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A Review on Beneficial Properties of Purple Okra

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Abstract

Okra is one of the most popular and commercially grown vegetables in different parts of the India due its nutritive, medicinal and economic value.Generally, green tender pods of okra are used as edible purpose and green varieties are commercially cultivated for most okra growing areas even export market also dominated by green varieties despite being the higher nutritive value of purple okra or red okra than green okra. Purple okra has enormous health benefits and can be used as traditional medicine in China and Indonesia. Several epidemiological studies proof superiority of purple okra over green okra due to presence of different types of antioxidants like beta-carotene, anthocyanin and phenolic compounds.Higher nutrients' composition of purple okra can prevent some chronic diseases like goitre, diabetes, hyperlipidaemia, microbial infections, ulcers, and neurodegenerative diseases, irritation of the stomach and colon, gonorrhoea, sore throat, dysentery and also lower blood sugar. The fruits of purple okra have beneficial properties like anti-gastric acid, anti-oxidative, anti-fatigue, anti-inflammatory and even have insecticidal properties.

Keywords: Anthocyanin, antioxidant properties, health benefits, nutritive value, purple okra

1. Introduction

The colour pigmentation of any vegetable crops including okra has tremendous beneficial effects due to the presence of different types of powerful antioxidants. Colour is an important agronomic or marker trait which has appealing effects to the consumers and breeders, respectively. Health-conscious consumers now prefer different colour vegetables including purple okra due to presence of health-promoting substances (Zhang et al., 2021) like beta-carotene, anthocyanin and chlorophyll etc. Generally, okra has green to red pigmentation in stem, leaf, flower and fruit. The green colour okra is more popular and predominant than purple or red colour okra in terms of consumer preferences, production and availability. The chlorophyll is solely responsible for green colour of okra whereas, accumulation of anthocyanin combines with chlorophyll responsible for the reddish-purple colouration in okra. The purple coloration of okra is due to the accumulation of two major anthocyanins like Cyanidin 3-O-Sambubioside and Delphinidin 3-O-Sambubioside (Zhang et al., 2021). Initially, accumulation of anthocyanin in okra pods occurs 2 days after anthesis. The anthocyanin degradation occurs in accordance of aging of okra fruit which restrict the harvesting time upto 8 days (Karmakar et al., 2022) for edible purpose. The anthocyanin pigment plays pivotal role in nutritive value of okra which gives extra importance to the purple or red colour variety of okra.

The green podded okra is much more familiar than the red or purple podded okra despite having high nutritional qualities and enormous health benefits than the green colour okra.Predominantly green podded okra is commercially grown in almost all okra growing areas of the world due to unavailability of purple or red varieties. Most of the research and developmental works also oriented with green podded okra though various epidemiological studies indicated the superiority of red or purple okra than green okra. The presence of different types of anthocyanin in red or purple okra makes the crop a powerhouse of nutrients which has immense health benefits. Generally immature tender pods of okra used as fresh vegetablehaving high nutritive value of carbohydrate, protein, fat, vitamins, minerals like iron, phosphorus, calcium, magnesium, iodin, dietary fibre, phenolic compounds, secondary metabolites like alkaloids,

terpenoids and flavonoids (Adetuyi and Ibrahim, 2014), antioxidants and oils, leaves are used for elimination of free radicals (Liu et al., 2005), seeds for oil extraction (Gemede et al., 2015), It plays an important role in human diet. Per 100 g of edible pods, contains 88.6 g of water, 36 kcal of energy, 8.20 g of carbohydrate, 2.10 g protein, 0.20 g of fat, 1.70 g fibre, 185.00 µg of β-carotene, 0.08 mg riboflavin, 0.04 mg thiamin, 0.60 mg niacin, 47.00 mg of ascorbic acid, 84.00 mg calcium, 90.00 mg phosphorus, 1.20 mg of Fe, (Lamont, 1999; Saifullah and Rabbani, 2009; Gopalan et al., 1971; Dilruba et al., 2009). Okra leaves contain 81.50 g water, 56.00 kcal energy, 4.40 g protein, 0.60 g fat, 11.30 g carbohydrate, 2.10 g fibre, 532.00 mg Ca, 70.00 mg P, 0.70 mg Fe, 385.00 µg β-carotene, 59.00 mg ascorbic acid, 2.80 mg riboflavin, 0.25 mg thiamin, 0.20 mg niacin (Gopalan et al., 1971). Okra seeds contain 20% protein and 20% edible oil (Tindall, 1983; Charrier, 1984; Oyelade et al., 2003).

