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Effect of Ethanol on Berries Quality, Biochemical Content and Shelf Life of Red Globe Grapes

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ABSTRACT

Red Globe is one of the important seeded, bold berries and late ripening table grapes cultivar. Due to vagary in climatic variables, mainly temperature, moisture in soil and air affects the quality of grapes. Colour of berries is very relevant aspect in Red Globe grapes. so, the study was conducted at the Instructional Cum Research Farm, ICAR- National Research Centre for Grapes, Manjari Farm, Pune from December 2021 to February 2022 in order to determine the effect of pre-harvest spray of different concentration of ethanol (0%, 10%, 20%, 30%) on the berry quality, biochemical content, and shelf life of Red Globe grapes. Ethanol shows positive effect on color intensity and anthocyanin content as well as physical parameters including average bunch weight, 50 bunch weight, and berry diameter. Ethanol extends the shelf life of grapes when stored at room temperature. Grapes treated with ethanol (20%) recorded lowest rate of fallen berry and ethanol 30 % treatments decreases rate of rotten berry, PLW % and rate rachis browning at 1st, 3rd and 5th day of shelf life as compare to control.

Keywords: Ethanol, Red glob grape, Shelf life, Quality

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INTRODUCTION

Due to the high nutritional and economic worth grapes (*Vitis vinifera* L.) are the world's second most widely produced fruit crop. Over 90% of overall production in India is accounted for by Maharashtra (78.30 %), Karnataka (17.95 %), Andhra Pradesh (0.55 %), Tamil Nadu (2.02 %), Mizoram (0.62 %), Punjab (0.28 %), and Telangana (0.18 %) (Anonymous, 2019). Red Globe is a table grape variety developed at UC Davis in California, USA. It was introduced to India in 1985 and was recommended for cultivation after a multi-locational evaluation. The varieties big clusters, bold berry size (22-25 mm diameter), a red round shape, and meaty pulp. It is a late-ripening cultivar that matures in over 135 days after pruning. Climate of the region had a good positive effect on storage performance of the Red Globe (Gargin and Altindisli, 2016). Fruit yield is about 20-25 tons per hector.

Although grapes are known to be non-climacteric, ethylene is a plant hormone that must be produced at the commencement of ripening for most fruits to reach maturity (Barry and Giovannoni, 2007). Endogenous ethylene levels in grapes are low and decline from bloom to ripening but they may rise at veraison, causing an increase in respiration. Ethylene levels have been found to be low before and after veraison (Coombe and Hale, 1973). Implying that ethylene plays minimal role in grape ripening. Exogenous ethylene or ethylene generating growth regulators have different impacts on grapes depending on the rate, timing, cultivar, and area (Chervin *et al.*, 2004).

Sprays of aqueous ethanol may have a comparable effect of Ethephon (El Kereamy *et al.*, 2002). Ethanol has been shown to increase anthocyanin levels in cranberries (Farag *et al.*, 1992). While ethanol vapour has been proven to speed up tomato ripening (Beaulieu and Saltveit, 1997). According to studies, depending on the concentration and time of ethanol sprayed to grapes, the ripening process can be slowed or accelerated (Beaulieu and Saltveit, 1997). Spraying aqueous ethanol on grapes 8 to 13 weeks after bloom increased anthocyanin levels in berry skins, juice, and wines (Chervin *et al.*, 2001). Ethanol may increase the production of UDP-glucose flavonoid 3-O-glucosyl transferase, a key enzyme in the glycosylation of anthocyanins and other secondary metabolites, such as aroma and flavour components (El Kereamy *et al.*, 2002). The impact of ethanol pre-harvest spraying on Red Globe grapes was explored in this study, which focused on grape quality, berry biochemical content, and shelf life.

