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Assessment of coloured seeded grape varieties for optimal raisin production under semi-arid condition

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Abstract

Fifteen coloured grape varieties were evaluated for bunch and raisin parameters. Highest bunch weight (226.8 g) was noted in E-5/20 AES x BC, while Muscat Hamburg had the maximum no of berry/bunch (95.7). H-25/11 had a maximum 50 berry weight (174.6 g), and the highest carbohydrate content (395.7 mg/g). Black Champa, had the highest TSS (25.4°B), maximum raisins recovery (25.0 %), highest phenol (4.3 mg/g), tannin (5.4 mg/g) and Omania Black had the maximum amount of anthocyanin (1363.3mg/g) content. Maximum reducing sugar was found in raisins made from E-5/12 AES x BC (142.4 g/mg), while minimum reducing sugar was recorded in raisins from Rizamet (97.6 mg/g). The highest protein content in raisins was recorded in Foster Seedlings (47.3 mg/g). Based on sensory evaluation, accession Foster Seedlings and Red Muscat performed better than others. Among the accessions studied, Black Champa, Foster Seedlings and Red Muscat performed better in sub-tropical climates for raisin making.

Key words: Anthocyanin, carbohydrates, climate, organoleptic, raisins, varieties

Introduction

Grape (*Vitis vinifera* L) is one of the important fruit crops grown in India under a variety of soil and climatic conditions. Fruit is mainly processed to make wine, juice, raisins, and table grapes. Grapes are being grown on an area of 1,62,000 hectares with an annual production of 3490 thousand MT (Anon., 2022). Of the total production of grapes, around 26% is converted into raisins. It is been observed that raisin production has been a significant agro-industrial activity, providing a versatile and nutritious product that caters to both domestic consumption and international trade (Sharma and Somkuwar, 2020). Considering the country's diverse agro-climatic conditions and demand for dried grapes, the cultivation of grapes for raisin production holds immense potential. In Maharashtra, grape cultivation for raisin making is restricted to Solapur and Sangli district while in Karnataka state, Bijapur district is the major raisin grape growing belt. The quality of dried grapes is affected by weather conditions and drying conditions prevailing during the period of raisin making. In these regions, high temperature and low humidity coincide with the harvesting period (March-April) thus helping to produce quality raisins.

The production of high-quality raisins depends on various biotic and abiotic factors, with grape variety and colour being crucial factors. The colour of grape varieties not only affects the visual appeal of raisins but also influences their taste, nutritional content, and overall market value (Thakur *et al.,* 2010). While the quality attributes which are directly related to human health also play an important role in selecting the varieties for raisin making. It is well proven that raisins are not only a good source of vitamins and minerals, but they are also cholesterol and fat free, rich in antioxidants, and dietary fiber and contain 70% fructose that is easy to digest (Anderson and Waters, 2013). Besides uses of raisins in bakery products, the demand for black raisins is increasing at a faster rate. Traditional grape varieties mainly Thompson Seedless and its clones (Tas-A-Ganesh, Manik Chaman and Sonaka) are widely adopted by the grape growers for raisin making (Somkuwar *et al.,* 2023). The assessment of coloured grape varieties for optimal raisin production therefore holds substantial importance in enhancing both the quality and economic viability of the industry. An investigation was therefore carried out to evaluate colour grape varieties with the potential for optimal raisin production in semi-arid condition.

Materials and methods

The experiment was carried out at the Research and Developmental farm of ICAR-National Research Centre for Grapes, Pune (latitude 18°32N and longitude 73°51E) during the year 2022-23. A five-year-old grape vineyard consisting of colored accessions raised on Dogridge rootstock, planted at 9 ft x 4 ft spacing, and trained to a Y trellis system was selected for the study. The experiment was conducted in randomized block design. The vines were pruned twice a year, once after the harvest of the crop to promote shoot growth and fruit bud differentiation, a practice called back pruning. After the cane maturity (five to six months), the mature canes were pruned in October, a practice known as forward pruning that develop the bunch.