Okra being a versatile crop having enormous health benefits can be used as traditional medicine in China and Indonesia (Wulandari and Wardani, 2019) although several epidemiological studies proof superiority of purple okra over green okra due to presence of different types of antioxidants like beta-carotene, anthocyanin and phenolic compounds. Epidemiological study also reported different health-related benefits of purple okra due to its higher nutrients' composition that can prevent some chronic diseases like goitre (Kumar et al., 2010), diabetes, hyperlipidaemia, microbial infections, ulcers, and neurodegenerative diseases (Petropoulos et al., 2018), irritation of the stomach and colon, gonorrhoea, sore throat (Lim, 2012), dysentery (Wulandari and Wardani, 2019) and also lower blood sugar (Dubey and Mishra, 2017). The fruits of okra have beneficial properties like anti-gastric acid, anti-oxidative, anti-fatigue, and anti-inflammatory (Zhang et al., 2021).

Though there is very limited information regarding purple fruited okra varieties or genotypes, lines and its beneficial properties even medicinal values are available in details.

2. Notified Varieties, Genotypes, Lines or Accessions of Purple Colour Okra

Very few purple colour okra varieties have been reported or released so far. However, some varieties having purple pigmentation on different plant parts like stem, leaves, veins of leaves, flower colour, fruit colour and seeds was reported. Some of the green varieties having purple pigmentation in different plant parts was also reported and presented in the Table 1

Table 1: Different purple or reddish colour okra varieties, genotypes, accessions, and species

Varieties/genotypes/Accessions/ Species of purple okra	Institute associated/ Reported from	Particulars	References
Gujarat Bhindi-1	Gujarat Agricultural University	Purple tinge on stem, dark green with purple tinge on leaves veins	Swamy, 2023
ArkaAnamika	IIHR Bangalore	Splashes of purple pigmentation on the stem, petiole and basal portion of lower surface of the leaves	Swamy, 2023
EMS-8 (Punjab 8)	PAU Ludhiana	Splashes of purple pigmentation on the stem, petiole and basal portion of lower surface of the leaves	Swamy, 2023
Kashi Lalima (VROR-157)	IIVR Varanasi	Red colour stem,	Singh et al. (2015)
		Reddish purple fruits rich in anthocyanin and phenolics which is tolerant to YVMV and OLCV, medium tall with short internodes and a fruit yield of 14-15 t ha^{-1} has been recommended for both summer and Kharif season cultivation in Uttar Pradesh, India	Swamy, 2023
Chinese purple okra varieties namely Yuncheng (Chinese 1), Xingyun (Chinese 2) and Red Chien (Chinese 3)	Egypt	Higher chemical composition, functional properties, antioxidant activity, and sensory properties	Abdel-salam et al. (2022)
Red Chien (Chinese 3)	Egypt	Higher amount of total phenolic, flavonoid contents and antioxidant activity	Abdel-salam et al. (2022)

Table 1: Continue...

Varieties/genotypes/Accessions/ Species of purple okra	Institute associated/ Reported from	Particulars	References
Red fruited okra genotypes	Western Ethiopia	Red colour on both sides except one found red colour inside of fruits	Temam et al. (2021)
PB05-291	Indonesia	Anthocyanin content fruit	Yora et al. (2018)
Purple fruited okra accessions	Sudan	Red colour at both sides of the petal base of flower	El Tahir (2023)
	Nigeria	Purple colour fruits	Swamy, 2023
Purple colour okra species and variety namely GH3801 Pora	Ghana	Unique purplish pigmented fruit	Oppong-Sekyere et al. (2011)

3. Purple Okra and its Nutritional Quality

Epidemiological studies indicated the superiority of purple okra over green okra in terms of antimicrobial property, antidiabetic potency, nutritive value etc.

