Physico-chemical and mineral composition of white seeded raisin varieties (*Vitis vinifera* L.) grown under semi-arid condition

Abstract

Raisins (dried grapes) are preferredfor their distinctive, delightful flavor, high nutritional content, and their potential to lower the risk of several serious and chronic conditions. The quality of raisins is crucial, as it has a direct impact on the health and well-being of those who consume them. The present study assessed the physiochemical composition, mineral content, and sensory parameters of white seeded raisins. The physiochemical parameters such as raisin weight, raisin recovery, *p*H, moisture, ash, carbohydrate, protein, and mineral content (potassium, phosphorus, calcium, magnesium, sodium, copper, iron, and zinc) were assessed. Result revealed that the grape variety Pandhari Sahebi showed higher raisin weight and protein content. Hussain Kadu recorded maximum moisture and carbohydrate content. Significantly, higher potassium and iron content was noted in Hussain Kadu. Based on the results, Hussain Kadu was preferred for raisincolour, texture and overall acceptability.

Keywords: Raisins, Minerals, Health benefit, Physicochemicalcomposition.

Introduction

Health and nutrition are the key factors that contribute most significantly to human development. Epidemiological research has consistently found that a diet high in fruits and vegetables is associated with a reduced risk of many chronic diseases (World Health Organization, 2008; Fang et al., 2010). Chronic diseases, or non-communicable diseases are long-term health issues that develop gradually and are often affected by lifestyle. Worldwide, these conditions including cardiovascular diseases, diabetes, cancer, and respiratory illnesses, significantly impact health, contribute to high rates of illness and death, and drive-up healthcare expenses. Raisins (*Vitis vinifera* L.) have been a popular food since 1490 BC because of their nutritional benefits and high micronutrient content (Restani et al., 2016).In India, grapes are primarily consumed as table grapes (71%), while a smaller portion is used to make various products such as raisins (27.0%), wine (1.5%), and other items (0.5%), including juice (Somkuwar et al., 2020). Raisins are prepared by drying grapes through various methods, including sun drying, natural air drying, or mechanical oven drying. Additionally, they can be artificially dried, dipped, or treated with sulfur dioxide to produce golden raisins. It wasone of the most significant and widely enjoyed dried fruits globally due to its high nutritional value

(Mnari et al.,2016). Raisins provide a rich supply of folic acid, pantothenic acid, vitamin B6, and other essential vitamins required for human nutrition. They are also a valuable source of calcium, magnesium, phosphorus, iron, copper, and zinc. Raisins, like other dried fruits, are concentrated source of carbohydrates, with approximately half of their available carbohydrates being fructose. They offer both soluble and insoluble fiber in amounts that significantly contribute to daily fiber intake, supporting cardiovascular health, reducing cancer risk, and alleviating constipation. Raisins also contain fructo-oligosaccharides (fructans), which function as probiotics and support colonic health. Furthermore, raisins are an excellent source of antioxidants, which provide strong protection against cardiovascular disease, aid in cancer recovery, and help alleviate constipation.Additionally, raisins contain no fat which is beneficial for human nutrition (Bongers et al., 1991). Their low moisture content, high soluble solids, and low pH make them naturally stable and resistant to spoilage. Due to immense potential of raisins in improving human's immune system, its demand is increasing year by year (Sindhu and Radhai Sri, 2015).Considering nutritional importance and raisins demand, an attempt was madeto analyze physicochemical and nutrient content of raisins under present investigation.

Material and methods

The experiment was conducted at the experimental farm of ICAR- National Research Center for Grapes, Pune (latitude 18°32'N and longitude73°51'E) during 2022-2023. Nine-year-old vines of grape germplasm raised on Dogridge rootstocks were selected for this study. All the standard recommended cultural practices were followed during the period of study. The raisin varieties used were Angoor Kalan, Cheema Sahebi, Aledo, Dilkhush, Cardinal, Phakdi, Muscat Petit Grains, E-10-34 (Thompson Seedless × Catawba), Pandhari Sahebi, Hussain Kadu, Spin Sahebi, F-26-8,EC- 552020, and EC-552109. One kilogram of fresh grapes was immersed in an emulsion containing 2.5% potassium carbonate and 1.5% ethyl oleate for 10 minutes. The grapes were then dried in the shade for 14-15 days until the moisture content of the dried raisins reached 16%. At this point, the final weight was measured, and the raisin recovery was determined using the appropriate formula:

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

Moisture content in the raisin sample were measured using moisture analyzer of LCGC (Model axis). Raisin pH wasestimatedaccording to AOAC methods (2000)using a pH-meter. To estimate ash content, drying the raisin sample (5g) at 100°C and churned over an electric heater.

