Raisin

27

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Abstract

Raisins are grapes which are in the dried form of different varieties of *Vitis vinifera* which are consumed all over the world. Raisins are rich in dietary fiber that has prebiotic effect. Raisins are an important source of many bioactive compounds such as phenolic compound and flavonoids polyphenols act as secondary metabolites in the biological activities of raisin. Phenolic acids, such as caffeic acid and coumaric acid, and the flavonoids such as quercetin and kaempferol have been identified in good concentration in raisins. The raisins work synergistically with fiber to maintain a healthy digestive system. Raisins are one of the best dry fruits for maintaining a good eye health benefit by protecting the cells from free radical damage. Oxidative damage and free radicals are risk factors for cancer, tumor growth, and aging raisin contain the good

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amount of antioxidants which defend the cell against free such radical devastation.

Keywords

Raisin · antioxidant · polyphenols · dietary fiber · health benefits

27.1 Introduction

Botanical name: *Vitis vinifera.*
Common name: Dry grapes.

Historically, raisins were accidentally discovered by humans in the early 2000 BC. Raisin is a word that came from the Latina *raceme* which means a cluster of grapes or berries (California raisins 2020). The sweet grapes that are dried in the sun and that shrivel up are called raisin. Until medieval times, raisins were the most-loved sweet after honey. Historians say that the ancient Armenians and Phoenicians had taken an initial step into impeccable viticulture, the process of grape growing (Winkler 1965).

Since 900 BC
The Phoenician started their colonial vineyard in Valencia and Malaga (Spain), and in Greece. Meanwhile, at the same time, the Armenians founded their vineyards in Turkey, Iran, and Iraq. Those places had spotless climate for making raisins and made a foremost market for the raisins. Historians believe that Currants – tiny seedless, tangy raisins – were planted in Corinth, Greece, hence the name (Vasilopoulou and Trichopoulou 2014).

Greeks traded with the Phoenicians and Armenians and the Romans consumed them in large quantities. Gradually, the popularity of the raisins grew with their value (California raisins 2020). Ancient physicians founded and treated with raisins for curing everything from the mushroom poisoning to old age.

Eleventh Century In the eleventh century, raisins were traded in Europe with the knights for their long travel as their most favorite one. A huge demand crisis occurred after that. The shipping techniques were improved for raisin to be sent to all the northern parts of Europe (Schönhärl 2013).

Fourteenth to Sixteenth Century In the mid-fourteenth century, raisins and currants played more important part in English cuisine, due to which they became very expensive.

In the sixteenth century, the viticulture spread to Germany and France. The English also tried to grow, but the climate was too cold and was not suitable for drying raisins (Winkler 1965).

In Spain, viticulture became popular; they made some more products like a variety of wines as dry table wine, sweet dessert wines, and Muscat raisins. In the Spanish conqueror's colonized Mexico, wine and raisins were familiarized soon.

Eighteenth Century In the eighteenth century, Spain passed on the knowledge about viticulture to Mexico in the colonizing time. They used it for the sacramental wines and grew the Muscat grape for raisin. In 1837, Spain turned to take power over the Mexican colonial government. They declined the mission system. In 1851, the Egyptian Muscat was grown near San Diego due to lack of water in San Joaquin valley where the climate was mild and there was extensive irrigation system for viticulture. In 1873, California's first raisin crops were grown by the people of California (Gray 2020). In 1876, English immigrants grew a seedless grape variety that was thin skinned, seedless, and sweet.

Nineteenth Century In the nineteenth century, California dancing raisin was introduced by California raisin industry. They raised marketing to increase awareness and demand for it.

Now the San Joaquin Valley in California supplies raisin for nearly half the world, making it the largest producer everywhere. Antarctica is the exceptional one in the world because of the cold climate region. April 30 became the national Raisin Day (Krosch 1989).

27.1.1 Production

The overall production of grapes in the world is 69 million tons presently (Table 27.1). India is the ninth largest producer of grape in the world with a production of 2,689,910 tons. India shares about 3.88% of total production of grapes in the world. In India, 78% of grape production is used for raw and fresh consumption (Christensen 2000). Only 17–20% of grapes are used to produce raisin and 1–2% are used for winemaking. The by-products made by grapes are raisin, jelly, jam, squash, grape juice, wine, tartaric acid, tannin oil, and cattle feed; the processed products such as wine, raisin, and grape juice are popular products all over the world from grapes (Sharma and Adsule 2007).