The purple okra extract has higher antioxidant capacity, quercetin and fenolic contents than green okra extract. Anjani et al. (2018) suggested the quercetin compound containing purple okra extract showed an antidiabetic potency.

Purple okra powder has also antidiabetic property than green okra powder and potential to improve fasting blood glucose, insulin, HOMA-B, and IGF-1 levels (Tyagita et al., 2021).

The purple okra fruits of Chinese 3 variety registered highest total phenolic, flavonoid contents and antioxidant activity as compared to other green okra varieties (Faten and Gehan, 2022).

Wulandari and Wardani (2019) suggested from their study that the purple okra fruit extract has antimicrobial properties which inhibit the growth of *Escherichia coli* bacteria, documented antimicrobial inhibition zone at the different concentration of treatment from which 40%, 50% and 60% resulted the best inhibition zone as compared to all treatments, but not significantly different from 70% and 80% concentration. As per study it was revealed that purple okra fruit extract can be used as an alternative to natural medicine which inhibits growth of bacteria (*Escherichia coli)*.

Anjani et al. (2018) reported from the comparative study of purple okra and green okra extract that the antioxidant capacity,fenolic, and quercetin contents of purple okra extract were higher (417.54 mg 100 g^{-1}; 3.60%; 0.45 mg g^{-1}) than green okra extract (341.43 mg 100 g^{-1}; 3.58%; 0.27 mg g^{-1}). Administration of GOE I, GOE II, POE I and POE II in diabetic did not give a significant effect to changes in body weight of rats, but effectively could improve repairmen of β cell pancreas destruction due to STZ induction. The results suggested that intervention of green okra extract and purple okra extract based on quercetin compound showed an antidiabetic potency of purple okra extract in streptozotocin induced diabetic rats.

Kumari et al. (2019) suggested that the traits having high cluster mean value may be considered for future breeding programme and revealed that the purple colour okra variety Kashi Lalima (red pod colour) registered delayed flowering and higher amount of ascorbic acid and anthocyanin content mainly due to red colour of pod and lower amount of chlorophyll a, chlorophyll b and total chlorophyll having high combining ability.

4. Purple Okra and its Antibiotic Properties

Anthocyanin rich okra genotypes include VROR-157 (Kashi Lalima) showed insecticidal property against shoot and fruit borer incidence. The biochemical parameters like total phenol (62.26 mg 100 g^{-1}) and anthocyanin (0.04 OD value) showed negative correlation with the borer incidence. (Halder et al., 2015).

5. Purple Okra and its Defence Mechanism

It was also reported that the Anthocyanins have defence mechanism against UV stress and prevent the penetration to soft tissue and protect the plant from deleterious effect of UV radiation. Kargar-Khorrami et al. (2014) suggested that the increased level of flavonoid content (16% and 30.55% over control) and anthocyanin content (21.78% and 29.16% over control) in the UV-B and UV-C treatments respectively of okra seedlings may be considered as biomarkers of intensity of UV radiation stress.

6. Conclusion

The different comparative studies and report indicated the superiority of purple okra than green okra due to its higher nutritive value and presence of carbohydrate, protein, fat, vitamins, minerals like iron, phosphorus, calcium, magnesium, iodin, dietary fibre, phenolic compounds, secondary metabolites like alkaloids, terpenoids, flavonoids, antioxidants and oils, leaves are used for elimination of free radicals from blood vessels. The beneficial properties of purple okra also addressed different health related issues of human being, showed insecticidal properties even act as protective mechanism from UV stresses. The richness purple okra in terms of higher nutrient content may be better alternative than green okra for the health conscious peoples.

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