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Storability of Some Grape Varieties in Syria

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ABSTRACT. Two table grape varieties (Helwani and Baladi) from three vineyards in southern Syria were studied. Fruits were stored in cooled rooms with or without sulfur dioxide (SO_2) and storage losses were evaluated. The results of these experiments showed that storability of fruits were negatively correlated with water supply (rainfall plus irrigation), and altitude. Storability of Helwani was better than that of Baladi. Percentage of total loss were 49 and 66.5 for Helwani and Baladi respectively. Total loss was reduced in SO_2 treatment during all different storage stages. Percentages of total loss were 42.9 and 57.4 for SO_2 treated and non-treated fruits, respectively.

Grape is ranked first among cultivated fruits in Syria. The number of planted trees is estimated at 80 millions. Out of that, there are 58 millions grape-producing trees, giving about 487 thousand tons of grapes annually (Statistical Abstract 1992). Based on the available data concerning the number of grape trees in the growing stage, it can be speculated that grape production will increase by 30% during the coming five years when young trees start their fruiting stage. Grapes in Syria are divided, according to their usage into, industrial and table varieties. Baladi and Helwani are widely spread and ranked at the forefront among the table grapes.

Grapes could be stored between 3 and 6 months at 0 to 3°C and relative humidity (RH) between 90-95%, and sulfur dioxide concentrations of 0.2 - 0.3% (Asker *et al.* 1987). During storage, grapes are spoiled mainly due to weight loss, physiological spoilage, and fungal infection (Lutz and Hardenburg 1968). Rate of

infection by the fungus *(Botrytis cinerea)* increases as the relative humidity in the atmosphere before harvest increases. It is possible to control these infections by treatment with 0.2 - 0.3% sulfur dioxide (SO_2) (Asker *et al.* 1987, and Bouzid 1984). This treatment does not have any effect on the spores that start development in the field before storage. Couey (1965) and Couey and Uota (1961) noticed that high (RH) in the store increases the efficacy of sulfur gas in controlling the spores of the fungi *Botrytis* and *Alternaria.* However, excessive use of sulfur can damage the treated fruits.

Despite the economical importance of grapes in Syria, production has not been matched with renewal of marketing processes such as sorting, transportation and storage. However, there has been recent interest in grape storage although data on storage conditions can only be derived from studies performed outside the country. The objectives of the present experiments were to test the storability of two Syrian table grape varieties grown in three different locations and stored with or without SO_2 treatment for different periods.

Materials and Methods

The two table grape varieties used were: (a) Baladi, characterized by big greenish white colored fruit with thick skin, and (b) Helwani, characterized by a big, firm, violet red colored fruit with thin skin, and hard flesh. Both varieties were harvested in the last week of September 1991 from two vineyards in south Syria (Damascus, and Sweida), while, only Helwani was harvested from Daraa. Grapes produced in Daraa and Sweida were rain-fed, while those produced in Damascus were irrigated in August (three times). The average rainfall for these locations are (206, 272 and 334 mm) and the altitudes are (729, 575 and 1330 m, for Damascus, Daraa, and Sweida, respectively). Grapes were divided into two groups with 4 replicates of 5 kg each. One group was treated with sulfur dioxide (SO_2) in the form of $NaHSO_3$, (1 g/5 kg fruits). Both groups were stored at (0 –3°C), and relative humidity (RH) between 75 and 85% for up to 9 weeks. Weight loss, spoilage, and total loss were evaluated after 3, 6, and 9 weeks of storage. Total loss was calculated according to the method of Sass (1984) using the following equation:

$$\text{Total loss} = 100 - \frac{(100 - \text{weight loss})\,(100 - \text{spoilage})}{100}$$

ANOVA routine of statview II computer package was used to analyze the data at 95% confidence level.