MATERIALS AND METHODS

The study was carried out at Research Farm, ICAR-National Research Centre for Grapes, Manjari Farm in Pune. The experimental site is located in Mid-West Maharashtra at an altitude of 559m above MSL at 18.32°N latitude and 73.51°E longitude. Pune has a tropical wet and dry climate, with typical temperatures ranging from 20 to 28°C. A mature irrigated Red Globe vineyard planted on Dogridge rootstock was employed for research. The rows of vines are 9 feet apart, and the plants are 5 feet apart. During the experiment, regular cultural operations were followed. The purpose of the study was to determine how ethanol affected the quality, biochemical content, and shelf life of Red Globe grapes. The experiment was planned using Randomized Block Design. Treatments viz. Control(T1), Ethanol 10 % (T2), Ethanol 20 %

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Table 1: Effect of ethanol on berry quality of Red Globe grapes

Treatment	Average Bunch Weight (gm)	50 Berry Weight (gm)	Berry Length (mm)	Berry Diameter (mm)	No. of Berries/ Bunch	Berry Firmness (%)	TSS (°Brix)	Acidity (%)
T1	404.2	380.00	21.33	22.00	52.18	76.33	18.3	0.53
T2	458.7	409.00	21.17	23.66	53.83	76.73	18.2	0.56
T3	465.0	452.33	22.67	24.83	54.33	81.33	19.2	0.57
T4	461.8	437.66	20.66	23.83	52.93	82.00	18.9	0.52
SE (m±)	15.35	10.69	0.51	0.2	1.26	2.33	0.45	0.005
CD @ 5%	47.32	32.95	NS	0.62	NS	NS	NS	NS

(T3) and Ethanol 30 % (T4). Ethanol with 99.9 percent of purity has been used with given doses. One-time application of ethanol treatments at veraison stage was given by dipping method.

Quality Parameters

Observations on quality of berries were recorded after harvest. Average bunch weight, 50 berry weight and number of berries per bunch was recorded on five bunch randomly selected per replication and their mean was recorded. Weight was estimated using weighing balance was expressed in grams. Ten berries were randomly selected from each replication for the measurement of berry diameter, berry length and Berry Firmness. Berry diameter and berry length was measured by using Vernier-calliper and average expressed in mm. Agrosta 100 Firmness Tester was used to measure the firmness in percentage. TSS and Acidity were measured in a homogenous sample made from these 15 berries per replication. Randomly selected berries were taken for juice extraction and TSS (°Brix) was determined using Hand Refractometer (DR 6000, A. Kruss Optronic GmbH, Hamburg, Germany). Acidity was determined by titrating berry juice with 0.1 N NaOH. Total acidity (g/L) was expressed as grams of tartaric acid per litre of juice then results were calculated in percentage of tartaric acid.

Biochemical Parameters

Folin-Ciocalteu method, as recommended by Singleton (1999), was used to measure total phenols and tannin using Gallic acid as a standard. The phenol concentration was measured in mg/g. The reducing sugar was estimated using the Dinitrosalicylic acid (DNSA) method, whereas total carbohydrate was determined using the Anthrone method with D-glucose as the standard (Sadasivam and Manickam, 1997). The colorimetric approach published by Bates (1973) was used to estimate proline content. The spectrophotometric absorbance of the extract at 420, 520, and 620 nm was used to calculate the color intensity (Glories, 1984). The anthocyanin content of the fruit samples was determined using Lee's technique (2005). Each treatment's means were used to tabulate the data collected on various metrics. SAS Version 9.3 was used to examine the data.

Shelf-Life Parameters

According to Crisosto *et al.* (2002) rachis browning wasnoted as follows: (0) green rachis (1) turning brown rachis (2) moderate browning of rachis (3) severe browning rachis (4) extreme browning of rachis was recorded at 1st day, at 3rd day and at 5th day. Number of fallen and rotten berry was also recorded at 1st day, at 3rd day and at 5th day. Physiological loss in weight (PLW %) was calculated by following formula.

$$\text{Physiological loss in weight (\%)} = \frac{\text{Initial weight of bunch - Final weight of bunch}}{\text{Initial weight of bunch}} \times 100$$