The ash was then collected in muffle furnace at 550°C for 5 hrs.24. Ash content was calculated using the following formula:

Ash content (%) = Weight of ash (g)/Weight of sample (g) X 100

To determine the biochemical, anthrone method with D-glucose as the standard was used to estimate carbohydrate (Sadasivam and Manickam, 1997) while,protein estimation was done usingLawry et al. (1951) method and was expressed in mg g-1. The estimation of phosphorus was made by Vanadomolybdatecomplex method by using Spectrophotometer. Zn, Fe and Cu were determined by direct feed digested sample on AAS by atomic absorption spectrophotometer. Mg, Ca, K and Na were determined by atomic absorption spectrophotometer.

A sensory evaluation of raisins was carried out by organoleptic test. The prepared raisins were served to a panel of twenty semi-trend members across a wide range of age groups. The Hedonic nine-point scale was used to collect data on sensory attributes. The scale used for the test ranged from dislike extremely to like extremely. The sensory parameters such as colour, texture, flavor, sweetness, test, and overall acceptability were selected for the evaluations.

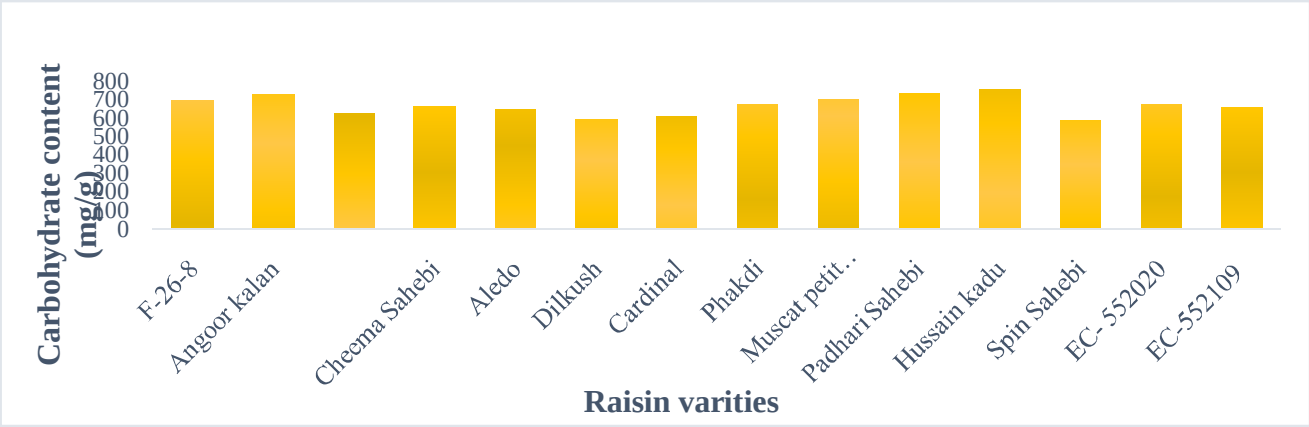
All parameters were determined in triplicate for each sample. The data recorded on various parameters was calculated using means of each treatment. Statistical analysis was performed with SAS (9.3).Analysis of variance (ANOVA) was used to assess the significance of differences among the various raisin varieties.

