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Study on quality parameters of grapes (*Vitis vinifera*) and raisins affected by grape type

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ABSTRACT

Grape (*Vitis vinifera* L.) is one of the most important fruit crops of the country well known for health benefits. Varietal variations are recorded in quality of grapes and processed products. In present study 10 grape varieties (white seedless and colour seeded) were evaluated for properties of grapes and raisins. Bigger bunches were recorded in H-27 and closely followed by Manjari Naveen while maximum weight of 10 berries was observed in E8-5. Among these higher TSS was recorded in Manjari Kishmish (22.40°B) while Manjari Naveen variety was noted with minimum TSS (18.13°B). Raisin recovery was ranged from 22.88% in H-27 to 26.40% in Manjari Kishmish. Weight of 50 raisins was maximum in Carolina Blackrose (50.38 g) while Thompson Seedless was registered with minimum weight of 50 raisins. Raisins obtained from Kishmish Moldoski contained maximum reducing sugar (55.43 g/100 g) followed by Black Maladein (51.04 g/100g) while minimum reducing content in was recorded in raisins from Gulabi (31.93 g/100 g). Raisins from Manjari Kishmish contained higher protein (43.94 mg/g) and same raisins were found with maximum carbohydrate content (776.43 mg/g). Raisins obtained from grapes of H17 contained higher values of phenols and anthocyanins. Sensory studies showed that raisins obtained from Thompson Seedless scored maximum for overall acceptability while Carolina Blackrose was favored for color. Raisins of Manjari Naveen were found flavor and appreciated.

Key words: Anthocyanins, Dried grapes, TSS, Phenols, Organoleptic

Presently grapevines are spread in 6 out of 7 continents of planet, between latitudes 4º and 51º in the Northern Hemisphere (NH) and between 6º and 45º in the Southern Hemisphere (SH) across a large diversity of climatic conditions (Tonietto and Carbonneau 2004). In India grape production is mainly concentrated in tropical regions of Maharashtra and Karnataka states. Grape (*Vitis vinifera* L.) is one of the important commercial fruit crops grown in the country. India produces 2.95 million tons of grapes from 0.139 million ha area with productivity of 21.28 t/ha (Anonymous 2020). In India, the fruit is consumed as table grapes (71%) or for the preparation of different products such as raisins (27.0%), wine (1.5%) and other products (0.5%) like juice (Sharma *et al*. 2018). Due to immense potential of raisins in improving human's immune system, its demand is increasing year by year (Sindhu and Radhai Sri 2015). Drying is one of the old processes for longer shelf life. Nowadays, dried grapes are becoming more popular in diet due to their pro-healthy compound (Jeszka-Skowron *et al*. 2017). The dried product called raisin is rich in carbohydrates, antioxidants, flavonoids, phenolic acids and vitamins in the concentrated form compared to the fresh grapes (Bennetta *et al*. 2011). Black raisins have high erphenolic compounds and high antioxidant activity among the dried food products (Karakaya and Tas 2001). In India, raisins are mainly produced in Sangli, Solapur and Nashik districts of Maharashtra and Vijayapura and Bagalkot districts of Karnataka. Thompson Seedless and its clonal selections (Tas-A-Ganesh, Sonaka, Manik Chaman etc.), Sharad Seedless and its clonal selections (Krishna Seedless, Sarita Seedless, Nanasaheb Purple Seedless, etc.) are used for raisin preparation (Sharma *et al.* 2018). Since, these varieties are also used for export and local consumption, the alternate sources for raisin preparation needs to be explored. Considering importance and demand of coloured seeded raisins, an attempt was made to evaluate performance of potential germplasms under present investigation.

MATERIALS AND METHODS

The experiment was conducted at experimental farm of ICAR-National Research Centre for Grapes, (latitude 18°32′N and longitude 73°51′E), Pune during 2014-15. Fourteen year old vines of grape germplasms raised on Dogridge rootstock were selected for the study. These vines were spaced at 10 feet between rows and 6 feet between vines, thus accommodating 726 vines per acre.

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Vines were trained on Y system of raining. All the standard recommended cultural practices were followed during the period of study. The germplsams used for evaluation purpose were Gulabi, E-8-31, E-8-5, H-27, Carolina Blackrose, Kishmish Moldoski, Black Maledein (Colour Seeded) and white seedless as Manjari Naveen, Manjari Kishmish and Thompson Seedless.