In India, raisins are mainly produced in the state of Maharashtra and Karnataka at places such as Sangli, Solapur, Nasik, and Bijapur. Indian raisins are available in different colors and sizes. They taste much sweeter than other types available form different parts of world. From 2012, the production of raisin in India has been increasing in the global industry. Marketing involves the movement very easily to consumers. From Sangli district, they send to Chennai, Mumbai, Delhi, and Kolkata markets (Gade 2018). Marketing of raisin is performed by different marketing channels or through cooperative societies or through private contractor forwarding agents.

Table 27.1 Global production of raisins in the last 3 years

	2016–17		2017–18		2018–19	
Country's	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)
Saudi Arab	5061.98	5097.63	4103.00	4313.70	2822.03	4082.95
Morocco	361	323.96	496	494.56	1643.00	2568.38
UAE	2057.71	2480.09	2199.49	2658.84	1433.19	2480.74
Sri Lanka	1602.76	1232.19	1234.56	1112.51	1488.01	1828.53
Vietnam	243	248.34	799	985.25	856	1488.44
Ukraine	3905.50	2831.78	2870.00	1970.93	1311.00	1323.86
Malaysia	983.09	954.23	892.98	955.29	920.56	1314.71
Indonesia	258.31	268.38	1022.00	1079.52	794	1230.66
Russia	4185.60	3445.21	1673.12	1473.59	1023.00	1167.32
Iraq	1366.00	1209.41	1157.00	1213.62	607	753.71
Nepal	208.41	184.66	572.78	527.91	472.2	678.75
Turkey	133	119.05	382	520.79	459	675.01
Brazil	162	227.93	566.5	477.52	451	412.01
Germany	706.84	348.47	948.38	470.64	665.32	400.39
Trinidad	270.02	258.59	408	327.35	251.4	344.35
Spain	570	529.21	191	239.49	222	343.23
Chile	39	60.35	155	238.53	163	337.25
Thailand	145.9	162.77	133	165.98	172	306.29
Qatar	17.62	17.69	91.6	116.18	186.41	290.32
Mauritius	237.36	213.27	207.27	202.59	214.82	286.04
Libya	27	39.48	0	0	147	282.6
Oman	181.57	224.73	263.15	351.18	168.54	230.6
Jordan	96	107.06	76	98.87	123	196.5
Poland	1343.00	1028.89	473	330.43	190	195.82

Romania	437	361.79	251	285.14	132	187.04
Mexico	264	176.56	397.6	271.54	167	181.61
Algeria	0	0	82	130.99	98	179.5
U K	301.43	163.91	391.09	216.51	207.46	177.99
Kuwait	10.15	13.4	9	13.22	82.63	162.63
Myanmar	2	2.61	103	131.22	82	148.55
Honduras	140	96.27	199	139.72	117	132.44
Singapore	91.3	94.65	109.71	115.64	93.31	131.32
Tunisia	0	0	0	0	62	121.48
Syria	0	0	19	27.2	57	100.65
Croatia	720	590.67	266	190.29	76	86.55
Serbia	20	16.25	57	35.74	76	77.23
Salvador	60	42.53	98	68.11	58	70.12
Iran	280	274.19	125	146.17	52.02	66.35
Egypt	0	0	150	180.53	37.01	63.42
Philippines	392.14	182.93	356.06	156.2	61.68	50.22
Guyana	29	65.56	55	43.97	40	45.72
Bulgaria	333	218.21	307	83.32	143	45.62
Lithuania	1106.00	848.19	190	159.57	38	44.8
Senegal	112	91.02	19.02	17.15	38.31	40.91
Fiji	24.07	24.63	5.18	7.45	35.1	40.04
Netherland	142.01	79	107.23	61.8	58	39.75
Albania	0	0	33	30.91	37	39.6
Australia	13.02	28.23	25.32	56.93	14.42	38.87
Bangladesh	0	0	52.5	76.51	24	37.25
New Zealand	2.69	4.37	5.34	10.19	21.23	36.42
Bahrain	44.8	45.85	24.23	23.44	28.07	35.81

(continued)

Table 27.1 (continued)