RESULTS AND DISCUSSION

Effect of ethanol on berry quality of Red Globe grapes

Quality Parameters such as average bunch weight (gm), 50 berry weight (gm) and berry diameter (mm) shows significant effect over different treatments. Ethanol spray with 20% observed highest bunch weight 465gm (T_3), highest weight of 50 berries 452gm (T_3) and highest berry diameter 24.83 mm (T_3) which was significantly superior other the treatments. (Chervin *et al.*, 2004) reported spraying of ethanol at 13 weeks post-flowering increased the berry weight by 10% at harvest without decreasing the °Brix value. (Chervin *et al.*, 2004) observed that ethylene perception, at this time is required for at least increasing berry grape diameter. The beginning of the second growth phase, berry growth is mainly linked to phloem fluxes but it is not excluded that some sap canes from xylem tissues on "Italia" table grapes (Colapietra and Alexander, 2006).

There is no significant difference between the treatments in terms of berry length (mm), number of berries per bunch, berry firmness (%), TSS (Brix) and acidity (%). Spray of Ethanol had no effect on the length or number of berries, according to the results (Table 1). Highest berry length observed in T_3 (22.67 mm) followed by T_1 (21.33mm), T_2 (21.17mm) while lowest berry length observed in T_4 (20.66 mm). Highest number of berries was observed in T_3 (54.33) as compare to control T_1 (52.18). These findings are supported to Zabadal and Bukovac (2006) who reported CPPU increased berry diameter more than it did berry length. Berry firmness was found highest in T_4 (82.00 %) and lowest in T_2 (76.33%) (Cantin *et al.*, 2007) reported that firmness of "Crimson seedless" grape remained unaffected by ABA and ethephon treatments.

TSS and acidity shows non-significant effect by the used foliar applications. Range of TSS between 18.27 to 19.22

Table 2: Effect of ethanol on biochemical content in Red Globe grapes

Treatments	Total Phenol (mg/g)	Total Tannin (mg/g)	Proline (µmoles/g)	Reducing Sugar (mg/g)	Color Intensity (%)	Anthocyanin (mg/100 g)
T1	0.47	0.8	1.75	55.32	4.96	17.36
T2	0.49	0.96	1.86	56.72	5.22	19.18
T3	0.51	1.07	1.92	58.08	6.12	20.08
T4	0.53	1.1	1.84	57.04	6.25	22.04
SEm±	0.01	0.11	0.13	2.44	0.07	0.46
CD@5%	NS	NS	NS	NS	0.22	1.42

°Brix and Acidity was 0.52 to 0.57 %. Peppi and Fidelibus (2008) reported that application of Abscisic acid or Ethephon had little effect on the soluble solids or acidity of the fruits.

Effect of ethanol on biochemical content in Red Globe grapes

Berry biochemical consists of total phenol, total tannin, proline, reducing sugar, colour intensity and anthocyanin. The data recorded on berry biochemical is presented in table 2. The differences of various biochemical *viz.* total phenol, total tannin, proline, reducing sugar among all treatments over control were non-significant. The treatment T_4 recorded highest total phenol (0.53 mg/g) followed by T_3 (0.51 mg/g) and T_3 (0.49 mg/g) whereas T_2 (0.47 mg/g) showed lowest phenol content. T_4 (1.10 mg/g) had the highest tannin content, followed by T_3 (1.07 mg/g) and T_2 (0.96 mg/g), with T_1 (0.8 mg/g) got the lowest tannin content. The highest proline content was found in T_3 (1.92moles/g), followed by T_2 (1.86moles/g) and T_4 (1.84moles/g), and the lowest proline level was found in T_1 (1.75 µmoles/g). T_3 shows highest reducing sugar concentration (58.08 mg/g), which was followed by T_4 (57.04 mg/g), T_2 (56.72 mg/g), and T_1 (55.32 mg/g).