Five randomly selected bunches were used to calculate average bunch weight in each replication. For recording data on 10 berry weight, 10 berries were collected from different parts of bunches. In each replication 5 sets were prepared and average value was used for a replication. The assay of total soluble solids (TSS) and total acidity (TA) was done by extracting juice from crushed berries and centrifuged at 5000 rpm for 5 min. For this purpose, OenoFoss (FTIR based wine analyzer) was utilized. One kg fresh grapes were dipped in an emulsion of 2.5% potassium carbonate and 1.5% ethyl oleate for 2 min and subsequently dried under raisin shade. When the moisture content of dried grapes was reached less than 16%, final weight was recorded and raisin recovery was calculated by using the formula:

Raisin recovery = weight of raisins/weight of fresh grapes ×100

Dinitrosalicylic acid (DNSA) method was used for the estimation of reducing sugar while, total carbohydrate was determined using Anthrone method with D-glucose as the standard (Sadasivam and Manickam 1996). Protein content was estimated according to method suggested by per Lowry *et al.* (1951) and was expressed in mg/g. The phenols were determined by Folin-Ciocalteu method as suggested by Singleton and Rossi (1965) using gallic acid as standard. The concentration of phenols was expressed in mg/g. Total anthocyanin content was determines by following pH differential method suggested by Lee *et al*. (2005)

To assess the sensory qualities of raisins, organoleptic test was conducted. The raisins prepared in this study were served to panel consisting of 20 semi trend members of diverse age group. Five point Hedonic scale was adopted to generate the data on sensory properties. The scale used for the test ranged from dislike extremely to like extremely. The sensory parameters such as color, texture, flavor, sweetness, test etc. were selected for the evaluations.

The experiment was conducted in randomized block design with 10 germplasms as treatments replicated three times. The data recorded on various parameters was tabulated using means of each treatment. The data was analyzed using SAS version 9.3.

RESULTS AND DISCUSSION

Significant differences were recorded for bunch weight, berry weight, *p*H, acidity, raisin recovery and weight of 50 raisins in all the studied germplasms (Table 1). Average bunch weight ranged from 122.00 to 301.23g. Maximum bunch weight was recorded in H-27 while it was minimum in Black Maledein. Weight of 10 berries also showed significant differences. Weight of 10 berries was found lowest in Kishmish Moldoski (19.68 g) while highest weight was recorded in E8-5 (48.60 g). Manjari Kishmish recorded highest total soluble solids (22.40°B) followed by Black Maledein (22.30°B), Thompson Seedless (22.27°B) while the variety Manjari Naveen recorded lowest TSS of 18.13°B. The juice *p*H ranged from 3.17 (H-27) to 3.87 (E8-31). Total acidity among the different grape varieties ranged between 5.33 g/L in Manjari Naveen to 6.17 g/L in Gulabi. The raisin recovery ranged from 22.88% (H-27) to 26.40% in Manjari Kishmish. The data on 50-raisin weight recorded at 16% moisture showed significant differences with minimumin Thompson Seedless (45.60 g) followed by Manjari Kishmish (45.70 g), Black Maledein and Gulabi (46.70 g each respectively) while the variety Carolina Blackrose was observed with maximum 50-raisin weight (50.38 g). TSS content in berries is an important parameter and directly related to quality and recovery of raisins. Christensen and Peacock (2000) stated that the optimal minimum value for TSS for Thompson Seedless grapes, measured before drying into raisins, should be above 19° Brix. The pH of fresh grapes is always acidic as during drying process the water content of grapes get evaporated

Table 1 Performance of grape germplasms for properties related to bunch, berries and raisins

Name of germplasm	Bunch wt (g)	10 berry wt. (g)	TSS (°Brix)	Juice *p*H	Acidity (g/L)	Raisin recovery (%)	50 raisin wt. (g)
H-27	301.23	30.66	22.23	3.17	5.48	22.88	48.47
Black Maldelein	122.00	22.46	22.30	3.27	5.50	23.65	46.70
Kishmish Moldoski	160.00	19.68	22.17	3.27	5.50	24.73	49.43
Gulabi	203.33	27.80	22.10	3.70	6.17	23.02	46.70
Carolina Blackrose	223.67	33.71	21.57	3.73	5.53	22.97	50.38
E8-31	132.33	24.63	20.47	3.87	5.50	23.57	48.73
E8-5	249.33	48.60	22.20	3.67	6.10	24.10	49.60
Thompson Seedless	251.67	25.50	22.27	3.60	5.50	25.03	45.60
Manjari Kishmish	216.67	25.07	22.40	3.63	5.57	26.40	45.70
Manjari Naveen	300.00	26.00	18.13	3.53	5.33	24.20	48.30
LSD (P=0.05)	8.20	0.53	0.34	0.21	0.15	0.44	0.92