Quality parameters: The grapes were harvested after attaining more than 22^0Brix total soluble solids (TSS). The juice was prepared and a drop was placed on the mirror of the hand refractometer to measure TSS. The total soluble solids were measured and expressed as ^{0}Brix. A random sample was taken from each replication after the fruit harvest from individual vines to analyze fruit quality parameters as average bunch weight,

number of berries/bunches, 50-berry weight, berry length and berry diameter, TSS, acidity and pH. Five kg of grapes harvested from each accession were cleaned in water to remove the dust. The harvested grapes were then dipped in a solution of 15 mL ethyl oleate and 2.5 g potassium carbonate in 100-litre water for 8-10 minutes, and then kept under raisin shade. Moisture analyzers were used to assess daily moisture levels (wet basis) for all samples during the drying process up to 16% moisture. By twisting and gently rubbing against the slotted surface of the net, dried grapes were manually separated from the rachis and pedicels. Randomly 100 raisins were selected from each replication and weighed. The estimated recovery of the raisins was determined after the raisins were dried using the following formula.

Raisins Recovery = Weight of raisins/weight of fresh grapes x 100

Organoleptic test: A panel of 10 experts conducted sensory evaluations utilizing a five-point hedonic scale for the evaluation of standard organoleptic qualities. Various raisin quality characteristics, such as colour and appearance, flavour, texture, and general acceptability were included on the scorecard. A completely randomized approach was used to analyze the sensory score data.

Biochemical parameters: The raisin samples were collected to analyze various biochemical parameters. Folin-Ciocalteu method was used to determine the amount of phenol present. Total phenolic content was expressed in mg/g. The fruit samples were analyzed through dinitro salicylic acid to estimate sugar reduction. The Lowery method was used to estimate the amount of protein. Anthrone technique was employed to estimate total carbohydrate content. By using the Lee *et al.*(2005), the total anthocyanin content was determined. The data recorded for the studied parameters were analyzed and expressed as the mean standard deviation of three replicates (*i.e.*, data from three independent extracts produced from the same sample of raisins).

Results and discussion

Quality parameters: The data recorded on various quality parameters is presented in Table 1. Significant differences were recorded for quality parameters, *i.e.*, average bunch weight, 50 berry weight, number of berries per bunch, berry length and diameter, TSS, acidity, and pH. The germplasm E-5/20 (Anab-E-Shahi x Black Champa) had the highest bunch weight (226.8 g), whereas E-8-2 had the lowest bunch weight (87.9 g). The accession H-25-11 (174.6 g) recorded the maximum 50-berry weight, compared to the lowest by E-8-2 (55.1 g), Muscat Hamburg recorded the maximum number of berries per bunch (95.1), while Black Champa recorded the minimum berries (34.3). Among the accessions studied, the berry diameter ranged from 12.7 to 21.4 mm. Rizamet and Red Globe both had larger berries than the smallest in E-8-2 (12.7 mm). The shortest berry length was recorded in E-8-2, while H25-11 (24.8 mm) recorded the longest berry. During the raisins making, TSS is an important component as it directly affects the quality and recovery of the raisins. In the present investigation, Black Champa recorded a higher TSS (25.4 brix) than others. Pusa Navrang x Red Globe recorded the lowest acidity (0.46%), followed by Black Champa and Omania Black (0.47%), while the variety Rizamet recorded the highest acidity (0.77%). According to Barnuud *et al.* (2014), berries from warmer regions showed higher pH levels and lower levels of anthocyanins and acidity than berries from cooler regions. The highest juice pH was recorded in EC-552109 (3.91), followed by E5/12 (3.89), whereas the lowest pH observed in Red Globe (3.22). The drying duration ranged from 12.7 (H25-11) to 18.0 days (E 5/12), showing a substantial variation for the raisin drying period between the cultivars. Belessiotis and Delyannis (2010) suggested that the raisins have a final moisture content of 14% when exposed to a drying atmosphere. Regarding the recovery of raisins, significant variations between germplasm were found. Black Champa had the highest recovery of raisins

Table 1. Quantitative and qualitative characters of different grapes accessions for raisins making