	2016–17		2017–18		2018–19	
Country's	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)
Suriname	19	16.45	0	0	25	35.37
Peru	18	28.33	71	110.88	19	33.3
Maldives	4.44	3.94	9.11	13.09	11.5	26.95
Greece	147	132.28	106	80.89	19	26.67
USA	7.94	23.18	9.59	26.42	6.56	25.96
Georgia	33	31.74	0.01	0.02	18	24.14
Korea	0	0	0	0	20.15	23.19
Canada	83.75	92.91	98.19	122.85	8.08	22.37
Nicaragua	40	28.21	60	40.32	20	22.33
Belarus	667	448.29	114	75	19	20.75
Belgium	95.02	76.77	82	59.11	18	12.03
Japan	4.85	6.72	4.97	6.14	4.17	7.69
Kenya	40.45	46.93	0.79	1.75	4.67	7.06
Switzerland	0.74	1.64	0.35	0.88	3.34	2.99
Nigeria	3.67	8.49	21.2	43.95	1.44	2.76
South Africa	0.86	1.3	0.36	0.58	0.63	1.83
Uganda	0.52	0.44	0.16	0.53	0.54	1.83
Hong Kong	0.85	1.31	0.31	0.64	0.57	1.67
Seychelles	0.99	1.32	0.39	0.72	0.67	1.63
Togo	0.24	0.24	0.31	0.36	0.64	1.34
Brunei	0.02	0.32	2.06	1.64	1.1	1.14
China	0	0	0	0.01	0.84	1.04
Cameroon	0	0	0.04	0.06	0.51	0.66
Reunion	0.5	0.48	0.25	0.48	0.3	0.64

Cayman Is	0	0	0.15	0.12	0.33	0.53
Zambia	0.05	0.14	0.2	0.41	0.16	0.52
Taiwan	0	0	0	0	0.3	0.5
Rwanda	0	0	0	0	0.11	0.42
Malawi	0.01	0.02	0.14	0.18	0.14	0.39
Ghana	0.09	0.2	0.16	0.4	0.1	0.28
Congo D Rep.	0.4	0.19	0.45	0.89	0.05	0.24
Gambia	0.14	0.13	0	0	0.17	0.22
Madagascar	0	0	0	0	0.04	0.21
Macao	0	0	0	0	1	0.2
Gabon	0	0	0	0	0.05	0.18
Cote D Ivoire	0	0	0.08	0.06	0.06	0.17
Botswana	0	0	0	0	0.08	0.15
Congo P Rep	0	0	0.1	0.18	0.1	0.14
France	0.1	0.07	0	0	0.03	0.13
Papua New Guinea	0	0	0	0	0.1	0.13
Bhutan	0	0	0.03	0.08	0.09	0.12
Cambodia	0.13	0.34	0	0	0	0.12
Benin	10.03	20.19	0.1	0.24	0.02	0.06
Mozambique	0.3	0.98	0.02	0.03	0.03	0.05
Sierra Leone	0	0	0.05	0.06	0.03	0.04
Panama Republic	0	0	0.02	0.05	0.01	0.03
Pakistan	9.52	11.74	0	0	0.01	0.02
Belize	0	0	0	0	0.01	0.01
Portugal	0.36	0.23	0	0	0.01	0.01
Argentina	18	25.65	41	55.2	0	0
Armenia	20	21.45	38	43.89	0	0

(continued)

Table 27.1 (continued)

	2016–17		2017–18		2018–19	
Country's	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)	Production (MT)	Rs. (Lakhs)
Barbados	37.2	30.84	19	13.65	0	0
Bosnia-Herzegovina	25	21.54	0	0	0	0
Colombia	19	11.85	0	0	0	0
Czech Republic	72	59.2	54	39.83	0	0
Denmark	2.1	0.65	0	0	0	0
Djibouti	0.6	0.73	0.5	0.37	0	0
Finland	0.01	0.01	0	0	0	0
Guatemala	38	30.36	0	0	0	0
Guinea	0	0	0.18	0.16	0	0
Guinea Bissau	0	0	0	0.01	0	0
Hungary	55	46.91	38	31.2	0	0
Italy	15.61	8.07	0	0	0	0
Jamaica	54.2	43	18	13.29	0	0
Latvia	128	97.7	0	0	0	0
Lebanon	19	19.28	38	54.6	0	0
Liberia	0	0	0.05	0.06	0	0
Mali	8	10.73	0	0	0	0
Moldova	93	75.67	0	0	0	0
Netherland	0	0	0.05	0.07	0	0
Paraguay	0	0	0.02	0.08	0	0
Serbia	49	34.87	57	39.26	0	0
Slovenia	3	2.22	0	0	0	0
St Lucia	0.01	0.01	0	0	0	0
Sudan	188	121.58	20	17.26	0	0

Sweden	27	29.26	0	0	0	0
Tanzania Rep	1.32	3.17	0	0	0	0
Uruguay	0.3	0.49	1	1.97	0	0
Yemen Republic	108.5	180.77	0	0	0	0
Total	**30,859.10**	**26,895.72**	**25,259.50**	**23,904.65**	**18,926.46**	**25,910.56**

Source: USDA (2018)

27.1.2 Botanical Description

The botanical name of Raisin is *Vitis vinifera*. Raisin has become a favorite food since 1490 BC because of their high micronutrient contents and nutritive value. Raisins are grown almost all over the world. There are various types of raisins found throughout the world. The production of it was surprisingly increasing gradually. Raisin contains the highest value of phenolic compounds and has high potential of damaging oxidizing agents in a living organism (Adam et al. 2016).