leading to more acidity (Mahmutoglu *et al*. 1996). During the ripening stage, high temperature under tropical condition might be helping to increase the sugar and reducing the acids. Barnuud *et al*. (2014) reported that at a common maturity of 22° Brix TSS, berries from the warmer regions had low levels of anthocyanins and acidity as well as high *p*H compared to berries from the cooler regions. It was observed that increase in 50 raisin weights was directly correlated to TSS and berry weight. The highest 50 raisin weight was observed in Carolina Black Rose (50.38 g). Our results are in accordance with Christensen *et al.* (1995) who demonstrated that weight of raisins is correlated to the fresh berry weight and the soluble solids available in fresh grape berry. TSS content of berries decides raisin recovery with positive correlation. Most studies have demonstrated that it is the single most important fresh fruit characteristic to correlate with raisin quality. Somkuwar *et al*. (2019) also observed varietal effects on various grape and raisin quality parameter and raisin recovery. They found Manjari Kishmish a promising variety in case of raisin recovery when compared with Thompson Seedless, Black Monukka, Kishmish Rosavis, Clone 2A, etc. Kanthakumari and Maheshwari (2006) also observed effect of grape varieties on quality and yield of grapes and raisins.

The data on biochemical constituent's of raisins made from different grape varieties are presented in Table 2. Reducing sugar ranged from 31.93-55.43 mg/g. The variety Gulabi recorded lowest reducing sugar of 31.93 mg/g while Kishmish Moldoski was recorded with highest amount of reducing sugar (55.43 mg/g). Protein content in raisins was ranged from 35.43mg/gto 43.94 mg/g. Raisins from Black Maledein recorded with protein content followed by E-8-31, Kishmish Moldoski while Manjari Kishmish was recorded with maximum protein content. Total carbohydrate content was ranged from 776.43 mg/g in Manjari Kishmish followed by Manjari Naveen (772.25 mg/g) and Thompson Seedless (732.05 mg/g), while the variety E-8-5 recorded with lowest carbohydrate content(555.29mg/g).Thompson Seedless recorded lowest concentration of phenols (0.12 mg/g) while H-27 recorded highest concentration of phenols (1.64 mg/g). Higher anthocyanin content in raisins was recorded in H-27 (0.93 mg/g) followed by E-8-31 (0.27 mg/g), E-8-5 (0.18 mg/g) while the variety Manjari Kishmish and Manjari Naveen recorded with lower anthocyanin content of 0.01 mg/g. Preparation of raisins from fresh grapes is the process of drying in which the berries lose water. The variations in biochemical content in raisins affected by different type of grapes which were dried and it is clearly observed in present study also. Thompson seedless is ruling variety

Table 2 Biochemical constituents of raisins prepared from identified germplasms

Name of germplasm	Reducing sugar (g/100 g)	Protein (mg/g)	Total carbohydrate (mg/g)	Phenols (mg/g)	Anthocyanin content (mg/g)
H-27	36.44	37.89	651.17	1.64	0.93
Black Maledein	51.04	35.43	654.61	1.07	0.12
KishmishMoldoski	55.43	37.37	669.96	1.21	0.04
Gulabi	31.93	38.87	653.16	0.97	0.12
Carolina Blackrose	39.27	41.89	650.54	1.12	0.14
E8-31	36.80	36.15	558.73	1.15	0.27
E8-5	38.33	40.48	555.29	1.07	0.18
Thompson Seedless	40.69	43.18	732.05	0.12	0.04
Manjari Kishmish	44.22	43.94	776.43	0.69	0.01
Manjari Naveen	40.53	43.00	772.25	0.97	0.01
LSD (P=0.05)	1.43	1.64	3.30	0.30	0.03