Treatments	Average bunch wt (g)	50 berry wt (g)	Number of berries/ bunch	Berry diameter (mm)	Berry length (mm)	TSS (°brix)	Acidity (%)	pH	Drying duration (Days)	Raisin recovery (%)	100 raisins weight (g)
E 5/12(AES x BC)	119.3	94.0	67.8	16.5	18.0	21.9	0.65	3.89	18.0	22.2	120.8
E-520 (AES x BC)	226.8	155.5	73.0	19.3	21.4	22.9	0.60	3.61	17.3	21.1	112.4
E-7/22 (AES x CLB)	132.5	110.2	66.8	17.5	22.2	22.1	0.53	3.77	17.7	21.8	57.0
E-8-2	87.9	55.1	65.9	12.7	13.5	23.2	0.61	3.62	16.0	24.1	103.5
Muscat Hamburg	177.0	92.7	95.1	18.5	16.5	23.8	0.47	3.54	17.3	21.5	97.8
Foster seedlings	167.7	97.4	85.5	15.9	16.2	24.1	0.55	3.81	15.0	22.6	61.9
Red Muscat	122.3	120.3	53.2	14.6	21.0	22.3	0.62	3.45	17.3	24.5	94.1
Red Globe	184.0	168.3	55.5	20.4	20.3	23.8	0.53	3.22	16.0	23.4	135.8
Gulabi	154.7	149.0	59.7	16.1	21.5	23.9	0.64	3.42	16.0	23.4	72.6
PN x Red Globe	91.1	89.9	55.8	14.0	17.3	22.1	0.46	3.54	15.3	21.8	63.9
Rizamet	194.2	139.1	69.7	21.4	22.8	20.9	0.77	3.36	17.0	24.4	53.3
EC-552109	177.3	152.3	72.3	17.4	19.4	22.7	0.63	3.91	17.0	21.8	88.8
Black Champa	187.9	237.9	34.3	16.6	19.5	25.4	0.47	3.34	15.7	25.0	96.4
Omania Black	118.0	112.8	52.4	16.5	16.5	24.9	0.47	3.70	15.0	23.2	56.4
H25-11	131.2	174.6	37.5	18.0	24.8	24.1	0.52	3.38	12.7	22.2	63.5
SEm±	1.3	1.5	1.5	0.7	1.0	0.7	0.2	0.02	0.9	0.83	2.5
CD at 5%	3.9	4.4	4.3	1.9	2.8	1.9	0.1	0.06	2.7	2.42	7.3

(25.0%), followed by Red Muscat (24.5%) and Rizamet (24.4%). It was observed that raisin recovery is positively correlated to the TSS of fresh berries. A maximum weight of 100 raisins was recorded in Red Globe due to the large size of seeds inside the berry. Seeded varieties tend to be larger, which increases the weight of the raisins (Somkuwar *et al.,* 2023).

Biochemical status of grape accessions: The data recorded on various biochemicals present in the raisins is presented in Table 2. Total phenol content ranged from 2.3 mg/g to 4.3 mg/g. The variety Black Champa recorded highest phenol (4.3 mg/g) as compared to others. The Black Champa variety had the highest tannin level (5.4 mg/g), while the H25-11 variety had the lowest (2.8 mg/g). Significant differences were recorded for reducing sugar content in raisins. Maximum reducing sugar was found in E5/12 (Anab E Shahi x Black Champa) accession while minimum sugar was found in Rizamet (97.6 mg/g). The raisins made from different accessions had significant variations in carbohydrate contents. The raisins of H25-11 recorded the highest carbohydrate (395.7 mg/g), whereas Omania Black had the lowest level (211.8 mg/g). Raisins have glucose and fructose as the main sources of carbohydrates which is easly absorbed by the body. For kids, babies, with celiac disease, athletes, and those in situations where they need immediate energy, this is important source of energy. The heart, kidneys, brain, and other muscles (as well as the central nervous system), all require carbohydrates to function (Srilakshmi, 2006). The minimum protein content in raisins was recorded in E-8-2 (24.6 mg/g) while a higher protein concentration was recorded in Foster Seedlings (47.3 mg/g). Higher anthocyanin content in raisins was recorded in Omania Black (1363.3 mg/L) while the lowest anthocyanin content in Red Globe (437.7 mg/L). Black raisins recorded higher amounts of antioxidant activity. Additionally, compared to seedless samples, raisins with seeds had much higher phenolic contents and demonstrated stronger antioxidant properties (Shao *et al.,* 2016). According to Sharma *et al.* (2018), seeded varieties with coloured have greater antioxidant capabilities than the seedless types.

