيا للحفاظ على حيوية الثمار. أما في حالة الرغبة في التخزين أو الشحن لمدة أطول من تلك الفترة فأنه من الضروري عندئذ استخدام درجة الصفر المنوي. وفي كل هذه الحالات فإن استخدام ثاني أكسيد الكبريت أصبح ضروريا للحد من انتشار الإصابة الفطرية.