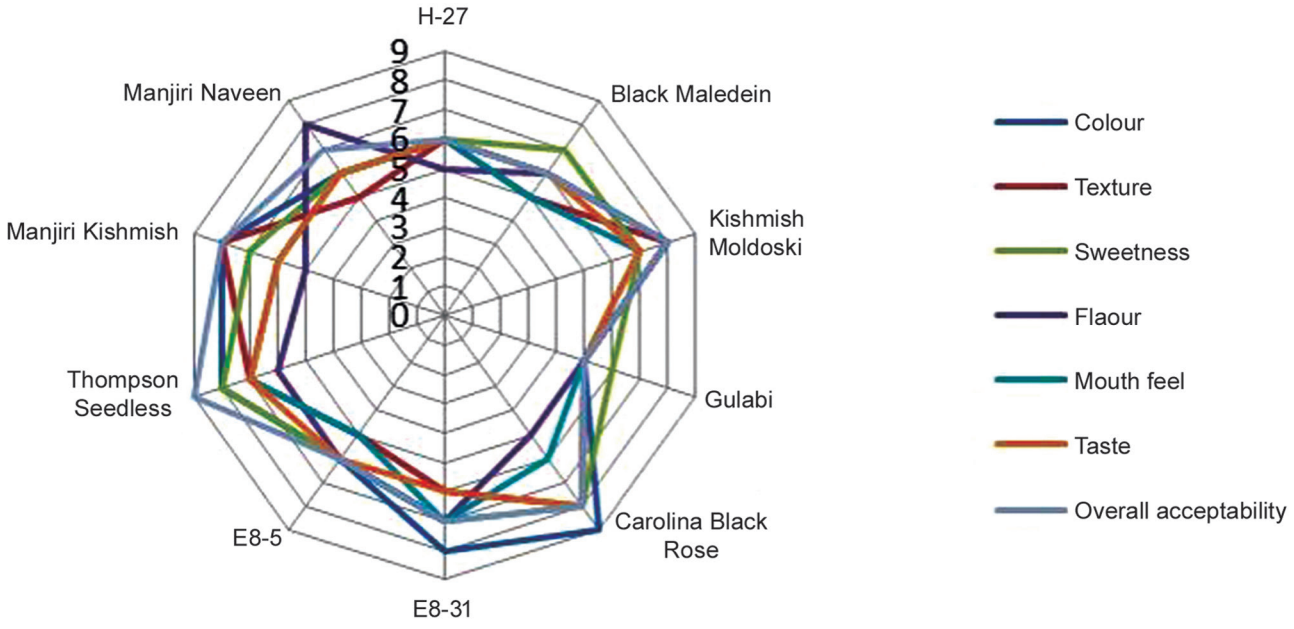

Fig 1 Sensory properties of raisins

widely grown in the world for raisin production, but darker coloured grapes and raisins are often perceived to having high levels of antioxidants and perceived to be healthier. Black raisins contained significantly higher values of TP and antioxidant activities than reddish-brown and yellowish-green raisins. Moreover, seeded raisins contained much higher phenols and showed better antioxidant activities than seedless samples (Shao *et al*. 2016). Black seeded grapes contain phenols in seeds and skin so the raisins made from black seeded grapes were found with higher content while raisins obtained from white grapes like Thompson Seedless, Manjari Naveen and Manjari Kishmish. Same type results were obtained by Shao *et al.* (2016) and noted large variations in phenolic compounds and their contents among different raisins. Sharma *et al*. (2018) stated that the coloured seeded varieties have higher antioxidant properties than seedless varieties.

Organoleptic study revealed that variety E8-31 and Carolina Blackrose was preferred for raisins colour as compared to other varieties. The raisins made from varieties, viz. Black Maledein, Kishmish Moldoski and Gulabi were considered better for sweetness (Fig 1). Overall acceptability was ranked maximum in Thompson Seedless followed by Manjari Kishmish. Manjari Naveen was scored maximum in terms of flavor. Kanthakumar and Maheshwari (2006) stated that taste and overall acceptability of raisins are affected by grape varieties also when they compared raisins of Madhu Angur and Thompson Seedless.

Grape growing is spreading in very wide climatic and soil conditions. Dried grape production is adopted as business worldwide and having high demand for various types of food industries but requiring different quality for different purposes. Varietal behavior under tropical conditions has been evaluated along with quality of raisins. It was observed that total sugars played a major role in raisin recovery. The variety Manjari Kishmish recorded highest raisin recovery of 26.40% as compared to other germplasms in this study. Black seeded varieties contained higher phenols and anthocyanins, showed more nutraceutical values. Considering organoleptic study, overall acceptability was higher in Thompson Seedless, while Carolina Blackrose was favored for color of raisins. Raisins from Manjari Naveen were having flavor as it is transferred from grapes. These studies can further be explored for utilization of dried grapes considering their quality, yield and specific character.

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