27.2 Antioxidant Properties

Antioxidants are found commonly in many foods and that help to prevent damages caused by the free radicals by neutralizing it. Antioxidants inhibit the oxidation reaction. Oxidation reaction can cause damage to the living cells. Antioxidants helps to neutralize oxidation reaction (Salah et al. 1995) which include vitamins, minerals, copper, selenium, and zinc. Raisins have many types: a few are seedless, golden seedless, raisins with seeds, sultana, Zante currant, and mixed species or varieties (Breksa et al. 2010). The antioxidant activity of raisin varies with different processing methods because phenolic compounds gets affected by different processing methods. The raisin extracts could be used as antioxidants is a food system. The higher amount of phenolic content in raisins helps in the antioxidant activity without negatively impacting sensory organs (Meng et al. 2011). Phenols, polyphenolics, and phenolic acid derivatives are most common antioxidant compounds, which are important for antioxidant activity (Karakaya et al. 2001). The flavonoids are also compounds of polyphenols. The flavonoids, free radical scavengers and enzyme inhibitors possess a good antioxidant activity (Mishra et al. 2010; Mnari et al. 2016). Phenolics are abundant in food materials. The phenolics are closely related to antioxidant activities, and phenolic acids and flavonoids present in raisin, such as benzoic and hydroxycinnamic acids, resveratrol, flavan-3-ols, catechin, and epicatechin, and flavanols, such as kaempferol, quercetin, myricetin, and anthocyanins, have potential antioxidant properties (Zhao et al. 2008). In raisin, the polyphenolic antioxidants play a major role in preventing cell damage. 2,2-Diphenyl-1-picryl hydrazyl assay [DPPH] is a common assay for screening of antioxidant activity, and other assays are CUPRAC (CUPric Reducing Antioxidant Capacity and PFRAP (Potassium Ferricyanide Reducing Power). The various parts of raisin that contain the antioxidant property are as follows.

27.2.1 Dry Raisin

The free radical assay is used to detect the antioxidant content. The different types of raisins were analyzed for the antioxidant activity by Kelebek et al. 2013. The types of raisin such as desert king, Muscat, red manaizi, wild redrose, blackcurrant, and seedless are primarily screened for the phytochemical activity. Studies have showed

that desert king had highest content of phenolic compounds which indicated its antioxidant capacity (Kelebek et al. 2013). The red manaizi and wild red rose also contain more phenolic content and thus indicated the presence of antioxidants.

27.2.2 Oil

From raisin, the extracted oil has been examined, which shows the nature of lower molecular weight of phenolic acids such as caffeic acid, epicatechin, gallic acid, and protocatechuic acid which are found in highest amount in raisin oil. The resveratrol and kaempferol compounds have also been identified in the extracts (Zhao and Hall 2007). The low molecular weight flavonoids such as catechin and epicatechin could be more responsible for the antioxidant activity, but the high molecular weight flavonoids does not contain any antioxidant activity (Arts et al. 2000); thus, researchers say that in the oil extract of raisin only the lower molecular weight flavonoids were found to be more sufficient for antioxidants activity.

27.2.3 Raisin Seeds

The seeds of raisins have more lipid contents. The lipid peroxidation is the reason for the deterioration of food product. The addition of antioxidant is a method of increasing the shelf life. The synthetic antioxidants compounds, such as butylated hydroxy anisole (BHA) and butylated hydroxytoluene, are restricted in food uses (Jayaprakasha et al. 2001). Therefore, the search for natural antioxidants, especially of plant origin, has greatly increased. The seed extract shows the presence of monomeric flavanols and procyanidin components which could act with free radicals to make the stable product and eliminating free radical chain reaction (Adam et al. 2016). Thus, it could also contain efficient antioxidant activities.

27.2.4 Skin Peel and Juice

The peel of sultanas variety of raisins contain high content of reducing sugar and amino acids (Schuster et al. 2017). Raisins peels naturally contain phenolic compounds and thus have more antioxidant properties. The phenolic compounds which are in high quantity are procyanidins in skin (Zhao and Hall 2008). The juice of dry grapes contains highly efficient amount of phenolic compounds like catechin, ferulic, p-coumaric, and caffeic acids. Simultaneously, phenolic compound expresses the presence of high antioxidant activity (Papadakis et al. 2006).