Results and Discussion

Production place

Weight loss of both varieties was significantly higher in Sweida than in Daraa and Damascus. The losses were 7.8, 7.4 and 11.3% for Helwani produced in Daraa, Damascus and Sweida, respectively, and 8.7 and 13.6% for Baladi produced in Damascus and Sweida respectively (Table 1). Spoilage of Helwani grapes produced in Damascus (32.8%) and Sweida (57.5%) were significantly higher than those produced in Daraa (11.5), and the spoilage of Baladi grapes produced in Sweida (88.8%) was significantly higher than those produced in Damascus (37.8%) (Table 1).

The total loss of grapes from Damascus and Sweida were significantly higher than those of Daraa (Helwani var.). Percentages of total loss were 18.4, 36.8 and 62.4 for Helwani produced in Daraa, Damascus and Sweida respectively, and 43.1 and 89.9% for Baladi produced in Damascus and Sweida respectively (Table 1).

The high losses caused by storage in grape varieties produced in Sweida, may be attributed to the environmental conditions of this location since it was the highest in rainfall, relative humidity, and altitude. These factors may resulted in producing juicy fruits with low storability. Sass (1993) found that high rainfall combined with relatively low air and soil temperatures resulted in reduction of storability. The high spoilage loss in grape varieties produced in Damascus may be attributed to irrigation before harvest. In this context Levavary (1970) found that irrigation with 60 mm shortly before harvest increased the storage losses of fruits.

Storage Treatments

No significant differences between SO_2 treatment and control were realized in average weight loss. SO_2 treatment showed lower spoilage percentage in both varieties, in all locations, except for Helwani produced in Sweida. After 9 weeks of storage the average spoilage percentages for Helwani were 27.6 and 39.6 for SO_2 treated and non-treated respectively, and for Baladi 52.8 and 73.8 for SO_2 treated and non-treated respectively (Table 2).

Regarding total loss, the use of SO_2 decreased the total loss in both varieties produced in all vineyard locations, except Helwani produced in Sweida. After 9 weeks of storage the total loss being 33.5 and 44.9% for Helwani, 56.9 and 76.1% for Baladi for SO_2 treated and non-treated samples respectively (Table 2).

Table 1. Effect of production place, varieties and storage treatment on the losses rate (%) in grapes

Var.	Helwani									Baladi								
Treatments	Control			SO_2			Treat. Average			Control			SO_2			Treat. Average		
Storage loss (%) / Production place	W.L	S	T.L	W.L	S	T.L	W.L	S	T.L	W.L	S	T.L	W.L	S	T.L	W.L	S	T.L
Damascus	8.0a*	60.0a	63.0a	7.1a	3.5a	10.6a	7.4a	31.8a	36.8a	8.7a	47.5a	52.2a	8.6a	28.0a	34.0a	8.7a	37.8a	43.1a
Sweida	10.3b	45.0a	51.2b	12.2b	70.0b	73.6b	11.3b	57.5b	62.4b	15.0b	100b	100b	12.2b	77.5b	79.8b	13.6b	88.8b	89.9b
Daraa	7.2a	13.8b	20.4c	8.0a	9.3a	16.4a	7.8a	11.5a	18.4a									
Average	8.5	39.6	44.9	9.1	27.6	33.5	8.8	33.6	39.2	11.9	73.8	76.8	10.4	52.8	56.9	11.5	63.3	66.5

W.L = Weight Loss S = Spoilage T.L = Total Loss

*Values within a column followed by the same letter are not significantly different at the 95% confidence level.

The high spoilage rate in the Helwani produced in Sweida may be attributed to damaged fruit tissues. This damage is probably due to the accumulation of sulfur used by farmers for protection against powdery mildew known to spread under high humid conditions. Whereas, the other two locations are considered to be relatively dry. Jankovic and Djeric (1988) found that the best concentration of potassium sulfites (K_2SO_3) for grape storage was 1 g/kg. since higher concentrations of sulfur caused harmful injuries to the berries. The positive effect of the optimum concentration of SO_2 on stored grapes can be explained by the fact that SO_2 can kill mould and extend the shelf life of grapes during storage. Similar observation has been reported by Smilanick *et al.* (1990) who reported that SO_2 killed 99% of the spores of the fungus *(Botrytis cinerea).*