Colour intensity and anthocyanin content varied significant result among the different treatments of Ethanol. Highest colour intensity observed in T_4 (6.25 %) which was at par with T_3 (6.12 %). It was followed by T_2 (5.22 %) and T_1 (4.96 %) shows lowest color intensity. Color intensity differences have been reported as a result of ethanol treatment (El Kereamy *et al.*, 2002). T_4 had the highest anthocyanin level (22.04 mg/100g), followed by T_3 (20.08 mg/100g) and T_2 (19.18 mg/100g), which were nearly identical, while T_1 (17.36 mg/100g) had the lowest. Farag *et al.* (1992) reported ethanol increased the anthocyanin content of cranberries when used in combination with Ethephon.

Effect of ethanol on shelf life of Red Globe grapes

The data on PLW (physiological loss in weight %) in grapes stored at room temperature is presented in table 3. In all the treatments, PLW (%) increased with the advancement in storage duration. The minimum physiological loss in weight was recorded in treatment T_4. The physiological loss in weight (%) in berries of control (T_1) increased rapidly on 1st day (2.13 %), on 3rd day (3.67%) and on 5th day (6.18%). When bunches treated with ethanol 30% (T_4) minimum physiological weight loss was observed on 1st day (1.15%), on 3rd day (2.16%) and on 5th day (4.74%) that bunches had more shelf-life period as compared to other treatments. Many research workers on other grape varieties, such as Al-Shoffe (2005) on the "Superior" variety, Ghawas (1997) on the "Flame seedless" and "Thompson seedless" had supported to the findings. Al-Qurashi (2013) reported ethanol spray especially at 20 % decreased weight loss compared to other treatments except for 10 % ethanol spray.

Fallen berry (%) recorded on 1st day (0.61), on 3rd day (1.87) and on 5th day (3.13) in T_3 and rotten berry (%) on 1st day (3.70), on 3rd day (5.55) and on 5th day (6.10) in T_4 it shows that less rate of fallen berry (%) treated with ethanol (20%) and ethanol (30 %) treatment decreases rate rotten berry at different dates of shelf life. Grapes treated with

Table 3: Effect of ethanol on shelf life of Red Globe grapes

Treatment	PLW %			Fallen berry %			Rotten Berry %			Rachis Browning		
	day 1st	day 3rd	day 5th	day 1st	day 3rd	day 5th	day 1st	day 3rd	day 5th	day 1st	day 3rd	day 5th
T_1	2.13	3.67	6.18	5.67	7.03	8.45	5.64	7.75	16.20	green	moderate brown	extrem brown
T_2	1.23	2.16	5.02	3.55	4.73	5.91	4.73	8.29	8.91	green	moderate brown	sever brown
T_3	1.55	2.29	4.87	0.61	1.87	3.13	3.75	6.24	7.50	green	moderate brown	sever brown
T_4	1.15	2.16	4.74	1.85	4.94	6.79	3.70	5.55	6.10	green	turning brown	sever brown
SEm±	0.04	0.07	0.09	0.14	0.15	0.17	0.08	0.09	0.33			
CD@5%	0.12	0.20	0.27	0.43	0.47	0.53	0.26	0.27	1.03			

ethanol (30%) recorded lowest rate of rachis browning at at different dates of shelf life. Cantin *et al.* (2007) evaluated similar results of berry shattering or fallen berry (separation from a cluster) for each cluster by subtracting the weights of detached berries from the overall cluster weight. Al-Qurashi *et al.* (2013) reported pre-harvest spray of CC and ethanol at both low and high concentrations significantly decreased berry decay percentage during storage compared to control.

CONCLUSION

In conclusion, this study shows significant results on color intensity and anthocyanin content as well as physical parameters including average bunch weight, 50 berry weight, and berry diameter. Ethanol extends the shelf life of grapes when stored at room temperature and it reduce decay incidence of berries. Grapes treated with ethanol (20%) followed by (30%) recorded lowest rate of fallen berry, PLW % and rachis browning at 1st, 3rd and 5th day of shelf life as compare to control.

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