Result and discussion

Significant differences were recorded for 50-raisin weight, raisin recovery, *p*H, moisture content, ash content, carbohydrate, and protein content in all the studied raisin varieties (Table 1). The highest value for 50-raisin weight was recorded for Dilkhush variety (56.13± 5.7g), while the lowest value was noted in Cheema Sahebi (33.38± 2.4g). Raisin recovery ranged from 20.95 to 26.17%. Maximum raisin recovery was recorded in Angoor Kalan while it was minimum in EC-552109. Different grape varieties had varying impacts on various quality parameters of raisins, as well as on raisin recovery (Somkuwar et al., 2020). The raisin pH content ranged from 3.27±0.3(Phakdi) to 4.08±0.6 (Angoor Kalan). The present study confirms the results of Mahmutoglu et al. (1996) who reported thatthe pH of fresh grapes is always acidic as during drying process the water content of grapes get evaporated leading to more acidity.The differences in physical attributes observed among the samples could be attributed to factors such as their origins, cultivars, growing conditions, cultural practices, harvest timing, climatic

conditions, as well as variations in processing methods and conditions during grape drying, treatment, storage, grading, packaging, and transportation. In the presentstudy, moisture content of raisin varied between 13 to 16 % in almost all the varieties of raisin. As per codex standards the limit of moisture content in raisin is defined less than 18 % for storage. Our results are in accordance with the result of Sharma et al. (2018) who recorded moisture content ranging between 9 to 16% in imported raisin varieties. Moisture content is a crucial parameter that affects mouthfeel and taste. If moisture levels fall below 14 percent, the product can become hard, while levels above 18 percent can lead to microbial contamination. The ash content present in raisins gives the total mineral content in it. Ash content of the raisin ranged from 3.454±0.052 to 7.526±0.323%. Maximum ash content was noted in Cheema Sahebi, while minimum in Angoor Kalan. The ash content in these raisins are comparable with the ash content of imported raisin as reported by Sharma et al. (2018).

Fig 1: Carbohydrate content (mg/100 g DW) of different white seeded raisin samples.



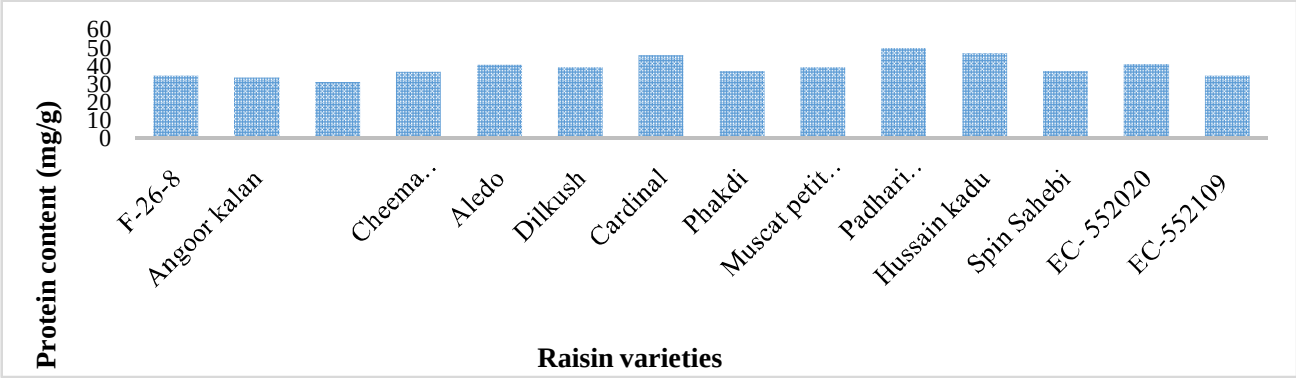


Fig 2: Protein content (mg/100 g DW) of different white seeded raisin samples.

The data on biochemical composition of raisins made from different grape varieties are presented in table 1, Fig 1 and 2. Total carbohydrate content was ranged from 755.63±10.95mg/g in Hussain Kadu followed by Pandhari Sahebi (734.6±11.21mg/g) and Angoor Kalan (721.67±10.42mg/g), while lowest carbohydrate was noted in Dilkhush variety (586.85±13.56). Protein content in raisin ranged from 30.89±6.71mg/g(E-10-34 ie., Thompson Seedless × Catawba)) to 49.56±7.53mg/g(Pandhari Sahebi)). The process of making raisins from fresh grapes involves drying, which results in the loss of water from the berries. The study clearly shows that variations in biochemical content of the raisins are influenced by the type of grapes used for drying.

Table 1: Physical parameters of white seeded raisin samples.