27.3 Identification of Chemical Compound(s) Responsible for Antioxidant Proprieties and the Pathways Involved in the Biological Activities

In raisin, the phenols, phenolic acids, flavonoids, tannins, and anthocyanins play a major role toward higher antioxidant activity. They are radical scavengers because they are nucleophiles that act as inhibiting lipid peroxidation and chelators of metal ions that induce oxidation (Yeung et al. 2003). In the raisin extract, most of phytochemical compounds with antioxidant property can prevent cells from causing damage due to oxidation. A more number of phenolic compounds with different characteristics and functions have been detected (Kaliora et al. 2009). In the food content, the presence of phenolic compound causes different variations in organoleptic like bitterness and sourness in taste. The color of the particulate is also because of phenolic compounds and anthocyanins. The phenolic compounds are categorized into two groups as phenolic acids and flavonoids. (Reddy et al. 2005).

The most predominant phenolic compound in raisins is 3,4-dihydroxybenzoic acid. The dried raisins are rich in antioxidant polyphenols, minerals, fiber, sugar, and organic acid. The 2nd most abundant phenolic compound present is epicatechin. During drying process of grapes into raisin, due to enzymatic and air oxidation, there may be loss of phenolic compounds (Ouchemoukh et al. 2012).

Raisins contain resveratrol which possess antioxidant, anti-inflammatory, anti-cancer, and lowering blood cholesterol ability. The biological effect of raisin is particularly associated with procyanidins content for anti-inflammatory activity (Di Lorenzo et al. 2016). The diabetic activities were examined in the diabetic rats that were treated with the raisin seed extract; it indicated the lower mRNA level of pro-inflammatory mediator in comparison with non-diabetic rat as observed by Adam et al. (2016). The phenolic compound of flavan-3-ols and procyanidins is degraded in raisin because of its oxidative reaction. The degradation process occurs independently in the drying process. The improvement in seeds of raisin has been attributed to the process, and catechin, epicatechin, epicatechin-3-gallate, epigallocatechin-3-gallate, and procyanidins were undetectable in many varieties (Jayaprakasha et al. 2001).

27.4 Health Benefits

Raisins are dried grapes; they are indeed rich and contain numerous nutrientst. Further, raisins have a minor supply of carotenoids and xanthin. Raisins are more helpful and beneficial addition to the diet (Raisins Nutrition Facts 2020). The resveratrol is a phytochemical compound that is present in raisin which is also responsible for the anticancer and cholesterol-lowering activities. It is protective against colon and melanoma cancers and also against coronary heart disease [CHD] and Alzheimer's disease (Salehi et al. 2018). Raisins help to promote and aid digestion. Raisin that contains soluble fiber, helps to give the proper shape to stool

as well, thus makes the passage of stool over intestines smooth. It improves digestion and regularity.

Raisins have oleanolic acid, one of the phytochemical compounds, which is essential for keeping the teeth safe from the decay, cavities, and brittle teeth (Zhang et al. 2013). They contain good amount of calcium and also prevent teeth from breakage and peeling off. The boron in raisin is good for maintaining the germ build-up in the mouth. The high amount of antioxidant in raisin helps to retain dermis follicle young and control the destruction against maturing cells. Raisins have more nutrients like zinc and selenium, which helps in the regeneration of skin cells (Schuster et al. 2017). Oxidative damage and free radicals are risk factors for cancer, tumor growth, and aging. In raisin, the nutritional antioxidants are essential and defend cells against free radicals' devastation.

One of the good health benefit of eating raisins is that they are good for eye health by protecting cells from free radical damage. It helps to shield the eyes against disorder like age-relevant degeneracy. The physicians noted that eating raisins regularly would help lower a person's blood sugar level (Kanellos et al. 2014). The raisin helps in reducing cardiovascular risk factors like blood pressure rate, and raisins have little sodium content and also consist of valuable origin of potassium, that aids blood vessels into recline. It contains beneficial amounts of minerals, such as iron, copper, magnesium, and potassium. It can promote equity of acidity levels in the stomach.

27.5 Conclusions

Raisin has attracted more and more attention because of their rich content of bioactive components and high natural antioxidant capacities. Different varieties have different requirements for raisin making. For raisin production, pretreatment is an important step to enhance the drying rate. Different pretreatments have an influence on grape quality, especially color, bioactive component, and texture. Therefore, novel pretreatment methods should be developed to improve the permeability of the grape skin without damaging the product attributes.

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