Comparison of varieties

Weight loss in Baladi produced in Damascus and Sweida was higher than Helwani produced and stored under the same conditions. After 9 weeks of storage the average weight losses being 11.1 and 8.8% for Baladi and Helwani respectively. The average spoilage in Baladi (63.3%) were higher than that of Helwani (33.6%) except for Helwani produced in Damascus and stored without SO_2, having higher spoilage (60%) than Baladi (47.5%). The average total loss of Helwani (39.2%) was lower than Baladi (63.3%) except for Helwani produced in Damascus, and stored without SO_2 treatment, which have higher percentage of total loss (63%), than Baladi (52.2%) (Table 2).

Al-Bachir and Sass (1987) and Sass (1993) indicated that storage losses and storability of grapes were variety dependent. They found that differences in storability between grape varieties were due to genetic characteristics and chemical properties. The high weight loss, spoilage and total loss in Baladi may be attributed to higher water content and thinner skin compared to Helwani (Hamed 1983).

Comparison of storage periods

Table 2 shows that there is an increase in weight loss along with storage times in both varieties in all locations, regardless of SO_2 treatment. Weight losses were 5.5, 6.7, and 9.7% for storage times 3, 6, and 9 weeks respectively. The increase in the rates of weight loss in the first 3 weeks may be attributed to high temperature of fruits, high respiration, and to the big difference in the water pressure between inside and outside the fruits (Sass 1993).

The spoilage percentage differed according to the variety, production place, and to SO_2 treatment. During the first 3 weeks of storage no spoilage was observed. The

average spoilage percentages were 6.7 and 45.5 after 6 and 9 weeks respectively (Table 2). A possible reason for not observing any spoilage during the first 3 weeks of storage may be due to the short time for spores to develop. In this context Sass (1993) reported a laboratory method in which mould fungi can be germinated during the first 10 days of storage. Hence one can predict the storability of grapes.

After 6 weeks of storage, spoilage was observed in both SO_2 treated and non treated samples but was less in SO_2 treated ones. The SO_2 treatment used in this study decreased fungal infection as reported by Smilanick *et al.* (1990), Asker *et al* . (1987), and Bouzid (1984).

After 9 weeks of storage, spoilage rates increased due to the spread of physiological and fungal diseases, since the efficiency of SO_2 treatment was largely reduced.

Similar trend was observed for total loss with the exception that total loss started in the first three weeks. The relative reductions being 5.5, 13.5 and 50% for 3, 6 and 9 weeks of storage respectively (Table 2).

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Table 2. Effect of storage period on the grape losses (%)