Organoleptic test: Foster Seedling (7.3) had the highest score for colour followed by Red Muscat (7.2). The accession E7/22 AES x CLB received the lowest grade for colour (5.8). Flavour scores for raisins made from Foster Seedling were higher (7.6) followed by Red Muscat (7.4), while E-8-2 received the lowest rating (6.4). The raisins of Foster Seedlings (7.6) and Red Muscat (7.5) received the highest marks for consistency. PN x Red Globe raisins (7.8) gained the maximum score for mouth feel, and for taste Muscat Hamburg and Red Muscat (7.5) recorded the highest score.

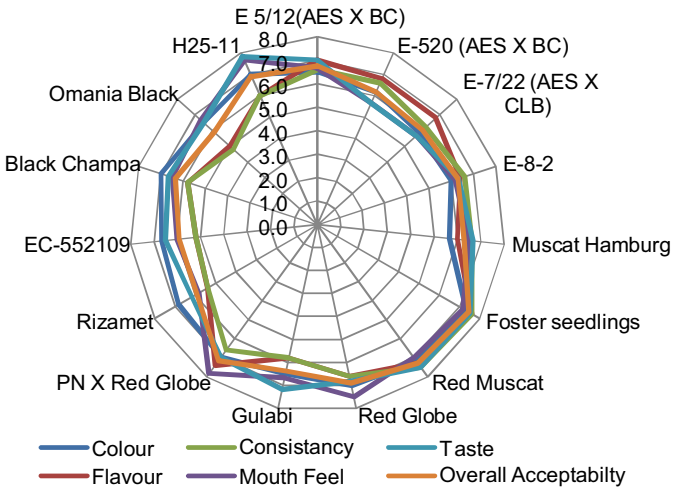

Fig. 1. Sensory score of raisins from different varieties

The study revealed that the Black Champa variety had the highest raisins recovery followed by Red Muscat (24.5%) and Rizamet (24.4%). Based on biochemical composition, Black Champa (4.3 & 5.4 mg/g) recorded the highest levels of phenol and tannin, while E-5/12 Anab E Shahi x Black Champa had the highest levels of reducing sugar (142.4 mg/g) and H-25-11 has the largest levels of carbohydrates (395.7 mg/g). Omania Black contained the highest concentration of anthocyanin (1363.3 mg/L). Based on sensory evaluation, Foster seedlings and Red Muscat recorded the best result as compared to others. Hence it is concluded that, Black Champa is suitable for raisins making in the sub-tropical region followed by Red Muscat and Foster Seedling.

Table 2. Biochemical composition of raisins prepared from different accession

Treatments	Phenol (mg/g)	Tannin (mg/g)	Reducing Sugar(mg/g)	Carbohydrate (mg/g)	Protein (mg/g)	Anthocyanin (mg/L)
E 5/12(AES x BC)	2.4	4.5	142.4	362.8	46.0	835.0
E-520 (AES x BC)	3.4	4.5	131.4	361.2	42.2	825.8
E-7/22 (AES x CLB)	3.6	3.5	120.1	325.0	41.9	700.1
E-8-2	2.3	3.7	171.3	314.3	24.6	638.7
Muscat Hamburg	4.1	5.3	106.8	377.9	46.2	1025.9
Foster seedlings	3.4	3.1	119.4	283.3	47.3	567.1
Red Muscat	3.0	3.4	115.1	271.6	33.3	476.8
Red Globe	3.2	3.4	105.7	281.7	31.3	437.7
Gulabi	3.4	3.2	121.1	296.5	28.8	656.9
PN x Red Globe	2.9	3.0	117.2	280.2	35.3	480.7
Rizamet	3.8	3.6	97.6	363.1	37.1	909.3
EC-552109	3.2	3.2	113.0	281.3	32.8	546.9
Black Champa	4.3	5.4	132.6	361.8	38.5	996.2
Omania Black	4.2	5.4	138.0	211.8	36.9	1363.3
H25-11	2.7	2.8	119.9	395.7	42.2	624.6
SEm±	0.1	0.3	4.2	4.2	0.9	20.1
CD at 5%	0.3	1.0	12.2	12.3	2.6	58.4

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