Accession name	50 raisin weight (g)	Raisin recovery (%)	Juice pH (%)	Moisture content (%)	Ash content (%)	Carbohydrate content (mg/g)	Protein content (mg/g)
F-26-8	34.61±3.4	24.8±0.40	3.91±0.2	13.54±0.23	7.315±0.045	689.45±12.78	34.51± 8.91
Angoor Kalan	37.89± 3.7	26.17±0.78	4.08±0.6	13.98±0.18	3.454±0.052	721.67±10.42	33.21±5.60
E-10-34 (Thompson Seedless × Catawba)	39.51± 7.1	24.67±0.16	3.69±0.4	14.67±0.63	5.718±0.092	625.63±11.23	30.89±6.71
Cheema Sahebi	33.38± 2.4	24.28±0.86	3.58±0.3	15.23±0.21	7.526±0.323	659.02±12.78	36.72±5.89
Aledo	37.52±2.1	23.42±0.40	3.46±0.4	13.45±0.32	4.05±0.403	643.21±9.80	40.51±7.13
Dilkhush	56.13± 5.7	22.45±0.47	3.36±0.3	14.73±0.18	3.801±0.141	586.85±13.56	38.93±8.16
Cardinal	40.44± 6.6	22.59±0.59	3.46±0.1	14.91±0.11	4.771±0.061	610.93±12.89	45.67±10.76
Phakdi	37.74± 2.9	25.19±0.74	3.27±0.3	13.12±0.23	5.958±0.123	675.48±12.04	36.75±8.45
Muscat petit grains	38.41± 5.1	22.09±0.29	3.43±0.4	14.62±0.13	5.924±0.083	703.4±13.41	38.97±6.31
Pandhari Sahebi	54.98± 4.3	22.67±0.31	3.64±0.5	13.84±0.19	5.236±0.201	734.6±11.21	49.56±7.53
Hussain Kadu	42.25± 3.2	23.11±0.57	3.44±0.1	15.76±0.31	4.098±0.216	755.63±10.95	46.78±6.33
Spin Sahebi	37.10±2.1	24.45±0.47	3.71±0.4	14.55±0.43	3.482±0.043	589.04±11.67	36.78±5.34
EC- 552020	44.32±1.8	24.6±0.41	3.51±0.1	14.81±0.37	5.999±0.122	673.81±13.41	40.89±6.13
EC-552109	49.28± 4.6	20.95±0.25	3.46±0.3	13.78±0.27	4.192±0.024	658.93±10.45	34.61±6.78

Values were expressed as Mean ± SD; n=3

Nutritional qualities of white seeded raisin

The white seeded raisin samples were analyzed for important mineral nutrients like potassium, sodium, calcium, magnesium, zinc, copper, and iron (Table 2). The raisin samples exhibited high potassium levels as compared to other macronutrients.Among the different raisin varietiesstudied; maximum potassium content was noted in Hussain Kadu (1.246±0.09%) followed by ……. while minimum in EC-552109 (1.237±0.046%). Similarly, Sharma et al. (2018) reported 0.396 to 0.861% potassium content in imported raisin while Gary and Arianna (2010) reported7.47 mg/g potassium content in seedless raisin. Potassium is an essential macronutrient for human health. It regulates the heartbeat, ensures proper function of the muscles and nerves, and is vital for synthesizing protein and metabolizing carbohydrates. A diet high in potassium helps to lower blood pressure and decreases the risk of cardiovascular disease and related deaths (Gharibzahedi and Jafari, 2017). The range of sodium content varied from 0.077±0.005 (Cardinal) to 0.113±0.018 (EC-552109). He and MacGregor (2008) found that potassium intake reduces urinary calcium loss and lowers the risk of osteoporosis. Additionally, it mitigates the adverse effects of sodium by helping to regulate blood pressure. The calcium content was found to be in the narrow range of 0.055±0.003 to 0.072±0.004% in the different raisin cultivars. The result clearly showed that the raisin samples contained magnesium (Mg) concentrations in the range of 0.153±0.007 to 0.201±0.006%. Magnesium plays an importantrole in maintaining bone integrity and growth, controlling the cardiac cycle, and facilitating the function of muscles and nerves. Our results are similar from those reported by Sharma et al. (2018). The phosphorus content ranged from 0.054±0.009 (Phakdi) to 0.262±0.023 (EC- 552020).Simsek et al. (2004) explained that variations in the mineral content of raisin concentrate samples are not only due to the composition of the fruit and growing conditions but also to inappropriate extraction conditions such as extraction time, temperature, and inadequate crushing. The zinc content of the raisin sample showed large variation from 3.301 to 5.051ppm with rest of varieties having intermediate values. Maximum copper content was noted in Dilkhush (3.552±0.173ppm) followed by Hussain Kadu (3.525±0.275ppm) while minimum in E-10-34 (Thompson Seedless × Catawba) (1.775±0.309ppm). Zinc is crucial for various cellular processes, as it is necessary for the function of numerous enzymes. It also contributes to improving immune response, synthesizing proteins and DNA, healing wounds, and regulating cell signaling and division. Zinc aids in proper