Var	Helwani												Baladi									Average		
Place	Damascus			Sweida			Daraa			Average			Damascus			Sweida			Average					
Storage/Loss period (5)	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L	W.L	S.	T.L
Control																								
3rd week	4.8a*	0.0a	4.8a	5.9a	0.0a	5.9a	4.4a	0.0a	4.4a	5.0a	0.0a	5.0a	5.3a	0.0a	5.3a	7.1a	0.0a	7.1a	6.2a	0.0a	6.2a	5.5a	0a	5.5a
6th week	6.7b	7.5b	13.5b	8.4b	16.3b	23.3b	6.2b	2.0b	8.0b	7.1a	8.6b	14.9b	7.4b	7.0b	13.9b	10.0b	17.5b	25.4b	8.7b	12.3b	19.7b	7.8b	10.1b	16.8b
9th week	7.8b	60.0c	63.0c	10.3c	45c	51.2c	7.5c	13.8c	20.4c	8.5c	39.6c	44.9c	8.7c	47.5c	52.1c	15.0c	100.0c	100.0c	11.9c	73.8c	76.1c	9.9c	53.3c	57.4c
SO_2																								
3rd week	4.5a	0.0a	4.5a	5.5a	0.0a	5.5a	4.9a	0.0a	4.9a	5.0a	0.0a	5.0a	5.3a	0.0a	5.3a	6.9a	0.0a	6.9a	6.1a	0.0a	6.1a	5.4a	0a	5.4a
6th week	6.1b	2.0b	8.3b	8.6b	8.8b	16.4b	6.5b	0.5b	6.8b	7.1b	3.8b	10.5b	7.0b	1.0b	7.1a	9.3b	4.8b	13.2b	8.2b	2.9b	10.4b	7.5b	3.4b	10.5b
9th week	7.1b	3.5b	10.6c	12.2c	70.0c	73.6c	8.0c	9.3b	16.4c	9.1c	27.6c	33.5c	8.6c	28.0c	34.0c	12.2c	77.5c	79.8c	10.4c	52.8c	56.9c	9.6c	37.7c	42.9c
Average control + SO_2																								
3rd week	4.7a	0.0a	4.7a	5.7a	0.0a	5.7a	4.7a	0.0a	4.7a	5.0a	0.0a	5.0a	5.3a	0.0a	5.3a	7.0a	0.0a	7.0a	6.2a	0.0a	6.2a	5.5a	0a	5.5a
6th week	6.4b	4.8b	10.9b	8.5b	12.5b	19.8b	6.4b	1.3b	7.4b	7.1b	6.2b	12.7b	7.2b	4.0b	10.8b	9.7a	11.1b	19.3b	8.5b	7.6b	15.1b	7.6b	6.7b	13.6b
9th week	7.4c	31.8c	36.8c	11.3c	57.5c	62.4c	7.8c	11.5c	18.4c	8.8c	33.6c	39.2	8.7c	37.8c	43.1c	13.6c	88.8c	89.9c	11.1c	63.3c	66.5c	9.7c	45.5c	50.1c

W.L. = Weight Loss S = Spoilage T.L = Total Loss

*Values within a column followed by the same letter are not significantly different at the 95% confidence level.

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قابلية بعض أصناف العنب للتخزين في سورية

محفوظ البشير

هيئة الطاقة الذرية السورية - دمشق- ص .ب (٦٠٩١) - سورية

يعتبر العنب من الفاكهة ذات الأهمية الاقتصادية الكبيرة في سورية ، ويحتل المركز الأول بين أنواع الفاكهة المزروعة محلياً ، وبالرغم من الأهمية الاقتصادية الكبيرة لهذا المحصول فإن المعلومات المستقاة من المؤسسات المعنية بتسويقه تشير إلى عدم توفر أية بيانات موثقة علمياً حول قابلية تخزينه . لذا تم اختبار قابلية ثمار الصنفين (البلدي والحلواني) المنزرعين في ثلاثة مواقع مختلفة في جنوب سورية (دمشق ، درعا ، السويداء) للتخزين . تم تخزين الثمار في غرفة مبردة باستعمال وعدم استعمال غاز ثاني أكسيد الكبريت (SO_4) وقد قدر الفاقد من الثمار في مراحل تخزين مختلفة ، وبينت نتائج هذه التجارب وجود علاقة عكسية بين ري الاشجار وكمية هطول الأمطار وارتفاع مواقع انتاج الثمار وقابليتها للتخزين ، حيث كانت قابلية تخزين الثمار المنتجة في موقع درعا أفضل منها للثمار المنتجة في الموقعين الاخرين اذ كانت نسبة الفقد ٤ ,١٨ و ٨ ,٣٦ و ٤ ,٦٢٪ للمواقع درعا ودمشق والسويداء على التتالي .

كما بينت النتائج ان قابلية ثمار الصنف الحلواني للتخزين أفضل منها لثمار الصنف البلدي ، اذ كانت نسبة الفقد ٤٩ و ٥ ,٦٦٪ للصنفين على التتالي ، وكان لاستعمال غاز ثاني اكسيد الكبريت أثر واضح في معدل الفقد الذي انخفض من

٤ ,٥٧ إلى ٩ ,٤٢٪ ، كما كان هناك علاقة طردية بين ارتفاع معدل الفقد وزيادة مدة التخزين حيث كان معدل الفقد ٥ ,٥ و ٥ ,١٣ و ٥٠٪ خلال مراحل التخزين ٣ و ٦ و ٩ أسابيع على التتالي .