growth and development throughout pregnancy, infancy, childhood, and adolescence, and it also plays a role in maintaining the sense of taste (Ryu and Aydemir, 2020). The iron content of the raisin samples varied significantly among the different raisin varieties from 59.361±5.231 to 71.736±5.831ppm. . Raisin's high iron content is considered advantageous for women, who often experience iron deficiency and anemia. Iron is crucial for the formation of hemoglobin, which carries oxygen in the blood. These findings confirm the significant role those consuming raisins at recommended amounts plays in supporting human health.

Table 2. Nutritional parameter of white seeded raisins.

Accession name	P content (%)	K content (%)	Na content (%)	Ca content (%)	Mg content (%)	Zn content (ppm)	Cu content (ppm)	Fe content (ppm)
F-26-8	0.066±0.008	1.011±0.065	0.084±0.011	0.063±0.007	0.195±0.004	3.975±0.767	2.651±0.519	60.052±1.112
Angoor Kalan	0.091±0.013	1.156±0.021	0.071±0.008	0.055±0.003	0.172±0.010	4.325±0.713	2.725±0.427	65.625±4.099
E-10-34 (Thompson Seedless × Catawba)	0.099±0.115	1.067±0.022	0.083±0.006	0.063±0.014	0.184±0.007	4.225±0.359	1.775±0.309	59.361±5.231
Cheema Sahebi	0.088±0.010	1.212±0.065	0.085±0.012	0.064±0.004	0.193±0.003	3.975±0.321	2.951±0.208	69.906±1.235
Aledo	0.175±0.010	1.101±0.018	0.102±0.015	0.067±0.006	0.185±0.002	4.075±0.556	2.516±0.454	65.859±4.367
Dilkhush	0.104±0.0106	1.206±0.097	0.085±0.022	0.061±0.008	0.187±0.011	3.901±0.408	3.552±0.173	65.625±5.437
Cardinal	0.083±0.012	1.162±0.062	0.077±0.005	0.061±0.003	0.187±0.011	5.051±0.404	2.725±0.623	69.825±7.154
Phakdi	0.054±0.009	1.04±0.06	0.086±0.011	0.065±0.002	0.181±0.003	3.351±0.556	2.316±0.294	68.025±2.531
Muscat Petit Grains	0.128±0.007	1.283±0.037	0.079±0.006	0.067±0.004	0.181±0.017	3.375±0.880	2.675±0.330	60.575±0.852
Pandhari Sahebi	0.175±0.011	1.133±0.019	0.094±0.013	0.067±0.003	0.183±0.005	3.775±0.684	2.753±0.311	64.825±4.425
Hussain Kadu	0.111±0.009	1.246±0.09	0.083±0.005	0.072±0.004	0.153±0.007	3.301±0.594	3.525±0.275	71.736±5.831
Spin Sahebi	0.094±0.009	1.084±0.019	0.109±0.011	0.064±0.006	0.155±0.011	3.975±0.639	3.251±0.591	60.512±4.632
EC- 552020	0.262±0.023	1.082±0.029	0.111±0.012	0.065±0.004	0.201±0.006	3.175±0.287	1.803±0.270	59.925±4.657
EC-552109	0.114±0.013	1.237±0.046	0.113±0.018	0.063±0.004	0.191±0.007	4.475±0.694	2.098±0.365	71.725±7.362

Values expressed in Mean±SD, n=3

Sensory analysis

The organoleptic test performed during 2022-2023 revealed that overall acceptability was highest in Hussain Kadu (7.5) followed by Phakdi (7.2) while lowest was in E-10-34 (Thompson Seedless × Catawba) (6.2). However, Hussain Kadu preferred for colour and texture (Fig. 1). Muscat Petit Grains and Cardinal scored maximum for sweetness. Highest mean score for mouthfeel (7.4) was observed in Pandhari Sahebi while taste (7.6) was noted in Hussain Kadu. Evaluationfor raisins quality includes various factors such as appearance, texture, taste, cleanliness, and other relevant attributes. These criteria are crucial for determining the market demand for raisins.The results of the current study confirm better performance of Hussain Kadu related to nutritional point of view. Somkuwar et al. (2024) also observed variability in the organoleptic quality of raisins produced from different grape varieties.

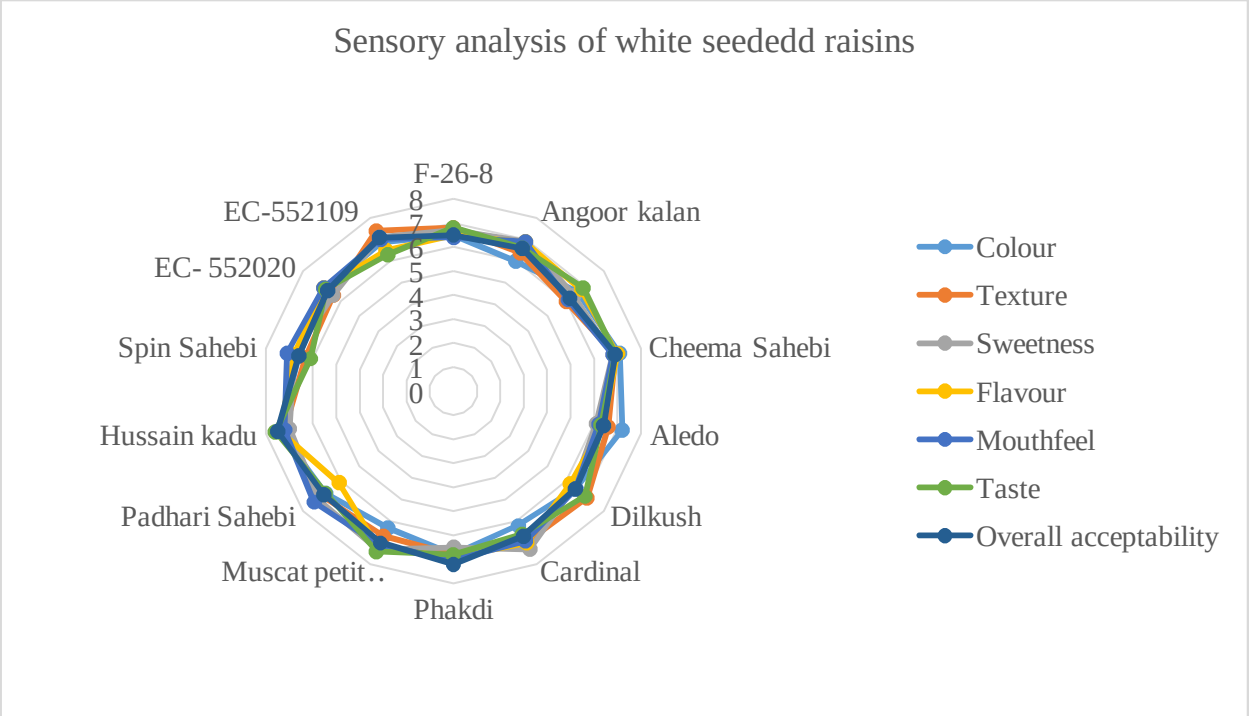


Fig 3. Sensory analysis of white seeded raisins.

Conclusion

In the present investigation, physiochemical parameter and mineral content of the different varieties of raisins varied greatly from one another. These variations can be attributed to the types of varieties and the differing environmental and experimental conditions. Our findings

demonstrated that all raisin varieties are a natural source of energy and essential minerals like potassium and magnesium, which may help prevent various diseases.

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